DEPARTMENT OF ELECTRICAL ENGINEERING

GOVT POLYTECHNIC KORAPUT

SUBJECT- TESTING AND MAINTAINANCE OF ELECTRIC MACHINE

SEMESTER- 6TH SEMESTER ELECTRICAL ENGINEERING

PREPARED BY-: SRI MAHESH KUMAR BISWAL

(LECT. IN ELECTRICAL ENGINEERING)

Testing & Maintenance of Electric Machine

SEM - 6th

Unit - ① Safety & Prevention of Accidents.

* Important Question *

Q.① Define following term w.r.t. electric accident.

i.> Safety ii.> Hazard
iii.> Accident iv.) Responsibility
v.> Authority vi.> Monitoring.

Ans→

i.> Safety :-

⇒ Such type of technique which can minimize unwanted accidents is called safety.

ii> Hazard :-

⇒ A hazard is any agent that can cause harm or damage to humans property or the environment.

Eg :- Electrical Hazard, Mechanical hazard etc.

iii> Accident :-

⇒ An unwanted or sudden events which can't anticipated in advance is called Accident.

Eg :- Electric Accident, Mechanical Accident etc.

iv.> Responsibility :-

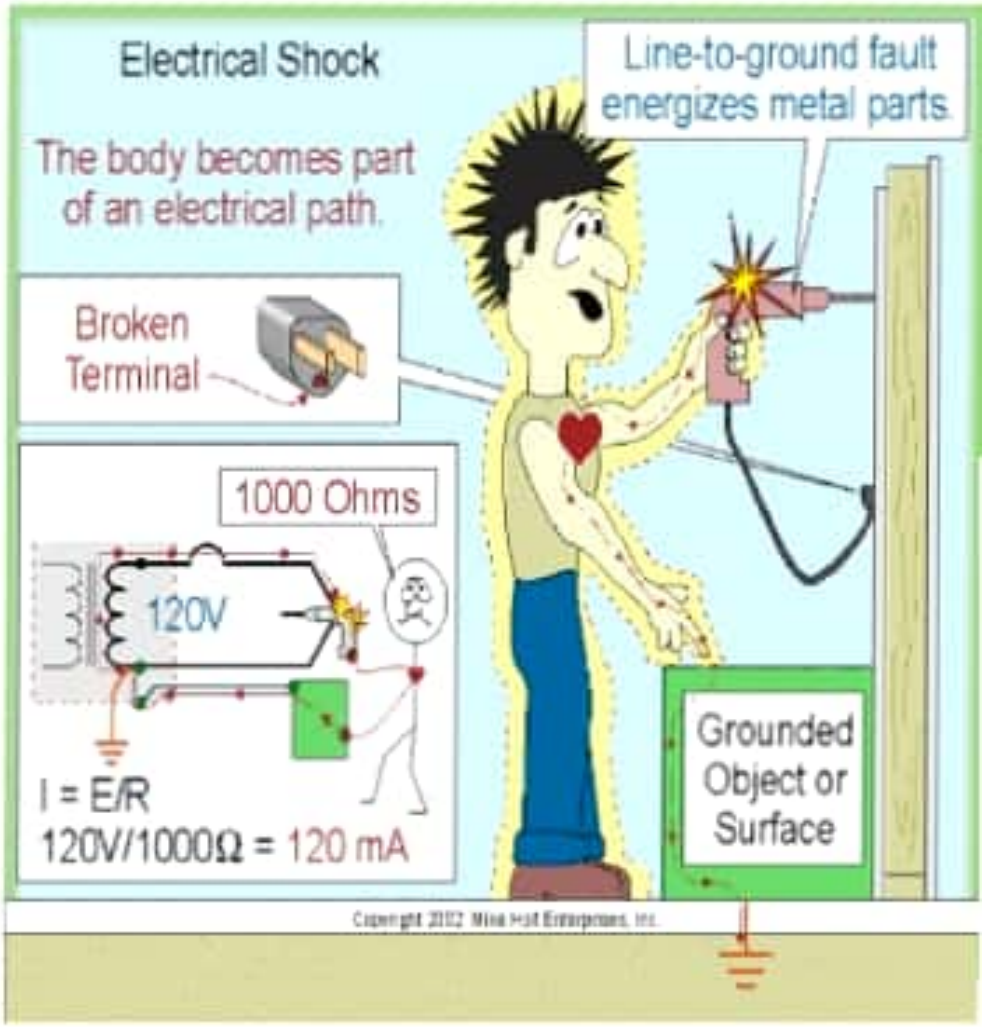
⇒ The meaning of responsibility in electric accident is - who is responsible for accident OR who was in the charge of that work where the accident took place

What Is An Electric Shock

- An electric shock occurs when someone comes in contact with an electric energy source.

or

- It is the physiological reaction or injury caused by electric current (AC/DC) passing through the human body



Symptoms

- Changes in alertness (consciousness)
- Broken bones
- Heart attack (chest, arm, neck, jaw, or back pain)
- Headache
- Problems with swallowing, vision, or hearing
- Irregular heartbeat
- Muscle spasms and pain
- Numbness or tingling
- Breathing problems or lung failure
- Seizures
- Skin burns

How Can you Get An Electric Shock

- By poorly insulated wires or ungrounded electrical equipments
- By using electrical equipment while in contact with water
- By being struck by lightning

Factors determining the severity of electric shock

- The type of current
  - ✓AC
  - ✓DC
- The amount of current
  - ✓Voltage
  - ✓Ampere
  - ✓Low frequency
  - ✓High frequency
- Duration of contact
- Surface area of contact or Electrical field strength
- The pathway the electricity takes through the body
- Overall health of person

DATE

Q.(2) Explain Electric shock & its treatment? [SBTE-2019]

Ans → • Electric shock :-

⇒ An electric shocks occurs when an electric current passes through our body.

• Electric shocks can burn both internal and external tissue and cause organ damage.

• Reason of Electric shocks :-

i.) Due to Contact with power lines.

ii.) Due to Contact with poorly insulated wire.

iii.) By using electrical equipment while in contact with water.

iv.) Due to lighting Strike.

v.) Due to ungrounded electric machinery.

• factor determining the severity of E.S. :-

i.) Type of Current → AC or DC

ii.) Amount of current & Voltage.

iii.) Amount of supply frequency.

iv.) Duration of Contact.

v.) Amount of body resistance.

• Treatment :-

i.) Disconnect the power supply.

ii.) Call the doctor immediately.

iii.) Used non-conducting object to push the person away from live wire.

DATE

(3) Explain the procedure to be followed to rescuing the person who has received an electric shock and write method of providing artificial respiration.

Ans:- In case, the victim becomes unconscious stop breathing and his heart still beats then the most urgent treatment for the victim is that he should be given artificial respiration uptill the victim starts breathing normally.

- Method of providing Artificial Respiration:
  - i.) Schafer's Method
  - ii.) Silvester's Method
  - iii.) Holger Nelson's Method
  - iv.) Mouth to mouth respiration.

1.) Schafer's Method:-

⇒ In this method of artificial respiration, patient is place face downward and his one arm extended directly overhead and other arm bent at elbow and with the face turned outward and resting on the second hand of fore arm so that nose & mouth are free for breathing.

⇒ When doctor is pressing on loin, expiration take place when doctor is bending backward inspiration takes place. Here, inspiration lasts for 3 sec & expiration lasts for 2 sec.

CLASSMATE

PAGE

DATE

(ii) Silvester's Method :-

- Also called Arm-lift-Chest-pressure method.
- In this method of artificial respiration, the victim was placed face up and the shoulders were elevated to allow the head to droop backward and pull out the tongue and hold it.

(iii) Nielson's arm-lift-back-pressure Method:

- In this method of artificial respiration, the victim (Person) lies prone (face down) with both arms folded and hands resting, one on the other, under his head. The arms are grasped above the elbow and lifted until firm resistance is met. This induces inspiration. then they are let down & pressure applied on the back to cause active expiration.

(iv) Mouth to mouth respiration Method :-

- This is the best method of artificial respiration.
- In this method, the victim was placed on his back & placed his head slightly downhill then doctor will blow expired air in patients mouth. This will cause inspiration.
- Also, By ~~using~~ taking mouth away expiration occurs passively.

So, inspiration is active, expiration is passive.

PAGE

classmate

चित्र 20.2—सिल्वेस्टर विधि से दो व्यक्तियों के द्वारा कृत्रिम श्वसन देने के लिए आसन

Sylvester method – Active Inspiration

Mouth to Mouth Respiration

Active Inspiration in Holger Nelson Method

DATE

④ What are the causes of electric fires? Explain its. [BBTE-2019]

Ans → When proper care & precautions are not taken of the electrical installations, equipment, machine etc then it will be result into electric fires

- Causes of Electric fires :-

i.) Improper wiring & loose connections.
ii.) Poor quality material used in installation
iii.) Due to Arsonists materials. Explosive used in electrical circuit & device.
iv.) Due to short Circuit & Overloading.
v.) Due to improper maintenance.

⑤ What precautions should be taken to avoid Fire due to electrical reasons?

Ans → i.) Test safety devices monthly.
ii.) Make sure electrical panel circuits are properly labeled.
iii.) Always replace fuses or circuit breker with the correct size and rating.
iv.) Stay at least 10 feet away from overhead power lines.
v.) Use tools & equipment according to I.E. instructions.
vi.) Use non-conducting wood.
vii.) Used fire extinguishers.

classmate PAGE

⑥ Explain operation of fire extinguishers? Also, write its types.

