



University of Tehran
School of Electrical and Computer Engineering

Course	High Voltage Substation Design and Project		
Course type, level, credit	Optional	Undergraduate	3 units
Field, Major	Electrical Engineering	Power	
Co-requisite(s)	<ul style="list-style-type: none"> - Insulations and High Voltage - Power System Analysis II 		
Prerequisite(s)	<ul style="list-style-type: none"> - Power System Analysis I 		
Prerequisite by topic	<ul style="list-style-type: none"> - Basic Insulation Levels (BIL) 		
Goals	Introduction of high voltage substation (HVS) equipments and their associated technical specifications is the aim of this course. In addition, basic electrical and non-electrical maps and diagrams of substations are studies.		
Outcome	<p>Students who successfully passed the course would learn the following:</p> <ul style="list-style-type: none"> - Understanding HVS electrical map reading strategies, and designing single line diagrams with various bus arrangements - Determining appropriate technical specifications of high voltage equipments - Designing ground grid using Cymgrd software - Calculating insulation coordination in presence of lightning arrester 		
Topics	<ol style="list-style-type: none"> 1. Introduction of various HVS parts 2. Electrical and environmental parameters influencing on HVS design 3. Busbar arrangements 4. Introduction of basic diagrams design 5. Disconnecting switch technical specifications 6. Circuit breaker technical specifications <ul style="list-style-type: none"> - Issues of load interruption using circuit breaker - Types of circuit breaker (Oil, SF6, Air blast, and Vacuum) - Circuit breaker operating mechanism 7. Ground grid design based on <ul style="list-style-type: none"> - strategy discussed in IEEE Std. 80, 2000 - finite element-based strategy (using Cymgrd software) 		

	8. Current transformer technical specifications 9. Voltage transformer technical specifications 10. Surge arrester technical specifications <ul style="list-style-type: none"> - Basic insulation levels - Surge arrester parts - Routing and surveying instruction - Rated voltage, rated discharge current, discharge energy class, and protective distance 11. Complementary topics <ul style="list-style-type: none"> - Line trap - Indoor, mobile and compact substations - Gas insulation substation (GIS) - Power transformer technical specifications In addition, students have site visit from three high voltage substations with different types and bus arrangements.
Required software	- Cymgrd
Assignments	
Projects	1 course project
Grading	Influential attendance: 10 % Quiz and project 25% Midterm exam: 30 % Final exam: 35 %
Textbook(s)	[1] H. Gremmel, <i>ABB Switchgear Manual</i> , 10th revised edition, ABB, 2001. [2] Technical documents of some existing high voltage substations, Moshanir consulting company, in Persian [3] National instructions and international standards regarding high voltage substation design
Further readings	[1] J. D. McDonald, <i>Electric Power Substations Engineering</i> , second edition, Taylor & Francis Group, 2006. [2] V. Hinrichsen, <i>Metal Oxide Surge Arresters Fundamentals</i> , first edition, Siemens, 2001. [3] <i>IEEE Guide for Safety in AC Substations Grounding</i> , IEEE Std. 80, 2000.