



## SRI VENKATESWARA COLLEGE OF ENGINEERING

## COURSE DELIVERY PLAN - THEORY

Department of Electrical and Electronics Engineering		LP: EE18701 Rev. No: 00
B.E/B.Tech/M.E/M.Tech : EEE	Regulation: 2018	Date: 23/07/2021
PG Specialisation : --		
Sub. Code / Sub. Name : EE18701 PROTECTION AND SWITCHGEAR		
Unit : I - PROTECTION SCHEMES		

Unit Syllabus: Principles and need for protective schemes – nature and causes of faults – types of faults – fault current calculation using symmetrical components – Methods of Neutral grounding – Zones of protection and essential qualities of protection – Protection schemes for distributed generation – Microgrid protection - IEEE standards for power system protection.

Objective: To educate the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.

Session No *	Topics to be covered	Ref	Teaching Aids
1	Principles and need for protective schemes	2	PPT
2	Nature and causes of faults	2	PPT
3	Types of faults	2	PPT
4	Fault current calculation using symmetrical components	3, 8	PPT
5	Methods of Neutral grounding	3, 8	PPT
6	Zones of protection and essential qualities of protection	3, 8	PPT
7	Protection schemes for distributed generation	3, 8	PPT
8	Microgrid protection	3, 8	PPT
9	IEEE standards for power system protection.	2	PPT
Content beyond syllabus covered (if any): Demonstration of Importance of Neutral in the Power system			
--			

\* Session duration: 50 minutes



Sub. Code / Sub. Name: EE18701 PROTECTION AND SWITCHGEAR

Unit : II - ELECTROMAGNETIC RELAYS

Unit Syllabus: Operating principles of relays – Universal torque equation – R-X diagram - Electromagnetic Relays – Over current, Directional, Distance, differential, Negative sequence and Under frequency relays

Objective: To introduce the characteristics and functions of relays and protection schemes.

Session No *	Topics to be covered	Ref	Teaching Aids
1	Operating principles of relays - Electromagnetic relays – attracted armature and induction type	2, 5	PPT
2	The Universal relay – Torque equation – R-X diagram	1	PPT
3	Overcurrent protection – time-current characteristics, current setting, time setting	2, 5	PPT
4	Directional (reverse power) relay	2, 5	PPT
5	Distance protection – impedance, reactance and MHO relay	2, 5	PPT
6	Reach of distance relays	2, 5	PPT
7	Differential relays CBS: A new approach of Mho distance relay for Transmission line protection	2, 5, 10	PPT
8	Negative sequence relays	2, 5	PPT
9	Under frequency relays	2, 5	PPT

Content beyond syllabus covered (if any): Demonstration of operation of Electromagnetic IDMT relays.

\* Session duration: 50 mins



Sub. Code / Sub. Name: EE18701 PROTECTION AND SWITCHGEAR

Unit : III - APPARATUS PROTECTION

Unit Syllabus: Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, busbars and transmission line.

Objective: To impart knowledge on apparatus protection

Session No *	Topics to be covered	Ref	Teaching Aids
1	Current transformers – Technical terms	4, 6	PPT
2	Current transformers - Theory, CT errors, applications in protection schemes	4, 6	PPT
3	Potential transformers - Theory, VT errors, applications in protection schemes	4, 6	PPT
4	Protection of transformers – percentage differential protection	4, 6	PPT
5	Buchholz relay – Protection of earthing transformer	4, 6	PPT
6	Protection of generators	4, 6	PPT
7	Protection of motors	4, 6	PPT
8	Protection of busbars	4, 6	PPT
9	Protection of transmission lines	4, 6	PPT

Content beyond syllabus covered (if any): Various protections schemes in the Substation

\* Session duration: 50 mins



Sub. Code / Sub. Name: EE18701 PROTECTION AND SWITCHGEAR

Unit : IV - STATIC RELAYS AND NUMERICAL PROTECTION

Unit Syllabus: Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Overcurrent protection, transformer differential protection, distant protection of transmission lines. Introduction to application of Artificial Intelligence in power system protection.