Ans * Fire Extinguisher :-

⇒ A fire extinguisher is a device which can be used to control a fire.

- Fire extinguishers can help remove the fire and may stop it from burning.

* Operation of Fire Extinguishers :-

⇒ There are four steps for using fire extinguisher ⟶ PASS

Step - i.> Pull pin at the top of the extinguisher, breaking the seal.

Step - ii.> Approach the fire standing at a safe distance.

Step - iii.> Squeeze the handles together to discharge the extinguishing agent.

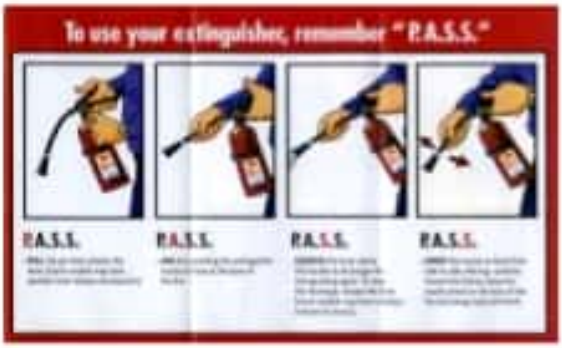
Step - iv.> Sweep the nozzle from side to side as you approach the fire, directing the extinguishing agent at the base of the flames.

* Types of Fire Extinguishers :-

i.> Dry powder extinguishers.
ii.> Foam fire extinguishers.
iii.> Carbon Tetrachloride Extinguishers.
iv.> Methyle Bromide Extinguishers.
v.> Carbon dioxide Gas Extinguishers.

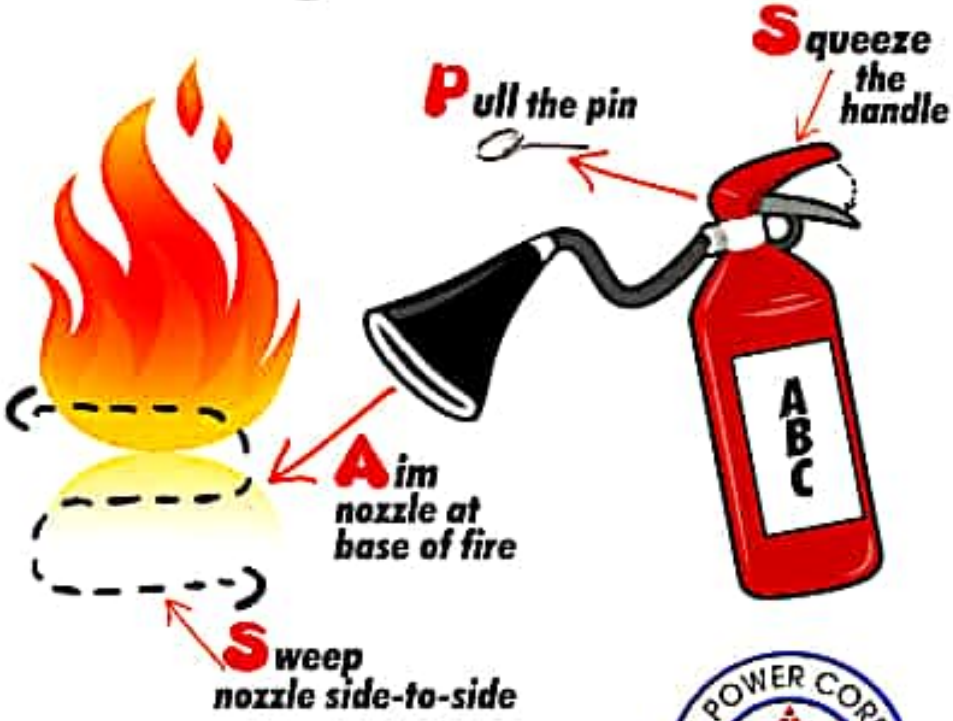
What is Fire Extinguisher ?

- A **Fire extinguisher** is a device which can be used to control a fire. Fire extinguishers can help remove the fire, and may stop it from burning.



To operate a Fire Extinguisher:

Pull
Aim
Squeeze
Sweep



Note: Use the correct Extinguisher.

NATIONAL POWER CORPORATION • 1936 •

② General Introduction.

DATE

① What are the objective of testing ~~DFOs~~.
'OR' Explain why testing is carried out on machine or equipments?

Ans → *Objective of Testing :-

i.) To know the quality of the machine, quality of materials used for manufacturing the machine.

ii.) To check the behaviour and Performance of the machine.

iii.) To check the improved design by retesting of machine.

iv.) To evaluate work products.

v.) To find failures & defects in the machine.

② State significance of I.S.S.

ns → *I.S.S. → Indian stati

*Objective :-

i.) To specify standards for machines.

ii.) To suggest standard tests for newely manufactured machine.

iii.) To specify the Plus/minus limits for the test results.

iv.) To specify the tolerance to accept the steams.

v.) To give Iss Certification.

classmate

PAGE

Distinguish b/w Routine & type test.

③ Write short-notes on following terms:-
i) Tolerance ii) Routine Test
iii) Type Test iv) Special Test.

Ans :-

i) Tolerance :-

⇒ The permissible variation is allowed as per I.S.S. & these variations are called Tolerance.

All types = ± 10% of guaranteed Value

ii) Routine Test :-

⇒ This type of Test is mainly performed for confirming the operational performance of the any machine.

⇒ This tests are carried out on each and every machine manufactured in the industry.

Eg:- insulation winding test, Winding resistance Test,

iii) Type Test :-

⇒ This type of tests are carried out on 2 or 3 randomly machine from the lot of the manufactured machine of same design & specification.

Eg:- Temperature-rise type test.
Dielectric type tests. etc.

iv) Special Test :-

⇒ This type of Tests are performed for specific purpose only as per demand for customer.

Eg:- Vibration Test, Noise level test.

(4) State objective of routine, type & special test.

Ans:-

* Objective:-

i.) To find error/defects in product.
ii.) To avoid accidents & minimize risk.
iii.) To determine the quality of material used in machine.
iv.) To provide an indication of the product reliability & quality.
v.) To confirm whether the results obtain during testing of machine.

(5.) Why machines are tested before commissioning. [SBTE- 2010, 2001).

** Ans:-

The machines are tested before commissioning (चालू करना), then chance of breakdown of machine is reduces, So, the maintenance cost is also reduced and equipment/machine become more effective and reliable.
Also, to avoid accidents & minimize risks.
Thus, Before Commissioning following tests are Performed in machine:-

i.) Check winding resistance as per rating.
ii.) Check earthing provision & cooling system.
iii.) To performed polarity & HV Test.
iv.) To check the spring tension, brush position & commutator surface.
v.) Check the alignment of shaft & coupling.

DATE

(6.) Explain the methods of testing?

Ans → Method of Testing :-

i.) Direct Method.
ii.) Indirect Method.
iii.) Regenerative Method.

1.) Direct Method of Testing :-

⇒ In this method of testing, the machine is directly connected with load or pulley and electrical load may be connected in the form of a calibrated machine.

- This type of test is applicable for small machine.

Eg :- Break Test & Calibrated machine Test

ii.) Regenerative Method of Testing :-

⇒ In this method of testing, Two identical machines are electrically and mechanically connected together and output of 2nd machine is fed back to 1st machine which saves power for testing.

Eg :- Hopkinson's Test, Back to Back Test.

iii.) Indirect Method of Testing :-

⇒ In this method of Testing, the load is not connected directly on the machine but it is run on no-load and the data obtained from the no-load test is used to find out efficiency, losses etc at different loads. Eg :- Swinburne's Test.

DATE

(7) Explain routine maintenance of electric machine. [SBTE-2019, VV1]

Ans:- Routine maintenance of electric machine is a overall daily maintenance of the machine.

- Routine maintenance is done on the regular basis whether that be daily weekly, monthy or yearly.
- Routine Maintenance Work:-
  - i) Clean motor of any dust or oil.
  - ii) Check oil level in bearings.
  - iii) Check the switches, staters & indicators.
  - iv) Check brush holders & clean them.
  - v) Check earthing connection to avoid shocks.

(8) What is preventive maintenance. (2014)

→ Preventive maintenance of electric machine is a regularly performed planned schedule maintenance of the machine.

- In order to avoid, major fault not develop in future and to prevent from burning out damages, breakdown etc., a preparing Planned schedule of maintenance is done which is called preventive maintenance.
- Preventive maintenance is also called time-based maintenance which activities are performed at fixed intervals of calender time, operating hours etc.
- It comes in two forms:-
  - i) Inspection & observation
  - ii) Intervention & replacement.

CLASSMATE PAGE

DATE

(9) What do you mean Breakdown Maintenance?

Ans → • Breakdown maintenance of machine is that maintenance which performed on a piece of equipment that has breakdown, faulted or otherwise cannot be operated.

• After this, the machine is completely shut down & immediately to be taken for — i) Inspection

ii) Fault finding & Repairs

• To avoid this condition, Breakdown maintenance is performed on the machine which are given:-

i) See free motion of rotating parts.

ii) Insulation is in tack.

iii) Check uniform air-gaps between Static & rotating gears.

iv) Check nut & bolts, terminals etc.

v) Check cooling system & repaired.

