

### UNIT III APPARATUS PROTECTION- PART A

1. Write the protection schemes used for stator protection.
  2. What is the necessity of using current transformer in protection.
  3. What is buchholz relay? Where it is used?
  4. What are the various possible transformer faults
  5. Why the protection of generator is complex.
  6. What are the different protection schemes used in busbars
  7. What are the applications of CTs and PTs in power system.
  8. What is importance of busbar protection.
  9. Busbar protection need special attention why?
  10. What are the two types of protection given for busbar.
1. **What are the types of graded used in line of radial relay feeder?**  
Definite time relay and inverse-definite time relay.
  2. **What are the various faults that would affect an alternator?**
    - (a) Stator faults 1, Phase to phase faults 2, Phase to earth faults 3, Inter turn faults
    - (b) 1, Earth faults 2, Fault between turns 3, Loss of excitation due to fuel failure
    - (c) 1, Over speed 2, Loss of drive 3, Vacuum failure resulting in condenser pressure rise, resulting in shattering of the turbine low pressure casing
    - (d) 1, Fault on lines 2, Fault on busbars
  3. **Why neutral resistor is added between neutral and earth of an alternator?**  
In order to limit the flow of current through neutral and earth a resistor is introduced between them.
  4. **What is the backup protection available for an alternator?**  
Over current and earth fault protection is the backup protections.
  5. **What are faults associated with an alternator?**
    - (a) External fault or through fault (b) Internal fault 1, Short circuit in transformer winding and connection 2, Incipient or slow developing faults
  6. **What are the main safety devices available with transformer?**  
Oil level gauge, sudden pressure delay, oil temperature indicator, winding temperature indicator .
  7. **What are the limitations of Buchholz relay?**
    - (a) Only fault below the oil level are detected.
    - (b) Mercury switch setting should be very accurate, otherwise even for vibration, there can be a false operation.
    - (c) The relay is of slow operating type, which is unsatisfactory

**8. What are the problems arising in differential protection in power transformer and how are they overcome?**

1. Difference in lengths of pilot wires on either sides of the relay. This is overcome by connecting adjustable resistors to pilot wires to get equipotential points on the pilot wires.
2. Difference in CT ratio error difference at high values of short circuit currents that makes the relay to operate even for external or through faults. This is overcome by introducing bias coil.
3. Tap changing alters the ratio of voltage and currents between HV and LV sides and the relay will sense this and act. Bias coil will solve this.
4. Magnetizing inrush current appears wherever a transformer is energized on its primary side producing harmonics. No current will be seen by the secondary CT's as there is no load in the circuit. This difference in current will actuate the differential relay. A harmonic restraining unit is added to the relay which will block it when the transformer is energized.

**9. What is REF relay?**

It is restricted earth fault relay. When the fault occurs very near to the neutral point of the transformer, the voltage available to drive the earth circuit is very small, which may not be sufficient to activate the relay, unless the cover only around 85%. Hence the relay is called REF relay.

**10. What is over fluxing protection in transformer?**

If the turns ratio of the transformer is more than 1:1, there will be higher core loss and the capability of the transformer to withstand this is limited to a few minutes only. This phenomenon is called over fluxing.

**11. Why busbar protection is needed?**

- (a) Fault level at busbar is high
- (b) The stability of the system is affected by the faults in the bus zone.
- (c) A fault in the bus bar causes interruption of supply to a large portion of the system network.

**12. What are the merits of carrier current protection?**

Fast operation, auto re-closing possible, easy discrimination of simultaneous faults.

**13. What are the errors in CT?**

- (a) Ratio error  
 Percentage ratio error =  $[(\text{Nominal ratio} - \text{Actual ratio}) / \text{Actual ratio}] \times 100$   
 The value of transformation ratio is not equal to the turns ratio. (b)  
 Phase angle error:  
 Phase angle  $\theta = 180 / \theta [(I_m \cos \theta - I_1 \sin \theta) / n I_s]$

**14. What is field suppression?**

When a fault occurs in an alternator winding even though the generator circuit breaker is tripped, the fault continues to feed because EMF is induced in the generator itself. Hence the field circuit breaker is opened and stored energy in the field winding is discharged through another resistor. This method is known as field suppression.

