

Daffodil Institute of Technology

Diploma-in-Electrical Technology

6th semester

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66773	Switch Gear & Protection	T P C
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AIMS

To provide the student with an opportunity to acquire knowledge, skill and attitude in the area of switchgear

and protection with special emphasis on :

- Busbar and sub-station equipment.
- Circuit breakers and relays.
- Protection system for busbar, alternators, transformer, feeder and transmission line.
- Protection against over voltage.
- Sub station.

SHORT DESCRIPTION

Switch gear; Electrical faults; Busbar arrangements; Short circuit current calculation; power system stability;

Current limiting reactors; Fuses; Circuit breakers; Relays; Protection of alternator & transformer; Protection of

feeder & transmission line; Busbar protection; Over-voltage on transmission line; Protection against lightning;

Sub-station.

DETAIL DESCRIPTION

Theory:

1. Understand the concepts of switch gear.

1.1 Define switch gear.

1.2 Discuss the importance of switch gear protection of electrical system.

1.3 List different types of switch gear.

1.4 Mention the switch gear equipment.

2. Paraphrase the concepts of electrical faults.

2.1 Define electrical faults.

2.2 Name the different types of faults in electrical power system.

2.3 Discuss the causes of faults in electrical power system.

2.4 Describe different types of faults in electrical power system.

3. Perceive the concepts of busbar arrangements.

3.1 Define busbar.

3.2 Describe different types of busbar.

3.3 Mention different types of busbar arrangements.

3.4 Explain different types of busbar arrangements.

3.5 Mention different types of faults in busbar.

4. Interpret the short circuit current calculation.

4.1 Define short circuit faults.

4.2 Describe the causes of short circuit fault.

4.3 Name different types of short circuit fault.

4.4 Mention the steps for symmetrical fault calculations.

4.5 Distinguish between symmetrical and unsymmetrical fault.

4.6 Explain the method of calculation of short circuit current.

4.7 Distinguish between per unit method and percentage method.

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4.8 Discuss the advantages of per unit methods of short circuit current calculation

4.9 Solve problems on short circuit current calculation.

5. Perceive the power system stability.

5.1 Define stability.

5.2 Describe transient, dynamic and steady state stability.

5.3 Define and mention the application of swing equation

5.4 Discuss the factors affecting transient stability.

5.5 Explain the method of improving transient stability.

5.6 Analyze the effect of sudden change in mechanical input.

6. Understand the principle of operation of current limiting reactors.

6.1 Define current limiting reactor.

6.2 Describe the principle of operation of current limiting reactor.

6.3 Discuss different types of current limiting reactors with diagram.

6.4 List the advantages and disadvantages of different types of current limiting reactor (CLR).

6.5 Solve problems related to the current limiting reactor (CLR).

7. Recognize the operation and construction of fuses.

7.1 Describe the principle of operation of fuses.

7.2 List different types of fuses.

7.3 Describe the current ratings of fusing element, fusing factor and breaking capacity.

7.4 Classify fuses according to the construction and current carrying capacity.

7.5 Describe the constructional features of the following fuses:

a. High Rupturing Capacity (HRC) fuse.

b. Carbon Tetrachloride (CTC) fuse.

c. Dropout fuse.

d. Horn gap fuse.

8. Perceive the concept of construction and operation of circuit breaker.

8.1 Define circuit breaker.

8.2 Describe the principle of operation of a circuit breaker and its function.

8.3 Describe arc and the process of its production & extinguishment.

8.4 Describe the construction and the principle of operation of the following circuit breakers:

a. Plain-break type circuit breaker.

b. Oil Circuit Breaker (OCB)

c. Low oil content circuit breaker.

d. Air Circuit Breaker (ACB).

e. Gas [Sulphur-Hexafluoride, SF

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] circuit breaker.

f. Vacuum Circuit Breaker (VCB).

g. Magnetic actuator type Circuit Breaker

8.5 Compare between Gas circuit breaker (GCB) and Vacuum Circuit Breaker (VCB).

8.6 Describe the mountings and ratings of a circuit breaker.

8.7 Explain miniature types of circuit breaker such as MCB, MCCB.

8.8 Describe the principle of operation of an automatic recloser(auto reclosr) and Isolator.

8.9 Compare among the circuit breaker, auto-recloser, fuse and isolator.

8.10 Solve problems on ratings of circuit breaker

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9. Clarify the features of relay.