• Breakdown maintenance is performed when ~~machine~~ the profit of production from machine is more than the cost of breakdown maintenance.

• Breakdown maintenance is carried out when machine may not find time to put for routine maintenance due to constant working load.

Eg:- Generator of plant, Pumping Machine etc

DATE

(10) Distinguish between routine maintenance and breakdown maintenance of electrical equipments.

Ans →

Routine Maintenance	Breakdown Maintenance
i) Maintenance before complete breakdown of equipment/machine is called routine maint.	i) Maintenance after complete breakdown of equipment/machine is called Breakdown Maint.
ii) Routine maintenance depends on operating cycle of machine.	ii) Breakdown Maintenance does not depend on operating cycle of machine.
iii) Routine maintenance is performed by the maintenace department	iii) Breakdown Maintenance is performed by authorized repair Centre.
iv) Due to routine maint. it provide safer working environment for workers.	iv) Breakdown Maint. will not provide safer working environment for workers
v) Eg:- Insulation resistance & blinding resistance.	v) Eg:- Generator of Plant, drinking water, pumping motor

classmate

PAGE

DATE

~~What are the different factor affecting~~

(11) Explain procedure for developing preventive maintenance or preventive maintenance schedule.

Ans→ The following points are firstly considered to prepare preventive maintenance schedule:-

i.) Too frequent inspections.

ii.) Too less frequency will invite failure of operation of machine.

So, the decide the frequency of inspection schedule taking into following item:-

i.) Age of machine.

ii.) Duty cycle of machine.

iii.) Cost of machine.

iv.) Overload working of the machine

v) Type of rating of machine.

vi.) Working Condition of industries

(12) What are the objective of Preventive maintenance? (MSBTE)

Ans :- Objective:

i.) To keep the plant in good working condition at the lowest cost.

ii.) To reduce loss in production time.

iii.) To increase life of machine/equipment

iv) To avoid direct loss of profit.

v) To avoid need for overtime.

vi.) To use less standby equipment.

vii.) To run the machine without any interruption.

CLASSMATE

PAGE

DATE

(3) Explain the "Total Productive maintenance"?

Ans:- Total Productive Maintenance:-

→ The system of maintaining and improving the integrity of production and quality system through the machine is called TPM.

- The main purpose of TPM is to increase the overall equipment/machine effectiveness of plant.

i.e. TPM focuses on keeping all equipment in top working condition to avoid breakdowns and delays in manufacturing processes.

Eg:- Hydroelectric power plant machinery maintenance, &
Thermal power Plant machinery maintenance etc.

- Since, In hydral power plant, definite quantity source of water is available when dams are full of water in rainy seasons (June to Sep). due to this plant works on its maxm capacity.

So, the preventive maintenance can be Performed in the session.

But in summer session, mostly hydral Plant is closed down and electric power demand is full-fill by the thermal PowerPlant

Also, in rainy season the machinery of thermal Power Plant is taken for breakdown maintenance.

So, This type of maintenance is called TPM.

Testing & Maintenance of Machine

SEM – 6th, FM DAT 10 BY Dr. Kunal Yadav

(3.)

(1.) Explain routine test of Electric machines.

Ans:- This type of test is mainly performed for conforming the operational performance of the any machine.

* Routine Test for 1Φ & 3Φ I.M.:-

i.) Insulation resistance Test

→ This type of test is Performed to measure the winding insulation resistance of the armature, field poles, & bearing of the machine.

ii) Blocked rotor Test:-

→ This type of test is performed to measure power factor, starting current and starting voltage. torque of machine.

iii) Bearing Vibration Test:-

→ This type of test is performed to measure velocity vibration amplitude of machine.

iv) No Load Test:-

→ This type of test is performed to measure the rotational losses of the motor and to find out its equivalent circuit parameters.

v) Quiet Running Test:-

→ This type of test is performed to measure the noise-level of the machine.

→ This test requires variable supply frequency.

DATE

② Explain type test of 1ϕ & 3ϕ I.M..

Ans → This type of tests are performed on 2 or 3 randomly machine from a lot of the manufactured machine of same design & specification.

* Type Test of 1-ϕ & 3ϕ I.M.:-

i) Temperature Test:-

→ This type of Test is performed to measure winding resistance Temp of machine.

→ In this Test, firstly measure the cold winding resistance (R_1) at room temp and then running the motor on full load for sufficient time and then finding hot resistance (R_2) at rise temp(t).

By using this relation:-

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

ii) Load Test:-

→ This type of test is performed to checking motor performance through plotted Graph observations.

iii) Momentary Overload Test:-

→ This type of test is performed to checking overload carrying capacity of the machine which is generally specified on machine body.

→ Generally, this test is performed immediately after the full load temp rise test.

DATE

③ Explain special tests of Electric Machine:

Ans→ This type of Tests are performed for specific purpose only as per demand for customer.

* Special test of 1-ϕ & 3ϕ I.M. :-

i> Bearing Vibration Test :-

→ This type of test is performed to measure velocity, vibration, amplitude, of Machine.

ii> Noise level Test :-

PAGE

placement

DATE

~~What is preventive maintenance~~

④ Explain Preventive maintenance of I.M.

Ans → Preventive maintenance is a regularly Performed Planned Schedule maintenance of the machine.

→ This type of maintenance is very important for machine, In order to increase the life of machine and keep working satisfactory.

→ Objective of Preventive Maintenance:-

1.) To keep the plant in good Working Condition at the lowest possible cost.
ii.) To use less standby equipment.
iii.) To prevent premature (अकाल) Failure.
iv.) To reduce loss in production time.
v.) To reduce any accidents & Hazards.

* Effect of Absence of Maintenance:-

1.) If cooling is not Perfect and temp rise is ignored insulation is affected.
ii.) Insulation resistance must not be less than 1 MΩ. if its measurement is ignored it will affect the operation.
iii.) Brush tension, brush seating, brush clearance shall be pooperly inspected if not then performance is affected.
iv.) If maintenance of cooling system is not done then overall system operation will be affected.

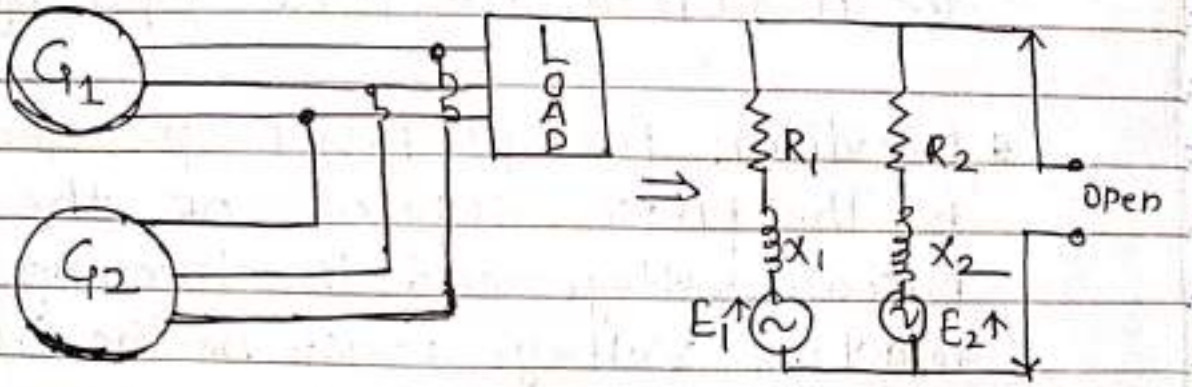
CLASSMATE

DATE

(5.) Explain the parallel operation of alternators with the help of neat circuit diagram. [SBTE-2019, 2011, 2006]

Ans →

→ When the load on a system exceeds the amount of power that a single or existing number of generator can deliver & an additional generator is connected to the system to deliver required power. This method of adding an alternator in the existing system is called "parallel operation of Alternators"



Here,

Consider two similar 3-ϕ alternator operating in parallel at no load. So, the magnitude of emf E_1 & E_2 are equal. These emf are acting in same direction w.r.t. load but w.r.t each other these emfs are in phase opposition. Thus,

When alternators are in exact synchronism E_1 & E_2 are in exact phase opposition and since E_1 & E_2 are no current flow, through closed circuit formed by two alternator.

DATE

* Reasons of Parallel operation:-
i) Several alternators can supply a bigger load then a single alternator.
ii) When any one machine is shutdown during operation, then remaining alternators operates at full load with greater efficiency.
iii) To reduce operating cost & Cost of energy generation.
iv) To increase the overall efficiency.
v) To fulfill the load requirement.

* Condition for parallel operation:-
i) The phase sequence of the busbar voltage and the incoming machine voltage must be the same.
ii) The Busbar voltage and the incoming machine terminal voltage must be in phase.
iii) No circulating current between the winding and bus-bar & the incoming alternator.
iv) The frequency of the incoming alternator must be same as the frequency of bus-bar voltage.
v) The phase angle of the two systems should be equal.

classmate

PAGE

(6) Write maintence schedule of alternator.