Objective: To introduce static and numerical relays

Session No *	Topics to be covered	Ref	Teaching Aids
1	Static relays – Phase, Amplitude Comparators	1, 9	PPT
2	Synthesis of various relays using Static comparators	1, 9	PPT
3	Block diagram of Numerical relays - advantages	1, 9	PPT
4	Data acquisition systems (DAS), Numerical relaying algorithm	1, 9	PPT
5	Numerical Overcurrent protection	1, 9	PPT
6	Numerical differential protection of transformer	1, 9	PPT
7	Numerical distant protection of transmission lines	1, 9	PPT
8	Introduction to application of Artificial Intelligence in power system protection	1	PPT
9	ANN – Design procedure and consideration, useful properties and capabilities CBS: A New Restricted Earth Fault Relay Based on Artificial Intelligence	1, 11	PPT

**Content beyond syllabus covered (if any):**

A New Restricted Earth Fault Relay Based on Artificial Intelligence

\* Session duration: 50 mins



Sub: Code / Sub: Name: EE18701 PROTECTION AND SWITCHGEAR

Unit : V - CIRCUIT BREAKERS

Unit Syllabus: Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching – current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6 and vacuum circuit breakers – high voltage DC circuit breaker - comparison of different circuit breakers – Rating and selection of Circuit breakers.

Objective: To impart knowledge on functioning of circuit breakers

Session No *	Topics to be covered	Ref	Teaching Aids
1	Physics of arcing phenomenon and arc interruption, DC and AC circuit breaking	1, 7	PPT
2	Restriking voltage and recovery voltage - rate of rise of recovery voltage – numerical example	1, 7	PPT
3	Resistance switching - numerical example	1, 7	PPT
4	Current chopping - interruption of capacitive current	1, 7	PPT
5	Types of circuit breakers - air blast, air break circuit breakers	1, 7	PPT
6	Oil, SF6 circuit breakers	1, 7	PPT
7	Vacuum, High voltage DC circuit breakers,	1, 7	PPT
8	Comparison of different circuit breakers	1, 7	PPT
9	Rating and selection of Circuit breakers	1, 7	PPT

Content beyond syllabus covered (if any): Manifestation of SF6 and Vacuum circuit breaker in the substation

--

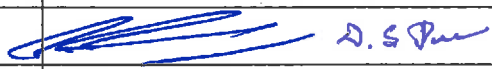

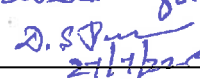
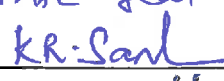

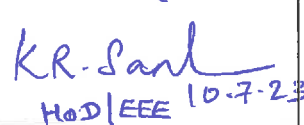
\* Session duration: 50 mins



Sub.Code / Sub Name: EE18701 PROTECTION AND SWITCHGEAR

### REFERENCES:

1. Badri Ram ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011.
2. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2010
4. Ravindra P.Singh, ' Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.
5. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G.Chotani,'Protection and Switchgear' Oxford University Press, 2011.
6. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 2008.
7. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.
8. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, 'A Text Book on Power System Engineering', Dhanpat Rai & Co.,1998.
9. [http://www.cdeep.iitb.ac.in/webpage\\_data/nptel/Electrical%20Engineering/Power%20System%20Protection/TOC\\_M1.html](http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20Engineering/Power%20System%20Protection/TOC_M1.html)
10. <https://iopscience.iop.org/article/10.1088/1757-899X/518/4/042027>
11. <http://www.ije.ir/Vol32/No1/A/8-2979.pdf>

	Prepared by	Approved by
Signature		
Name	Dr.C.Gopinath      D.S.Purushothaman	Dr.KR.Santha
Designation	Associate Professor      Assistant Professor	Vice Principal, Professor, HoD/EEE
Date	23.07.2021	23.07.2021
Remarks *:	Same lesson plan is followed for the academic year 2022-23 odd semester  	
Remarks *:	The same lesson plan is followed for the academic year 2023-2024 (odd semester)   HO D/EEE 10.7.23	

\* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD