SARDAR RAJA COLLEGE OF ENGINEERING ALANGULAM

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

MICRO LESSION PLAN

SUBJECT CODE : EE2402

SUBJECT NAME : PROTECTION AND SWITCHGEAR

YEAR : IV

SEM : VII

CLASS : B.E

STAFF NAME

Mrs. S. VELKANI,
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EE2402 PROTECTION AND SWITCHGEAR **L T P C**
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UNIT-I INTRODUCTION **9**

Importance of protective schemes for electrical apparatus and power system. Qualitative review of faults and fault currents - relay terminology – definitions - and essential qualities of protection.
Protection against over voltages due to lightning and switching - arcing grounds - Peterson Coil - ground wires - surge absorber and diverters
Power System earthing – neutral Earthing - basic ideas of insulation coordination.

UNIT-II OPERATING PRINCIPLES AND RELAY CHARACTERISTICS **9**

Electromagnetic relays – over current, directional and non-directional, distance, negative sequence, differential and under frequency relays – Introduction to static relays.

UNIT-III APPARATUS PROTECTION **9**

Main considerations in apparatus protection - transformer, generator and motor protection - protection of busbars. Transmission line protection - zones of protection. CTs and PTs and their applications in protection schemes.

UNIT-IV THEORY OF CIRCUIT INTERRUPTION **9**

Physics of arc phenomena and arc interruption.
DC and AC circuit breaking - restriking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current.

UNIT-V CIRCUIT BREAKERS **9**

Types of circuit breakers – air blast, air break, oil, SF_6 and vacuum circuit breakers – comparative merits of different circuit breakers – testing of circuit breakers.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, 'A Text Book on Power System Engineering', Dhanpat Rai & Co., 1998. (For All Chapters 1, 2, 3, 4 and 5).
2. R.K.Rajput, A Tex book of Power System Engineering. Laxmi Publications, First Edition Reprint 2007.

REFERENCES

1. Sunil S. Rao, 'Switchgear and Protection', Khanna publishers, New Delhi, 1986.
2. C.L. Wadhwa, 'Electrical Power Systems', Newage International (P) Ltd., 2000.
3. B. Ravindranath, and N. Chander, 'Power System Protection & Switchgear', Wiley Eastern Ltd., 1977.
4. Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill, 2001.
5. Y.G. Paithankar and S.R. Bhide, 'Fundamentals of Power System Protection', Prentice Hall of India Pvt. Ltd., New Delhi–110001, 2003.

SUBJECT DESCRIPTION AND OBJECTIVES

DESCRIPTION:

The modern electric power system consists of several elements such as alternators, transformers, station bus-bars, transmission lines and other equipment. It is desirable and necessary to protect each element from a variety of fault conditions which may occur.

A switchgear or electrical switchgear is a generic term which includes all the switching devices associated with mainly power system protection. It also includes all devices associated with control, metering and regulating of electrical. Assembly of such devices in a logical manner forms switchgear.

OBJECTIVES:

- To discuss the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- To understand the characteristics and functions of relays and protection schemes.
- To understand the problems associated with circuit interruption by a circuit breaker.

MICRO LESSION PLAN

Week	Hours	LECTURE TOPICS	READING
	UNIT I –INTRODUCTION		
I	**1**	Importance of protective schemes for electrical apparatus and power system	**T1**
	2	Qualitative review of faults and fault currents	**T1**
	3	Relay terminology- definitions	**T1**
	4	Essential qualities of protection.	**R3**
	5	Protection against over voltages due to lightning and switching	**T1**
II	**6**	Arcing grounds, Peterson Coil	**T1**
	7	Ground wires, Surge absorber and diverters	**T1**
	8,9	Power System earthing(AV Class) Neutral Earthing Basic ideas of insulation coordination	**T1**
III	**UNIT II- OPERATING PRINCIPLES AND RELAY CHARACTERISTICS**		
	10	Electromagnetic relays	**T1**
	11	Over current relay	**T1**
	12	Directional relay	**T1**
	13	Non-directional relay	**T1**
	14	Distance relay	**T1**
IV	**15**	Negative sequence relay	**T1**
	16	Differential relays(AV Class)	**T1**
	17	Under frequency relays	**T1**
	18	Introduction to static relays.	**T1**
V	**UNIT III- APPARATUS PROTECTION**		
	19	Main considerations in apparatus protection	**T1**
	20	Transformer protection.	**T1**
	21	Generator Protection ,Motor Protection	**T1**
	22,23	Protection of busbars (AV Class)	**T1**
VI	**24,25**	Transmission line protection, Zones of protection.	**T1**
	26,27	CTs and PTs and their applications in protection schemes.	**T1**
VII	**UNIT IV- THEORY OF CIRCUIT INTERRUPTION**		
	28,29	Physics of arc phenomena	**T1**
	30	Arc interruption	**T1**
	31	DC circuit breaking ,AC circuit breaking	**T1**
	32	Restriking voltage and recovery voltage	**T1**
	33,34	Rate of rise of recovery voltage	**T1**

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EE72-PROTECTION AND SWITCHGEAR

QUESTION BANK

UNIT I

PART A

1.What is an importance of protective scheme.
2.What are the types of faults.
3.What are the causes of faults in power system.
4. What are functions of protective relaying?
5.What is meant by switchgear.
6.What is backup protection
7.What are factors affecting the choice of protection.
8.What are essential qualities of protective relaying.
9.What is surge absorber.
10.Define surge diverter.
11.What is meant by neutral earthing
12.What is insulation coordination.