Ans → Maintence Schedule of alternator:-

Monthy Schedule

* Items to be Inspected	⇒	inspection notes
i) Ball & Roller Bearings	→	Make sure that grease or oil is not leaking out of the bearing housings.
ii) Brushes	→	Check length of brushes.
iii) Collector	→	Check collector for dust, roughness & Wear & Tear.
iv) Commutator	→	Check Commutator for roughness.
v) Bolts	→	Check loose bolts, loose pans & electrical connections.

6-Months Schedule

* Items to be inspected	⇒	inspection notes
i) Bearings	→	Check all bearing, pull back bearing cap to inspect grease condition.
ii) Commutator	→	Check risers for crackers.
iii) Insulation	→	Measure 1 min & 10 min insulating resistance & Calculate polarization index and compare with previous record data.
iv) Shaft	→	Check corners of the exposed ends of the shaft & key way for the crack due to fortion.
v) Vibrations	→	Check the balance & alignment.

DATE

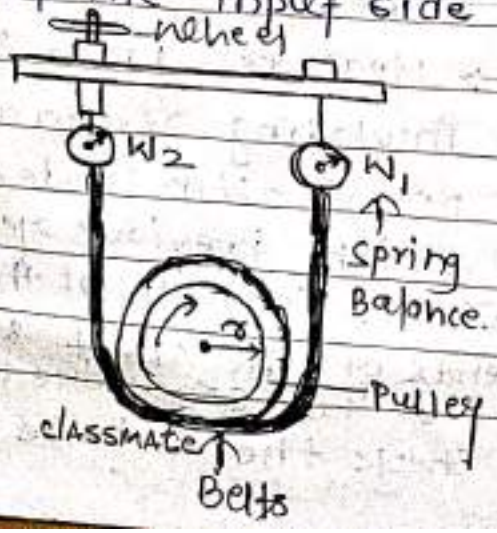
(7.) Explain with neat diagram how a brake test is carried out on DC series Machine.

Ans → **Brake Test of DC Series Motor:-**

- This is the direct method of testing of DC series motor which is useful to find efficiency of small DC motor.
- **Theory:-**

The output power of the DC motor is measured by applying brake to a pully. One rope is wound around the pulley and its two ends are attached to spring balances W_1 & W_2.

- One end of the rope is slack side and other end is tight side it means that we can tight rope from one end.
- The tension of the rope can be adjusted by using swivels untill the Ammeter at the input side shown in figure:-



PAGE

DATE

Now,

- The shaft torque developed by the motor. $T_{sh} = F \times r$

$= (w_1 - w_2) \times r$ kg-m

$= 9.81 (w_1 - w_2) \times r$ N-m ①

- Motor output power, $(P_{out}) = T_{sh} \times \omega$

$= T_{sh} \times \frac{2\pi N_w}{60}$

then

$P_{out} = T_{sh} \times \frac{2\pi N}{60}$

$= (2\pi/60) \times 9.81 (w_1 - w_2) \times r \times N$

$= 1.02 \times (w_1 - w_2) \times r \times N$

- Motor input power $(P_{in}) = VI$

then,

Efficiency of motor at full load

$= (\text{output power} / \text{input power}) \times 100\%$

$= \left(\frac{1.02 \times (w_1 - w_2) \times r \times N}{VI} \right) \times 100\%$

* Advantage

i) It is a direct method of testing.

ii) Accurate Results.

iii) Commutation difficulties can be observed.

iv) All type of DC machine can be tested by this method.

v) Temperature of the machine can be noted.

* Disadvantage:-

i) This test is not useful to find out internal losses.

ii) The output power is wasted.

iii) The spring balance reading are not stable.

iv) This test is used only constant flux machine.

Testing & Maintenance of Transformers

(4.) FM → 18 DATE

(1.) List out the various testing on transformer.

Ans → Transformer:-

Such type of electrical static device which is used to step up & step down the voltage & current with constant frequency is called transformer.

- List of type test :-
  i) Measurement of DC resistance.
  ii) Temperature rise test.
  iii) Impulse voltage withstand Test.
  iv) Polarity test
  v) Voltage ratio test etc.

- List of routine test:-
  i) Measurement of DC resistance.
  ii) Polarity test
  iii) Phasing out test
  iv) Magnestising current test.
  v) High Voltage test.

- Special test lists:-
  i) Noise level test.
  ii) Harmonics & present in x-mer emftst.
  iii) zero phase sequence of 3Φ-Xmer
  iv) Dielectric tests
  v) Zero sequence impedance test.

DATE

(Q) Explain Procedure for Conducting following tests:-

i.) Measurement of winding Resistance
ii.) Noload losses & current test
iii.) impedance Voltage
iv.) insulation resistance test.
v.) Induced over voltage withstand test
vi.) Separate source voltage withstand test.
vii.) Temperature rise test of oil & winding.
viii.) Back to Back Test.
ix.) Short circuit test
x.) Open delta test.

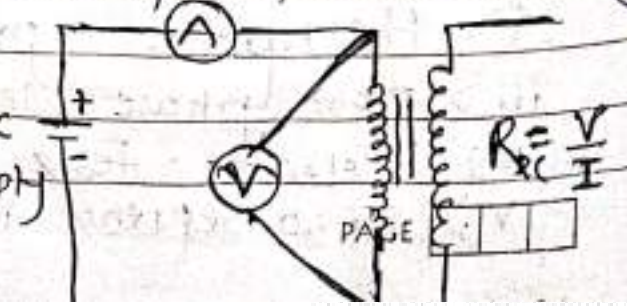
1.) Measurement of Winding Resistance:-

→ This test is aims to determine the difference in designed value of resistance and actual value of resistance.

→ The simplest method of measuring DC resistance is by using Voltmeter & Ammeter.

→ The resistance of each winding is measured by passing DC & temp of the winding is recorded.

→ Care must be taken to reduce supply self inductive effects.



DATE

ii) Test for determing magnetising current and Coreless or no load losses:-

→ This test is performed on open ckt across the secondary and applying stricly rated voltage across primary. 1-ϕ AC supply.

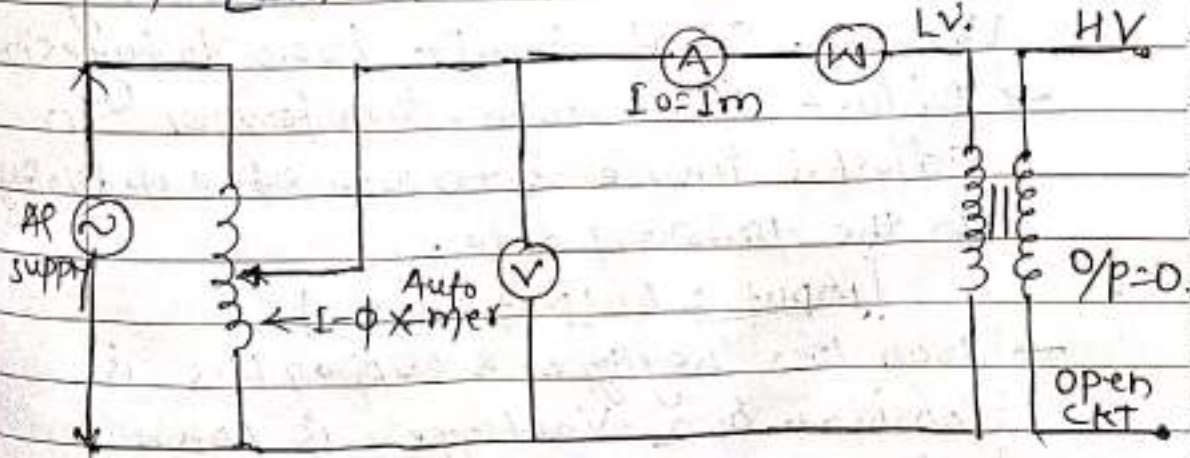
→ for the testing convient this test is preffered to be conducted on L.V. side, leaving high voltage side open circuited.

→ The no-load power consumption is u loss totally.

→ As the no-load current is very low The copper losses in the primary are negligible, therefore the waattmeter reading in this test represent rated core loss or iron loss.

[W_o = core losses = $V_o I_o \cos\phi$ = $KVA\cos\phi$]

so, [$I_m = I_o \sin\phi$ & $I_w = I_o \cos\phi$]

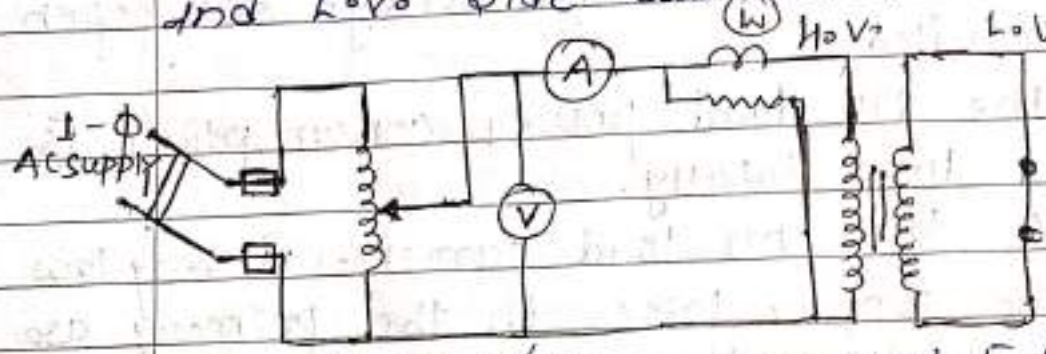


DATE

(III) Measurement of impedance and load loss (Cu-loss):-

→ This test another name is short circuit test.

