SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B.Tech. II - Semester IV (Working Professional)	
Subject Name: Substation Automation and Design	**Subject Code: BTEL14481**

Type of course:	**Professional Elective Course (PEC)**
Prerequisite:	Basic knowledge of power system
Rationale:	The latest technologies have created an increasing demand for the generation, transmission, and distribution of electricity. Substations are a crucial segment of our power grid. Substations are used to step-up voltages for the long-distance transmission of energy and to step-down voltages for industrial and residential use. This course provides an insight into the various components of substation, design of earthing in substation, lightning protection fire protection and substation automation.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	**T**	**P**	**C**	**TEE**	**CA1**	**CA2**	**TEP**	**CA3**	**100**
3	0	**0**	**3**	60	25	15	-	-	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination.

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Sub-Station Design: General aspects of sub-station design, Site consideration, design consideration and environmental consideration of substation, layout with all equipments.	**5**	**10%**
2.	Bus-Bar Design: Bus bar arrangement with detailed layout-single bus-bar arrangement, single sectionalized bus-bar scheme, main and transfer bus-bar scheme, ring bus scheme, breaker and half scheme, double bus bar arrangement, double bus and transfer bus arrangement.	**5**	**10%**
3.	Switch Operation: Isolating switches, location, rating, selection, operation and control. Interlocking-mechanical and electrical, rating and selection of isolators	**5**	**10%**
4.	Transformers and Circuit Breakers: Voltage & Current Transformers. Governing specifications, rating & selection requirement of CT's & PT's for different protection schemes. Standard ratings & selection. Restricting voltage & recovery voltage, particular performance & testing of circuit breaker.	**8**	**20%**
5	Control & Relay panels: Design of control & relay panels. Planning of control circuit. Voltage selection scheme. General Earthing of a substation.	**4**	**10%**

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6	Complete design of Earthing grid, Lightning stroke protection and Fire Protection. Lightning stroke protection-lightning parameters, empirical design methods. Substation fire protection-Fire hazards, fire protection measures, fire protection selection criterion. Maintenance, uprating and expanding existing substations.	**7**	**15%**
7	Substation automation and auxiliary systems: substation automation architecture; data acquisition and control elements, AC and DC auxiliary systems, 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. AC and DC auxiliary systems,	**11**	**25%**

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30	**30**	**20**	**10**	**05**	**05**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from the above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Electrical Substation Engineering and Practice Engineering & Practice EHV-AC, HVDC and SF6-GIS	Sunil S.Rao.	Khanna Publishers	1992	3rd Edition
2.	Sub-Station Engineering Design & Computer Applications"	R. S. Dahiya, Vinay Attri	S K Kataria and sons Publications	2013	1st Edition
3.	"Substation Design and Equipment"	P. S. Satnam, P. V. Gupta,	Dhanapat Rai Publications	2013	1st Edition,
4.	"Electric Power Distribution Engineering	Turan Gonen	" CRC press	2014	3rd Edition
5.	Electric Power Substations Engineering	John D. McDonald	" CRC press	2017	3rd Edition

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Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Explain the principles of design and operation of electric Sub-Station Design	10
CO-2	Apply analytic techniques pertaining to primary Bus-Bar Design systems.	10
CO-3	Use basic design principles for Switch Operation and facilities	20
CO-4	Examine primary Transformers and Circuit Breakers systems using computer-based modelling	25
CO-5	Discuss computational algorithms of Control & Relay panels' system analysis and operation	25

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	2	2	1	1	2	1	-	-	1	2	-	2	2	1
CO-2	2	2	2	1	1	2	1	-	-	1	2	-	2	2	1
CO-3	2	2	2	1	1	2	1	-	-	1	2	-	2	2	1
CO-4	2	2	2	2	3	2	1	-	1	1	2	-	2	3	1
CO-5	2	2	2	2	3	2	1	-	1	1	2	-	2	3	1

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