9.1 Define relay.

9.2 Classify the relays on the basis of construction, principle of operation, mode of use, qualities and the timing characteristics.

9.3 Describe the principle of operation and construction of the following protective and control relays:

- a. Solenoid and plunger type relay.
- b. Induction type over current relay.
- c. Reverse power relay.
- d. Directional over load relay.
- e. Thermal relay.
- f. Buchholz relay.
- g. Differential relay.
- h. Induction type impedance or distance relay.
- i. Numeric Relay
- j Earth fault (EF)and Restricted Earth fault Relay(REF)

9.4 Describe control and relay panel.

9.5 List the factors to be considered for the maintenance of a relay.

10. Understand the principle of protection of alternator and transformer.

10.1 List the major features of good protective gears for alternators and transformers.

10.2 List the major faults that may occur in alternator and transformer.

10.3 Describe Merz-Price protection of alternator.

10.4 Describe Merz-Price protection of transformer.

10.5 Solve problems on transformer protection (Merz-Price system).

10.6 Describe the reverse power protection of alternators by reverse power relay.

10.7 Describe the internal fault protection of transformer by Buchholz relay.

11. Perceive the principle of protection of feeder and transmission line.

11.1 Describe the time graded protection of radial feeder.

11.2 Describe the reverse power and over load protection of parallel feeders by over current and reverse power relay.

11.3 Describe Merz-Price voltage balance system for protection of feeder for internal (in between the relay set) fault.

11.4 Explain Translay system of protection for internal (in between the relay set) fault of feeder.

11.5 Describe the over load protection of transmission lines by definite distance relay.

11.6 Discuss the over load protection of transmission line by time distance relay.

12. Understand the principle of static relays and protections.

12.1 Define static relay.

12.2 List the advantages of static relays.

12.3 Describe amplitude comparator.

12.4 Explain level detector.

12.5 Describe static-time-lag over current relay.

12.6 Analysis busbar protection by static relay.

12.7 Describe busbar protection by saturable reactor protection system

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13. Paraphrase the causes and effects of over voltage on a transmission line.

13.1 Describe surge.

13.2 Explain the resonance in transmission line.

13.3 Explain the switching effect.

13.4 Describe the causes of insulation failure and its effect.

13.5 Discuss the arcing earth.

13.6 Describe the construction and function of peterson coil.

13.7 Explain lightning and its effect.

13.8 Classify the lightning strokes.

13.9 Explain electrostatic induction.

14. Perceive the system of protection against lightning.

14.1 Describe the protective function and principle of operation of a lightning arrester.

14.2 Distinguish between lightning arrester, surge diverter and surge absorber.

14.3 Describe the construction and principle of operation of the following lightning arresters:

- a. Rod gap
- b. Horn gap
- c. Expulsion type
- d. Oxide film
- e. Thyrite

14.4 Explain the protective function of a condenser or diverter.

14.5 Explain the function of Ferranti Surge Absorber.

14.6 Explain the function of ground wire.

15. Realize the utility and function of a sub-station.

15.1 Describe the function and importance of a sub station as a part of the power supply system.

15.2 Distinguish between indoor and outdoor sub-station.

15.3 List the factors to be considered in selecting the site of a sub-station.

15.4 Sketch the layout plan of an indoor sub-station.

15.5 List different components of an indoor sub station.

15.6 Mention the functions of the components of an indoor sub-station.

15.7 Sketch the layout plan of an indoor sub-station.

15.8 List different components of an outdoor sub-station and describe their function.

16. Understand the concept of Gas Insulated Sub Station(GIS)

16.1 Define Gas Insulated Sub Station (GIS)

16.2 Familiarize with different parts of a Gas Insulated Sub Station (GIS)

16.3 List the advantage of Gas Insulated Sub Station (GIS)

16.4 Compare between Air Insulated Sub Station & Gas Insulated Sub Station

16.5 Describe Gas monitoring system of a Gas Insulated Sub Station

16.6 Describe Gas handling process and precaution about quality of GAS.

Practical:

1. Categorize different types of fuses and measure the current carrying capacity of

HRC fuse.

1.1 Identify and sort out different type of fuses from a given number of fuses.

1.2 Sketch different parts of HRC fuse.

1.3 Select a HRC fuse for a particular electrical circuit.

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1.4 Connect the selected HRC fuse to the circuit.