→ Generally, meter's are connected in HV side to which a vasieble voltage can be applied with the help of a auto-transformer and L.V. side are short circuited.



→ A suitable voltage arround 5 to 10% of rated voltage is applied across the primary.

→ for convienient reading and testing S.C. test is conducted on high voltage, short circuit low voltage side.

→ Adjust the auto-transformer to adjusted insure 5 to 10% of rated voltage on the primary side.

Input = Output + losses

→ Iron loss negligle & copper loss is consider. bcz voltage is low.

Thus,

$$W_{sc} = I_{sc}^2 R$$

CLASSMATE PAGE

DATE

(IV.) Insulation Resistance Test of X-mer.

→ Before commissioning the transformer it is necessary to know that the insulation resistance of a transformer is greater than a specified value, to avoid excessive leakage current.

→ Meggar test for insulation are carried out between windings & core and between core & clamping bolts.

→ The insulation resistance of each winding in turn to all the other windings, core & frame or tank connected together and to earth shall be measured and recorded. following table can be refered for megger test:-

Voltage of winding	Voltage applied by megger	Mm insulation resistance (MΩ)
400V	500V	2
11KV	1000V	50
33KV	2500V	180
132KV	2500V	500

→ There are following methods for measurement of insulation Resistance:-

i.) Spot test or Short time method.
ii.) Time Resistance Test
iii.) step voltage Test

classmate

PAGE

DATE

(V) Induced over voltage withstand test:-

→ This test is the type of routine test which performed on all the x-mers.

→ This test is started by increasing applied voltage not greater than 1/3rd of test voltage, the voltage is then increased rapidly to full test voltage value for 60 seconds.

→ The frequency of applied voltage should be twice the rated frequency of transformer. then the voltage is rapidly reduced to 1/3rd of full test voltage before switching off.

→ The purpose of using double frequency is to avoid excess excitation current during test. The double frequency supply is obtained from a separate alternator.

→ When the test frequency exceeds twice the rated frequency of the transformer the duration of the test shall be $\left[\frac{120 \times \text{Rated frequency}}{\text{Test frequency}}\right]$ but not less than 15 sec.

So, This test is also called as flash test.

Q. Explain with neat sketch power frequency high voltage Test on transformer.

DATE

(VII) Separate Source Voltage Withstand Test:-

→ This test is the power frequency high voltage test of transformers.

→ This test is made with the help of single phase AC voltage of sinusoidal waveforms as far as possible and at a frequency not less than 80% of rated frequency.

→ The test is started at a voltage not greater than 1/3rd of the test voltage and is rapidly increased to the test voltage value.

→ The full test voltage is applied for 60 seconds between winding under test and all terminals of the remaining winding, core, frame & tank of the transformer connected together to earth.

→ At the end of the test, the voltage is rapidly reduced to less than 1/3rd of the test voltage and then the supply is switched off.

→ The peak value of voltage is measured with the help of digital peak voltmeter associated with capacitive voltage divider.

Q.* Describe the Impulse Voltage withstand test on transformers.

(VIII) Impulse Voltage withstand Test:-

→ This is a type test.

→ In practice the transformer is subjected to lightening strokes and switching surges. So, in this case, ordinary high voltage test are not useful.

→ The test voltage wave is generated by a special type of generator called impulse or surge generator.

→ This test does not clearly indicate about the quality of insulating materials when it is subjected to high voltage due to lightening and switch transient.

(IX) Temperature rise test of oil & winding:-

→ This test can be performed at any temperature not exceeding 40°c and no correction is made if ambient temperature is below 40°c

→ If winding resistance is greater than 0.05 Ω the temperature rise can be easily found out by using the formula:- $$\frac{R_{t2}}{R_{t1}} = \frac{234.5 + t_2}{234.5 + t_1}$$

→ But if winding resistance is less than 0.05Ω the method explained above does not gives accurate results Solution: temp° is measured by thermometer to work out the temp° rise.

DATE

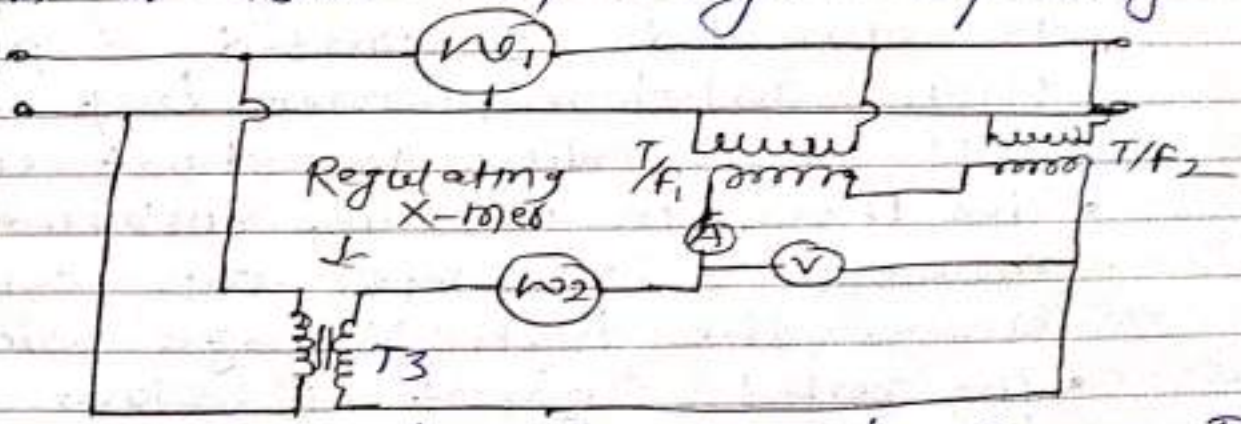
Different method of determining Temperature :-

i.) Back to Back Test
ii.) Short Circuit Test
iii.) Open delta Test.

Back to Back Test :-

Sumpher's test or back to back test is the type of test which is used for large transformer.

These test through determing their efficiency, temp rise and regulation then a load of high capacity.



T_1 & T_2 are two identical transformer T_3 = auto X-mer, A = Ammeter, V = Voltmeter W = Wattmeter.

The wattmeter reading (W_1) connected in the primary side indicates total no-load loss or iron loss of two x-mer.

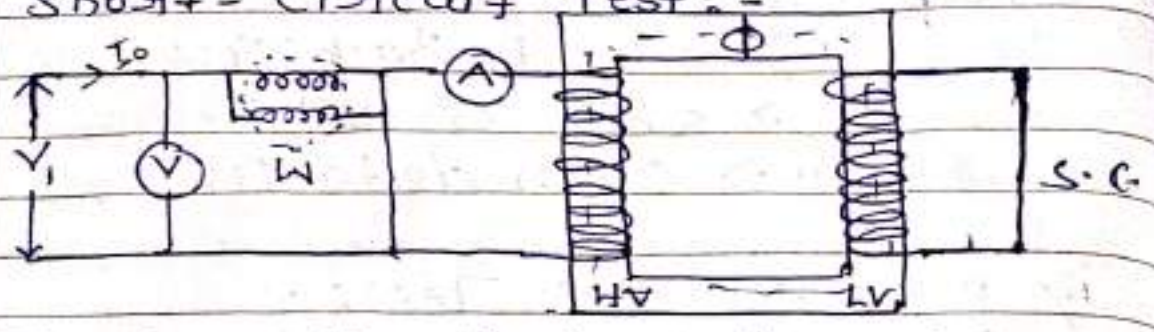
The wattmeter reading - W_2 connected in secondary side indicates total copper loss of two x-mer.

PAGE

DATE

③ Explain Short-Circuit Test of X-mer.

Ans → Short-Circuit Test :-



- The short circuit test is performed for determining the given parameter of X-mer :- 1.) Cu-loss at full load
  ii.) Equivalent Resistance (R_{01})
  iii.) impedance & Reactance (X_{01})
- In this test, the high Voltage winding is connected to rated supply Voltage with autotransformer but low Voltage winding is short circuited.
- The three measuring instruments Wattmeter Ammeter & Voltmeter are connected across the high Voltage winding.
- The rated Current is flow in the high Voltage winding that flow of rated current in low voltage winding.

Thus, let, Wattmeter reading = W_{Cu}

Voltmeter reading = $V_{SC} = V_1$

Ammeter reading = $I_{SC} = I_1$

& Cu-loss (W_{Cu}) = $I_1^2 R_{01}$

then,

$$Z_{01} = \frac{V_{SC}}{I_{SC}} \quad , \quad R_{01} = \frac{W_{Cu}}{I^2_{SC}}$$

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

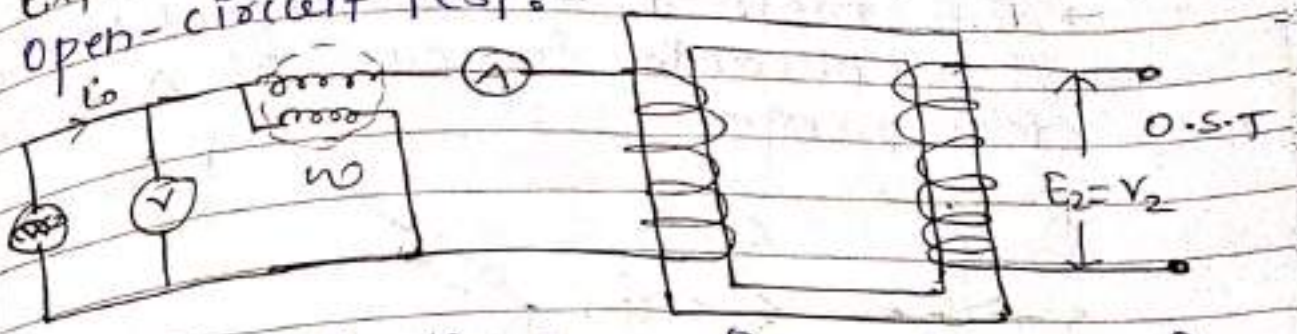
CLASSMATE

PAGE

DATE

(4) Explain open-circuit Test of X-mer.

