SUBSTATION DESIGN AND AUTOMATION
(Professional Elective- III)

Course Code: 19EE1156 **L T P C**

3 0 0 3

Prerequisites: Power system protection, Electrical Measurements, Power system-I & II

Course Outcomes: At the end of the course, the student will be able to
CO1: Describe the main consideration in the process of substation design
CO2: Outline the working principles of substation switching equipment
CO3: Explain the different types of bus configurations
CO4: Design criteria of substation grounding and protection
CO5: Illustrate the substation communication (SCADA)

UNIT-I 10 Lectures
INTRODUCTION
Background, Need Determination, Budgeting, Financing, Traditional and innovative Substation Design, Site Selection and Acquisition, Design, Construction and Commissioning Process

Learning Outcome:
1. Understand the importance of the substation design (L2)
2. Demonstrate the traditional and innovative design for substation the similarities between magnetic and electrical circuits (L3)
3. Outline the different factor for effecting substation design (L4)

UNIT-II 10 Lectures
HIGH VOLTAGE SWITCHING EQUIPMENT
Ambient conditions, Disconnect switches, Load Break switches, high speed grounding switches, power fuses, circuit switches, circuit breakers.

Learning Outcome:
1. Explain the different ambient conditions which effect the substation equipment (L3)
2. Illustrate the HV switching equipments of substation (L3)
3. Understand the working of circuit breakers (L2)

UNIT-III 10 Lectures
TYPES OF SUBSTATIONS & BUS/SWITCHING CONFIGURATIONS
Transmission substation, distribution substation, collector substation, switching substations, gas insulated substations, air insulated substations, bus configurations: single bus, double bus, double break, main and transfer bus, double bus, single breaker, ring bus, break-and-a-half, Comparison of configurations.

Learning Outcome:
1. Summarize the different types of substations(L2)
2. Classify the bus configurations (L4)
3. Compare the different types of bus configurations (L5)

UNIT-IV 10 Lectures

DESIGN OF SUBSTATION GROUNDING AND PROTECTION

Reasons for substation grounding system, accidental ground circuit, Design criteria-Actual Touch and step voltage, soil resistivity, grid resistance, grid current, use of the design equations, selection of conductors, grounding fence, other design considerations. Lightning stroke protection-lightning parameters, empirical design methods. Substation fire protection-Fire hazards, fire protection measures, fire protection selection criterion.

Learning Outcome:

1. Explain the protection measures of substation for fire and lightning (L3)
2. Understand the need of substation grounding (L2)
3. Design criteria for substation grounding (L6)

UNIT-V 10 Lectures

SUBSTATION AUTOMATION AND COMMUNICATIONS

Introduction, components of substation automation system, automation applications, protocol fundamentals, supervisory control and data acquisition (SCADA) historical perspective, SCADA functional requirements, SCADA communication requirements, components of SCADA system, SCADA communication protocols, the structure of a SCADA communication protocol, security for substation communications, security methods, security assessment.

Learning Outcome:

1. Discuss the applications of Automation (L2)
2. Outline the communication protocols, structure of a SCADA (L4)
3. Discuss the need of security for substation communications(L2)

TEXT BOOKS:

1. John D. McDonald, *Electrical Power Substation Engineering*, CRC Press, 3rd Edition, 2017.

REFERENCES:

1. R. S. Dahiya, VinayAttri,"*Sub-Station Engineering Design & Computer Applications*" S K Kataria and sons Publications, 1st Edition, 2013.
2. P. S. Satnam, P. V. Gupta, "*Substation Design and Equipment*" Dhanapat Rai Publications, 1st Edition, 2013.
3. Turan Gonen, "*Electric Power Distribution Engineering*" CRC press, third edition, 2014.

WEB RESOURCES:

1. https://www.transgrid.com.au/what-we-do/our-network/connections
2. https://new.abb.com/substations
3. https://ieeexplore.ieee.org/document/178016
4. https://www.sciencedirect.com/topics/engineering/substations