**15. What are the causes of bus zone faults?**

- \_ Failure of support insulator resulting in earth fault
- \_ Flashover across support insulator during over voltage
- \_ Heavily polluted insulator causing flashover
- \_ Earthquake, mechanical damage etc.

**16. What are the problems in bus zone differential protection?**

- \_ Large number of circuits, different current levels for different circuits for external faults.
- \_ Saturation of CT cores due to dc component and ac component in short circuit currents. The saturation introduces ratio error.
- \_ Sectionalizing of the bus makes circuit complicated.
- \_ Setting of relays need a change with large load changes.

**17. What is static relay?**

It is a relay in which measurement or comparison of electrical quantities is made in a static network which is designed to give an output signal when a threshold condition is passed which operates a tripping device.

**18. What is power swing?**

During switching of lines or wrong synchronization surges of real and reactive power flowing in transmission line causes severe oscillations in the voltage and current vectors. It is represented by curves originating in load regions and traveling towards relay characteristic.

A static relay may have one or more programmable units such as microprocessors or microcomputers in its circuit.

**20. What is CPMC?**

It is combined protection, monitoring and control system incorporated in the static system.

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**22. What is REF relay?**

It is restricted earth fault relay. When the fault occurs very near to the neutral point of the transformer, the voltage available to drive the earth circuit is very small, which may not be sufficient to activate the relay, unless the relay is set for a very low current. Hence the zone of protection in the winding of the transformer is restricted to cover only around 85%. Hence the relay is called REF relay.

**23. What is over fluxing protection in transformer?**

If the turns ratio of the transformer is more than 1:1, there will be higher core loss and the capability of the transformer to withstand this is limited to a few minutes only. This phenomenon is called over fluxing.

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The value of transformation ratio is not equal to the turns

- ratio. (b) Phase angle error:

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**32. What is a programmable relay?**

A static relay may have one or more programmable units such as microprocessors or microcomputers in its circuit.

**16 Marks Questions PART - B**

1a) (i) Explain the factors which cause difficulty in applying Merz-Price circulating current principle to a power transformers. (8)

(ii) A three phase transformer of 220/11000 Line Volts is Connected in star / delta. The protective transformers on 220 V side have a current ratio of 600/5. What should be the current transformer ratio on 11000 V side? (8)Or

(b) Describe the differential pilot wire method of protection of feeder. (16)

13.a.i. A generator is protected by restricted earth fault protection. The generator ratings are 13.2KV, 10MVA. The percentage of winding protected against Phase to earth fault is 85%. The relay setting is such that it trips for 20% out of balance. Calculate the resistance to be added in the neutral to ground connection (8)

ii. Explain the Stator interturn protection scheme of alternator (8)(or)

13.a. Explain a biased differential protection scheme applied to 3-Phase transformer with diagram. Also tabulate the different types of C.T connections used for different types of transformer primary and secondary winding connection. List out the advantages of biased differential protection over simple differential protection. (16)OR

13.b. Discuss the various types of fault which may occur on in an 3-phase induction motor and their corresponding protective scheme (16)

13.b.i Explain the Merz Price protection scheme of alternator (8)

ii. Discuss the various types of faults which may occur on stator of an alternator and their corresponding protective scheme.

13.(a) (i) Describe the construction and working of bucholz relay. (10)

(ii) Discuss the time graded over current protection for parallel Feeders.

(b) (i) Explain with the neat diagram the application of Merz-price circulating Current principle for protection of alternator. (12)

(ii) What is the role of instrument transformer in protective Schemes.

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