Ans → Open-circuit Test:-



- The open circuit test is performed for determining the no load loss or coreloss and parameter R_o & X_o of the X-mer.
- In this test, the rated voltage is applied to primary side & secondary side is open circuited. A wattmeter (W), Voltmeter (V) and Ammeter (A) are connected in the L.V. winding because iron losses will be same if measured on either winding.
- The value of no load current is very small as compared to full load current. So the copper loss occurs only on the primary winding of the X-mer because the secondary winding is open circuited. Thus the reading of wattmeter only represent the core and iron losses the core losses of the X-mer is same for all types of loads.

Thus, $R_o = \frac{V_1}{I_W}$ | $X_o = \frac{V_1}{I_m}$ | $I_\mu = \sqrt{I_o^2 - I_W^2}$

$I_m = I_{OSin\phi}$

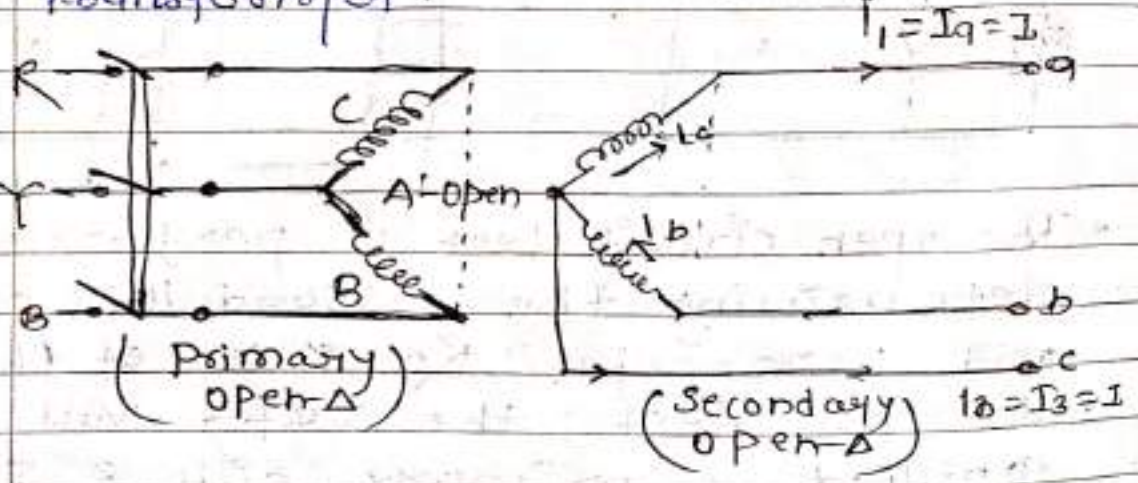
$\cos\phi_o = \frac{W}{V_1 I_o}$ | $B_o = \sqrt{I_o^2 - g_o^2}$

PAGE

DATE

(5) Explain Open delta Test of 3ϕ X-mers. (6)

→ This method of testing of transformers is applicable in case of Δ–Δ connected transformers.



→ The method of transforming 3-ϕ power by 3-phase winding i.e. 3 transformers is a regular ordinary method in which 3-units of 10KVA will supply a power of 3×10 = 30KVA

→ But it possible to transforms 3-ϕ power by means of only two single phase transformers by opening delta connection (when one of the three transformer disabled). This is shown in the following cases. By-T connections also 3ϕ can be transformed by only two single phase transformers phases A, B, & C, q, b & c supply R, Y, B phase transformers.

→ Thus, KVA Rating of X-mer = $\frac{V_L I_L}{\sqrt{3}}$

classmate

DATE

Routine Maintenace & X-mer.

Explain Preventive maintenance of distribution Transformer which is used for the purpose of distribution of power 11KV/433 is the standard Voltage rating.

In distribution transformer, many faults not develop in future and To prevent from burning out, damage breakdowns etc a due care is taken by preparing a planned schedule of maintenance which can be called as preventive maintenance.

The preventive maintenance through distribution transformer increases reliability these maintenance is economonical than other method of maintenance. So, This method is very convenient.

Routine Maintenance:-

After the Stoppage of distribution transformer on the earlier day the next day the machine or distribution transformer is to be neatly cleared to removed to avoid shocks from leakage dust, Swaastage etc.

In distribution transformer, earth connection must be checked to avoid shocks from leakage currents.

So, routine maintenace of distribution transformer is to daily checked.

DATE

Q(7) Periodic checks for replacement of oil & silica gel:-

Ans → # Transformer oil check for replacement:-

- Transformer oil is an insulator b/w the metal parts of the transformer and the wiring within the tank.
- Over time, the oil can be contained with moisture or create combustible gases.
- By sampling and testing that oil we can plan repairing or replacing the transformer before a failure occurs.

So, it is necessary the periodic check for replacement of X-mer oils.

Silica gel check for replacement:-

- Silica gel is used for the absorbtion of moisture in X-mer absence of which the dielectric strength of the transformer oil goes down.
- The breather is used for the movement of air out of the conservator tank during oil expansion and into the conservator tank during normal conditions.
- When periodic check and replacement of silica gel then transformer moisture absorbtion condition is good.

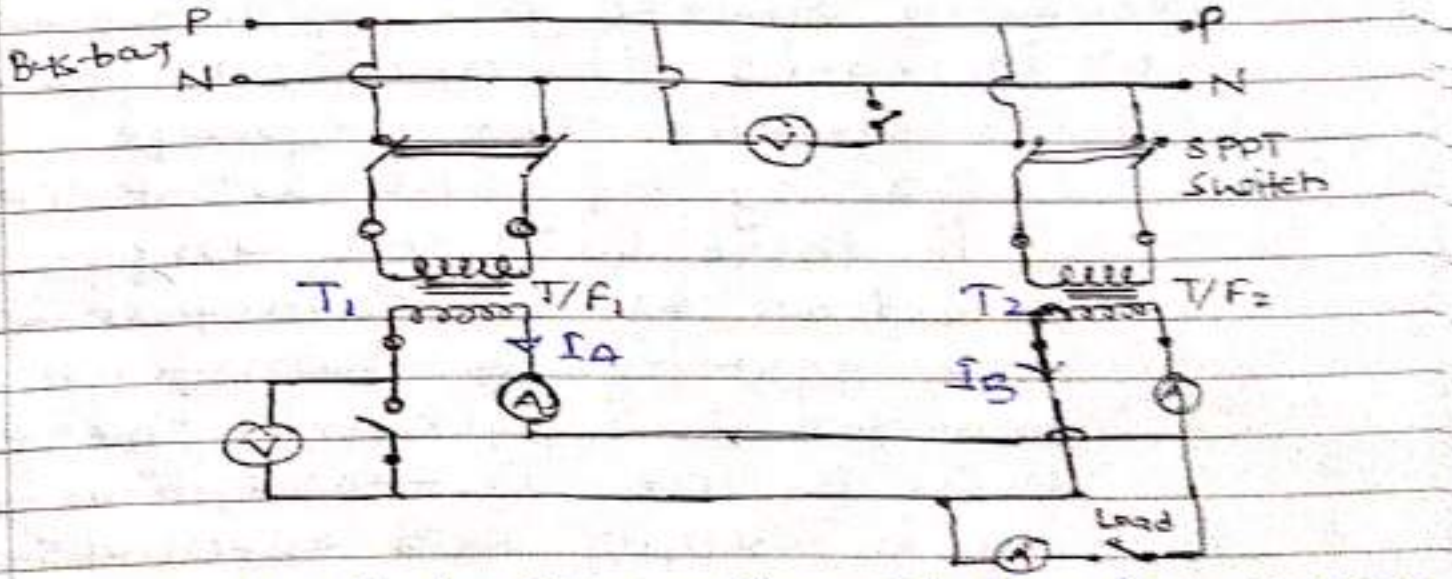
Q(8)
Ans → #

DATE

Explain parallel operation of 1-ϕ x-mer.

* Parallel operation of 1-ϕ x-mer:-

Parallel operation of a single phase transformer means that the two or more transformers having the same polarities, same turn ratios, same phase sequence and the same voltage ratio are connected in parallel with each other. which is shown in given figure:-



In parallel connection of the two x-mers their primary winding are connected to the common bus-bars and secondary winding are connected in parallel with load.

Also, The current IA & IB have two components The 1st components represents the x-mers share the load current & 2nd component is a circulating current in the secondary winding of the 1-ϕ x-mers.

