PROGRAMME ELECTIVE COURSEVERTICALS FOR HONOURS / MINOR DEGREE

VERTICAL I : POWER ENGINEERING

22EEHO101	SUBSTATION ENGINEERING AND AUTOMATION			SEMESTER			
PREREQUISTIES		CATEGORY		PEC	Credit		3
Power system protection, Electrical Measurements, Power system		Hours/Week		L	T	P	TH
				3	0	0	3

Course Objectives:

1.	To understand the importance of the substation design
2.	To outline the different factor for effecting substation design
3.	To classify the bus configurations
4.	To know the design criteria for substation grounding
5.	To understand the importance of substation automation

UNIT I	INTRODUCTION	9	0	0	9

Background, Need Determination, Budgeting, Financing, Traditional and innovative Substation Design, Site Selection and Acquisition, Design, Construction and Commissioning Process

UNIT II	HIGH VOLTAGE SWITCHING EQUIPMENT	9	0	0	9

Ambient conditions, Disconnect switches, Load Break switches, high speed grounding switches, power fuses, circuit switches, circuit breakers.

UNIT III	TYPES OF SUBSTATIONS & BUS/SWITCHING CONFIGURATIONS	9	0	0	9

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.

UNIT IV	DESIGN OF SUBSTATION GROUNDING AND PROTECTION	9	0	0	9

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.

UNIT V	SUBSTATION AUTOMATION AND COMMUNICATIONS	9	0	0	9

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.

Total (45L+0T)= 45 Periods

Text Books:

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

Reference Books:

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

E-Reference

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

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand the commissioning of substation	L2: Understanding
CO2	:	Know working principles of substation switching equipment	L2: Understanding
CO3	:	Identify the different types of bus configurations	L1: Remembering
CO4	:	Design substation grounding and protection	L6: Creating
CO5	:	Analyse the substation communication (SCADA)	L4: Analysing

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	3	1	1		1	1			1		2	2	1
CO2	1	2	1	1	1								1	1	2
CO3	1	3	2	2	2		1	1				1	1	2	1
CO4	2	2	3	2	3	2						1	2	2	1
CO5	1	2	1	1	3	1	1	1			1	1	2	2	1
Avg	1.4	2.2	2	1.4	2	1.5	1	1	0	0	1	1	1.6	1.8	1.2

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)