PART B

1.Explain the different types faults in power system.
2.Explain how fault current is calculated using symmetrical components.
3.What are the basic requirement of protective relaying explain.
4.Describe the essential qualities of a protective relay.
5.Explain with neat diagram of different types of earthing made in power system.
6.Explain Arc suppression coil earthing with diagram.
7.Explain surge absorber and diverters.
8.Explain about neutral earthing and list their advantages.

UNIT II

PARTA

1. Define protective relay.
2. Give the types of electromagnetic relays.
3. What are the essential qualities of a relay?
4. How the relays are basically classified.
5. What is meant by directional relay?
6. What is differential relay and list the applications of differential relay.
7. What is R-X diagram?
8.Define plug setting multiplier.
9.Define static relay
10.What are the advantages and disadvantages of static relay.
11.Define pickup value and current setting as applied to protective relaying.
13.Give any two application of electromagnetic relay.
14.Give block diagram of static relay.

15.What are the advantages of overcurrent relay over electromagnetic relay.
16.Define the terms a)pickup value b) plug setting multiplier

PART - B

1. What are the different types of electromagnetic relays? Discuss their field of applications.
2. What are the various types of over current relays? Discuss their area of application.
3. Describe the operating principle, constructional features and area of applications of reverse power or directional relay.
4. Describe the construction and principle of operation of an induction type directional over current relay.
5. Describe the construction and principle of operation of an induction type nondirectional over current relay.
6. Explain the working principle of distance relays.
7. Write a detailed note on differential relays.
8. Explain with sketches and their R-X diagrams for the following distance relays.
(i) Impedance relay
(ii) Mho relay
(iii) Reactance relay
9.Explain about static relay with neat diagram.

UNIT III

PARTA

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.

PART – B

1.What are the various types of faults which can occur in alternator? Explain in brief.
2.Explain the circulating current protection in alternator.
3.Explain the basic differential protection scheme for generator.

4.Explain the merz price circulating current scheme for the protection of three phase
power transformer.
5.Explain the different protection scheme necessary for the protection of a power transformer.
6.Explain the following protection schemes of alternators
(i) Stator interturn protection(ii)Merz price protection.
7.Explain the principle of pilot wire relaying schemes for protection of transmission lines.
8.Compare CT and PT
9.Draw and Explain protection scheme of an A.C induction motor three phase.
10.Draw and Explain the construction and working of Buchholz relay

UNIT IV
PARTA

1. What is an arc?
2. Define arc interruption
3. What is meant by restriking voltage.
4. Define recovery voltage.
5. Define current chopping.
6. Mention the different methods of high resistance arc interruption.
7. Define rate of rise of recovery voltage.
8.What is meant by resistance switching
9.What are the advantages of DC circuit breaker.
10.Compare AC & DC circuit breaker.

UNIT IV
PART B

1.Explain the terms restriking voltage, recovery voltage and RRRV.
2.Derive the expression for restriking voltage and RRRV.
3.Explain resistance switching.
4.Explain current chopping
5.Explain interruption of capacitive current
6.Explain the phenomena of arc and arc interruption.
7.Describe DC circuit breaking.
8.What are different arc interruption methods? Explain any one in detail.
9.Draw a schematic of a HVDC circuit breaker and explain its working.

UNIT V
PARTA

1. What are the basic requirements of circuit breaker?
2. What is circuit breaker?
3. What is breaking capacity?
4. What are the functional requirements of a circuit breaker under fault condition?
5. What are the advantages of low oil circuit breaker?
6. What are the types of air blast circuit breaker?

7. What are the advantages of SF6 circuit breaker?
8. How does circuit breaker differ from switch?
9. What are the types of circuit breaker?
10. Write two merits of vacuum circuit breaker.
11. What is self compensated explosion pot?

PART B

1. Explain about the various types of air blast circuit breaker.
2. Explain about the various types of air break circuit breaker.
3. Explain about the various types of oil circuit breaker.
4. Explain the operating principle of SF6 circuit breaker with neat diagram.
5. Describe construction, operating principle and application of vacuum circuit breaker.
6. What are the different methods of testing of circuit breakers? Discuss their merits and demerits.