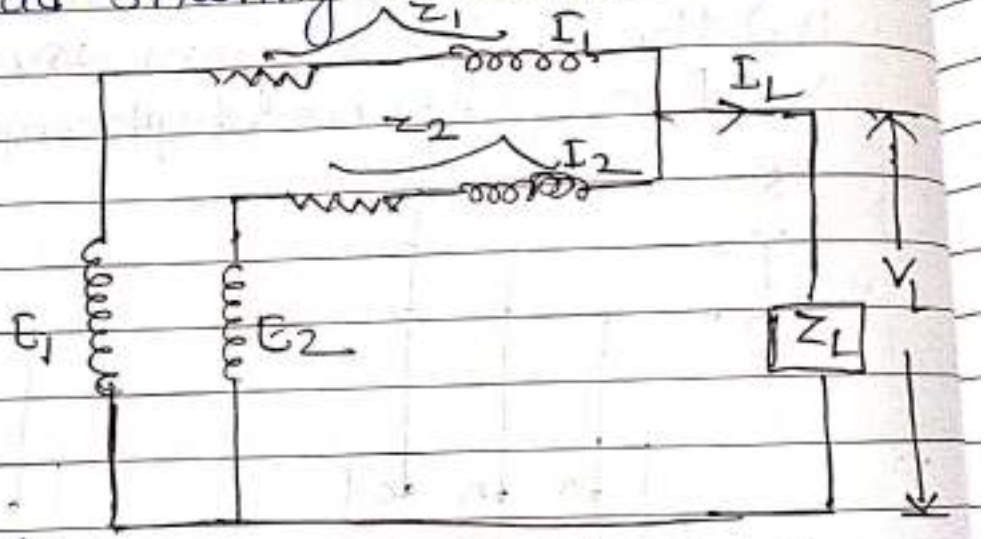
DATE

(10) Explain load sharing calculations

Ans * load sharing :-

load sharing is the standard method of connecting transformers in parallel is to have the same turn ratio, % impedance & KVA rating.

* load sharing calculations :-



Now,

(induced emf - losses = output)

$E_1 - I_1 Z_1 = V_L$ ①

& $E_2 - I_2 Z_2 = V_L$ ②

Since, $E_1 = E_2$

then $I_1 Z_1 = I_2 Z_2$

$\therefore I_1 = \frac{I_2 Z_2}{Z_1}$

we know that

$$I_1 + I_2 = I_L$$

classmate

PAGE

DATE

then from eqn ① & ⑪

$$I_2\left(\frac{Z_2}{Z_1}\right) + I_2 = I_L$$

$$\Rightarrow I_2 = I_L\left(\frac{Z_1}{Z_1+Z_2}\right) \quad \text{---(iii)}$$

$$\therefore I_1 = I_L\left(\frac{Z_2}{Z_1+Z_2}\right) \quad \text{---(iv)}$$

then,

from equation (iii) & (iv)

$$\boxed{\frac{I_2}{I_1} = \frac{Z_1}{Z_2}}$$

or $$\boxed{\frac{VI_2}{VI_1} = \frac{Z_1}{Z_2}}$$

where, VI_2 = apparent power

So, $VI_2 = S_2$

& $VI_1 = S_1$

Thus, $$\boxed{\frac{S_2}{S_1} = \frac{Z_1}{Z_2}}$$

(6) Testing & Maintence of Insulation

DATE

(1) What do you mean insulation?

Ans → Insulating materials offers very high resistance to the flow of current. They have the resistivity of the order of 10 Ω-m. The transformer tank is filled with minerals oil.

- The insulating materials exists in three forms :- Solid, liquid & gaseous form.
- Solid insulation → Wood, paper, rubber, mica, bakelite, porcelain asbestos, ceramic etc.
- liquid insulation → Varnish, mineral oil, Petroleum oil, Air, SF_6 Neon, H_2 & CO_2 etc.
- Properties of insulating Materials :-

i.> The insulating materials should have a high value of volume resistance and surface resistance.

ii.> The insulating materials should have a greater di-electric strength.

iii.> The insulating materials should have higher value of di-electric constant.

iv.> The insulating materials should have less di-electric loss.

v.) The insulating materials should have more tensile strength & good flexibility

vi.> The insulating materials should ~~have~~ remain stable without damaging their electrical/mechanical properties within the allowed temp limits.

DATE

② State Classification of insulating materials as per IS-1271-95 R. State temp^r limit with Examples?

Ans →

S.No.	Insulation classes	Max^m Temp^r	Insulating Materials.
①	Class Y/O	90°C	Cotton, silk, paper, wool, PVC, VIR, etc.
②	Class-A	105°C	Cotton, silk, paper, press cellulose Fastey etc.
③	Class-B	120°C	laminated cotton, Glass fiber, asbestos, mica, Shellac etc. leatherioid paper, PVA
④	Class-B	130°C	Glass fibers, asbestos, Mica, bituminous etc.
⑤	Class-F	155°C	Asbestos, mica, built up mica, fiber textile etc.
⑥	Class-H	180°C	Made of Inorganic material glued with Silicon resin or glass fiber
⑦	Class-C	Over 180°C	Mica, porcelain, glass quartz, Ceramics Slate marble etc.

Usage:- Transformer, alternator, motor etc.

DATE

③ State the factors on which life of insulation depends. [Most Important]

Ans → Factor Affecting life of Insulation Material

⇒ i> Temperature:-

$$R_t = R_0 (1 - \alpha_0 t)$$
$$e_t = e_0 (1 - \alpha_0 t)$$

[Insulation Resistance ↑↓ = Temperature ↓↑
Dielectric loss ↑↓ = Temperature ↑↓]

ii> Absorption of moisture:-

⇒ The absorption of moisture by insulating materials decrease its surface resistance. So, due to this insulation failure.

iii> Mechanical Stress:-

⇒ Mechanical Stress are developed in the material due to electromechanical forces. Stresses during running condition, which is true for rotating electrical machine. It develops very small cracks in the insulation. So, reduce the life of insulating materials.

iv> Electrical Stress:-

⇒ During lightening heavy impulse surge voltages come across the insulating materials, even switching produces voltage surges. So, due to this insulation failure.

v> Deposition of dust, dirt & oil:-

⇒ The surrounding atomsphere contains dust, dirt particles. These are accumulated over the electrical machine and the dirt dust reduce the insulation resistance. So,

DATE

④ State different methods for measurement of insulation Resistance. Explain one in brief.

Ans→ following are the methods of measurement of insulation Resistance by the megger:-

i.) Spot Test
ii.) Time Resistance Test
iii.) Step Voltage Test.

i.) Spot Test:-

→ In this method of Testing the megger is connected across the insulation & test voltage is applied for a fix period of time normally 60sec & take the reading.

⇒ When plotted graph is increasing then it indicates good insulation.

→ This test is suitable for a short wiring run.

ii.) Time-Resistance Test:-

→ In this method of testing, the megger is connected across the insulation & test voltage is applied for a period of 10-30Min & take the reading.

⇒ finally, A Graph is plotted by taking time on x-axis & megger reading in MΩ on y-axis

classmate

PAGE

DATE

• A good insulation shows a continuous increase in the IR resistance value.

• This test is suitable for the predictive & preventive maintenance of machines.

Thus $DAR = \frac{60th\ Second\ reading\ of\ megger}{30th\ Sec\ reading\ of\ megger}$

iii.) Step Voltage Test:-

⇒ In this method of testing, the magger is connected across the insulation & test voltage is applied for a period of 60sec & take the reading.

• The test voltage at each step is from lower voltage to higher voltage

• Good insulation will show a continuous increase in the resistance value.

* Insulation resistance Measurement by Voltmeter Method:-

⇒ This method can be used when a megger is not available. A high resistance DC voltmeter with a range of 500 & 600Volts may be used to determine the insulation resistance, provided that the sensitivity of the meter is 100Ω/V or higher.

$R = \frac{R_m(V_1 - V_2)}{V_2}$

DATE

(5) Explain the method of measuring temperature of internal parts of winding / machine.

Ans → * Method of Measuring Temperatures:-

1.) Thermometer Method.

ii) Resistance by Voltmeter-Ammeter Method

iii) Embedded Detector Method.

i) Thermometer Method:-

⇒ This method is mostly used for determining of Stator core, bearing, transformer top oil, transformer core etc.

• The thermometer is placed in the packets provided in the machine.

ii) Resistance by Voltmeter Ammeter Method:-

⇒ Measure the resistance initially then run the machine at its rated load till the machine reaches thermal equilibrium. Then disconnect the machine, from supply measure the resistance by Voltmeter ammeter method.

Thus, $t_2 = \frac{R_2(234.5+t_1)-234.5}{R_1}$

iii) Embedded Detector Method:-

⇒ This method is generally used in case of very large machine having the rating above 100 HP. At the time of manufacture of the machine, thermocouple is inserted below the coil in the slot where the temperature will be max^m. The emf produced in the thermocouple is Calibrated directly in terms of temperature.

DATE

* Applying the Correction factor when the machine is hot:-

⇒ The insulating materials posses negative temperature coefficient of resistance. So, the insulation resistance decrease with increase in temperature and vice-versa. So, insulation resistance should be immediately after the machine is stopped. If the insulation resistance measured at different temperature are to be compared to a common reference temperature generally 75°C. So, correction factor is used either for division or multiplication. The multiplying or division factor is obtained from the curves drawn for obtaining temperature resistance correction data.