1.5 Increase the load and measure the fusing current.

2. Perform the identification of different parts of an Air blast Circuit Breaker (ACB) with tripping their mechanism.

2.1 Identify different parts of an Air blast Circuit Breaker (ACB) with its moving and fixed contacts.

2.2 Sketch the main parts of the ACB.

2.3 Turn on and Turn off the ACB manually and observe its make and break mechanism.

2.4 Sketch the connection diagram of the ACB in a circuit and connect physically according to the diagram.

2.5 Read the name plate of the ACB and record its current rating.

2.6 Check the breaking operation during abnormal condition of the ACB by making a short circuit.

3. Perform the identification of different parts of an Vacuum Circuit Breaker (VCB) and observe the tripping mechanism.

3.1 Identify different parts of a VCB with special stress on its moving and fixed contacts.

3.2 Sketch the main parts of a VCB.

3.3 Turn-on and Turn-off the VCB manually and observe its make and break mechanism.

3.4 Check the oil level of the VCB.

3.5 Draw the connection diagram of the VCB in a circuit..

3.6 Connect the CB according to the diagram.

3.7 Read the name plate of the VCB and note down its current rating.

3.8 Check the breaking operation during abnormal condition of the VCB by making a short circuit

4. Perform the identification of different parts of a Sulphur-Hexafluorid (SF

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) Gas Circuit breaker and

observe their tripping mechanism.

4.1 Identify different parts of a SF6 circuit breaker with its moving and fixed contacts.

4.2 Sketch the main parts of the SF6 circuit breaker.

4.3 Turn-on and Turn-off the GCB (Gas circuit Breaker) manually and observe its make and break mechanism.

4.4 Connect the GCB according to the diagram.

4.5 Read the name plate of the GCB and record its current rating.

4.6 Check the breaking operation during abnormal condition of the GCB by making a short circuit.

5. Perform the operation and identification of different parts of an induction type over current relay (IOR).

5.1 Identify, sketch and level different parts of an induction type over current relay.

5.2 Draw the circuit diagram of the Induction type Over current Relay (IOR).

5.3 Sketch the diagram of the mimic trip circuit consists of a 1.5 V dry cell and small torch light bulb simulating the tripping arrangement.

5.4 Connect the relay (IOR) according to the circuit diagram and set the load current and allow it to work

beyond the set value of load current.

5.5 Observe the operation of the relay and the simulation tripping.

6. Sketching the layout of the electrical sub-station situated in campus and understanding its operation.

6.1 Identify different protective devices, equipment and accessories of the sub station.

6.2 Note the rating of transformer, circuit breaker, isolator, CT & PT, HT & LT switch gear.

6.3 Sketch the front view of the panel board.

6.4 Draw the block diagram of the sub-station showing all the components.

6.5 Draw the single line diagram of the sub-station.

6.6 Sketch the layout diagram of the sub-station.

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7. Visit an outdoor distribution sub-station situated near to the institute campus and prepare a report.

7.1 Identify the in-coming and out-going line of the sub-station.

7.2 Identify different equipments, their ratings and positions in the sub-station.

7.3 Read the name plate and record all the information including the feeder capacity.

7.4 Draw the front view of the control panel.

7.5 Sketch the layout of the sub-station showing the position of all the components by block diagram.

7.6 Draw the single line diagram of the outdoor sub-station.

7.7 Submit a complete technical report of the study visit.

8. Study a widely used lightning arrester.

8.1 Identify different components of thyrite lightning arrester or any type of given lightning arrester.

8.2 Sketch the cross sectional view of the given lightning arrester and label its different components.

9. Visit a nearest grid sub-station of the national grid system and submit a report.

9.1 Identify the incoming and outgoing lines.

9.2 Identify different equipment, their ratings and positions in the sub-station.

9.3 Read the name plate of the sub-station equipment and record all the information.

9.4 Draw the front view of the control panel.

9.5 Draw the layout of the sub-station showing the positions of all the components by block.

9.6 Draw the single line diagram of the grid sub-station.

9.7 Submit a complete technical report of the study visit.

10. Study the catalogue and write the report.

10.1 Collect commercial catalogue and price list of switch gear and protective devices from different local

and foreign manufactures.

10.2 Study the collected literature.

10.3 Draw a standard specification for the required switch gear.

10.4 Submit a technical report based on the information of the collected papers.

REFERENCE BOOKS

1 Switch Gear & Protection - S. Rao.

2 Electrical Power - J. B. Gupta.

3 Principles of Power System - V. K. Mehta.

4 Modern Power System - Nagrath Kothari.

5. Fundamental of switchgear and Protection - J. B. Gupta