For Eg:-

If the insulation Resistance at 75°C is 1 MΩ

Then, its values at 40°C = 1 × 5 = 5 MΩ

At 45°C Insulation resistance is 4 × 1 = 4 MΩ

Similarly at 95°C Insulation resistance is 1 × 2·5 = 2·5 MΩ

classmate!

DATE

⑥ State & explain the properties of transformer oil.

Ans → Transformer oil is a special type of oil which has excellent electrical insulating properties and is stable at high temperature.

- Transformer oil is used in oil-filled electrical power transformers to insulate, stop arcing and corona discharge & to dissipate the heat of the transformer.

* Properties of Transformer oil :-

i.) Electrical Properties :-

⇒ Dielectric strength, specific resistance dielectric dissipation factor.

ii.) Chemical properties :-

⇒ Water Content, Acidity, Sludge,

iii.) physical Properties :-

⇒ Interfacial tension, Viscosity, flash point, pour point.

OR Also,

i.) Water content should be more than 5ppm

ii.) For good insulating oil the acidity neutralisation value should be 0.03 mg/gm

iii.) The density of insulating oil should equal to 0.89 gm/cm3

iv.) Flash point of insulating oil should be less than 160°C

v.) Its resistivity should be about 200°C

DATE

⑦ List the four agents which Contaminates the insulating oil.

Ans → The insulating oil gets contaminated when the following impurities are present in the insulating oil :-

i.) Water

ii.) Dirt/dust

iii.) Carbon deposits

iv.) Acids & Alcohols.

v.) Sulphur

vi.) Grease

vii.) Gases

viii.) Acetones & Aldehydes.

ix.) Ketons.

x.) Presence of Sludge

Thus,

Due to this impurities, di-electric strength of insulating oil will reduce and further in may loose its dielectric and insulating properties.

Since, oil plays a very important role in transformer.

- This is used for dual purpose i.e. for cooling purpose and insulation purpose. Due care is taken in condition monitoring of transformer oil.

Also, Transformer oil is a mineral oil. The dust particles when present in the oil becomes charged & reduce breakdown strength.

DATE

(8) Explain how following test is carried for transformers.

i) Acidity Test
ii) Sludge Test
iii) Crackle Test
iv) Flash point Test
v) Dielectric Strength Test

i) Acidity Test:-

⇒ This test is performed for finding acid content in the oil.

- Taking 10gms of sample oil in the 250ml conical flask. then take 50ml of alcohol in another flask and add 10ml of phenolphthalein solution. This mixture is heated to 40-50°C temp and neutralized with a solution of KOH by quick titration.
- Now, this neutralized alcohol is added to the oil sample taken in the first flask. The sample is heated to boiling point for at least 5minutes.
- To this is then added 1 c.c. of phenolphthalein and is cooled to 90 to 50°C and titrated quickly with KOH solution. then find

$$\text{total acidity} = \frac{5.61 \times N \times V}{W}$$

where N = Normality of KOH
V = Volume of KOH

ii) Sludge Test:-

⇒ Sludge is a precipitate / mixture of impurities and acid in the transformer oil.

- Sludge formation in the transformer oil is due to the oxidation reaction with damage of sludge insulation and decomposition of oil and insulation in transformer oil.
- So, increasing of moisture in transformer oil can form sludge due to the reason of reducing the dielectric strength and corrosion.

iii) Flash point Test:-

⇒ In this test the transformer oil is heated continously till a point is reached at which the vapour is formed on the surface of oil fires spontaneously.

- The temperature of oil at this point should be less than 130°C & 140°C.
- When using transformer oil, the flash point of transformer oil should be considered according to use temperature. The general flash point should be 20 to 30°C higher than the use temp to ensure safe use & reduce volatilization loss.

DATE

iv) Crackel Test:-

⇒ This test is performed to finding the presence of water or moisture in the transformer oil.

⇒ In this test, A sample of transformer oil under test is taken in the test tube. then it is heated on a gas burner, If water or moisture is present in the transformer oil. then hissing sound is heard.

Thus, it indicates the presence of moisture content & in the transformer oil.

v) Breakdown Voltage Test:-

→ In this method of Testing, A sample of oil is taken from the transformer tank. in this kit, there are two electrodes seperated by small gap of 2.5mm between them. The gap of electrode is first checked with a guage.

⇒ The cup is filled with sample oil to be tested up to about 1 cm above the electrodes.

⇒ Now, slowly rise the voltage between the electrodes till sparking starts b/w the electrodes and note down voltage reading. & Average Value of these reading is taken.

DATE

(9.) Explain the ~~procedure~~ Method for cleaning of insulation of electrical machines.

Ans⇒ The failure of insulation takes place due to absorption of moisture, oil, dust, dirt, excessive heat, Vibration, over voltage and aging are the main reasons for failure of insulation.

- Removal of loose dust:-

The loose dust accumulated over the surface of winding in the ventilating duct can be removed by applying compressed air at a pressure about 2·1 to 2·8 kg/cm² from a portable vaccum cleaner. for this work the person should use mask, safety etc.

- Cleaning with Water:-

Cleaning ~~with~~ of electrical machinery with fresh water and detergent. Also, excess moisture wiped off with clean dry cloth and the machine should be baked in dry oven.

- Oily Viscous film:-

The oily viscous film can be removed with a piece of cheese cloth. Use approved petroleum solvent. Don't use excess petroleum solvent which may cloth damage insulation. So, Remove the oily film by

- Encrusted dirt:-

The encrusted dirt or stickly dirt can be removed carefully with a brush of wood or fiber.

DATE

(10) Why revarnishing is required? State various methods of revarnishing.

Ans → The winding, cores and other parts of machine are revarnished to fill air pockets, voids, gaps for perfect insulation.

i) Air Dry Varnish by brush:-

⇒ Revarnishing for winding, small machines are carried out by using air dry varnish applied by brushes

ii) Air dry Varnish by spray:-

Air dry varnish is applied by spray so that it goes into air pockets, slot gaps, voids.

iii) Hot-Dip method using baking Varnish:-

A) The wound armature, stator, rotor etc are heated in the baking oven at about 100°C for atleast one hour so that the moisture present in it will get evaporated.

B) It is completly immersed in varnish tank and is kept in immersed condition for atleast half an hour, so that air is filled in all the air pockets in winding & slots etc.

DATE

(11) Explain the various methods of heating of machine.

Ans # External Heat Method:-

⇒ This is the method of drying insulation most frequently used. The various methods applying external heat are:-

i) Baking in the oven

ii) By using boiler

iii) By using electric heater & lamps

Internal Heat Method:-

⇒ The insulation of the winding can be dried with the help of heat produced in the winding by I^2R loss. This Cu-loss are converted into heat which is used to dry the insulation.

(12) What is vaccum impregnation and how it is done?

Ans → Vaccum Impregnation is carried out in a Vaccum Impregnation Plant which consists of a double jacked vaccum impregnating chamber. It is having a top removing cover. There is a seperate Varnish Storing tank. A Compressor cum Vacuum-exhauster which can create a desired Pressure or Vaccum by using proper valves connected to the chamber.

⑥ Installation

FM-08 DATE

① Explain the factors involved in designing the machine foundation.

Ans→ All electrical machines are mounted on the foundations so that its static load and also the dynamic load of the rotating machine is transmitted to the ground. So, the found should be strong in construction so as to prevent displacement and vibration of the running machine.

Thus,

* The following information is required to designing the machine foundation :-

i.) Drawing of machine from foundation design point of view.
ii.) Dimension of the machine.
iii.) information about condition of soil.
iv.) Height & Weight of machine.
v.) capacity & speed of machine.

* The machine foundation should satisfy the following requirements :-

i.) The foundation should be horizontal in level.
ii.) The foundation must be rigid.
iii.) It should be free from Vibrations.
iv.) It should transmit both static and dynamic weight of the machine to ground.
v.) The foundation should be made from Concreate mix.
vi.) The machine must be rigidly bolted foundation.

PAGE

DATE

② State three basic requirement of machine foundation.

Ans→ ① Static Machine :-

⇒ Since, transformer is a static machine i.e. which operate without moving parts. So, Generally a simple foundation is satisfactory. It should be firm horizontal and dry. Once installed and erected, the transformer shall not move or bed down so as to tilt over. Even small movement of the transformer is not desired as it may break the electrical connections. So, Perfect horizontal base keeps oil level correct. For high capacity transformer rollers are provided and the rails are fixed on the plinth.

② Rotating Machine :-

⇒ A solid foundation of Concrete is provide for the installing of rotating machine. To avoid misalignment of plate proper mounting of the machine, the motor or prime mover and the driven machine are mounted on the common foundation. The foundation consists of following :-

A.> foundation made of cement, & concrete.
B.> The bed plate.
C.> foundation bolts.

Thus, Usually the manufacturer put both the machine on common steel base

classmate

DATE

③ Write procedure for levelling & alignment of two shafts of directly & indirectly coupled drives

Ans→ Procedure for levelling of directly coupled drives :-

⇒ This type of coupling can be used when it is possible to arrange the motor in the same line as that of driven machine. This coupling also called direct coupling & flexible coupling.

- In direct coupling metal flanges are fitted on the shaft ends. The two flanges are held together by means of bolts.
- In direct coupling the bolt ends are covered by means of rubber or leather bushes.

PAGE

classmate