SCHEME OF COURSE WORK

Course Details:

Course Title	**: HIGH VOLTAGE DC TRANSMISSION**		
Course Code	**: 13EE2207**	**L P C**	**: 4 0 3**
Program:	**: Master of Technology.**		
Specialization:	**: Power Electronics & Drives**		
Semester	**: I**		
Prerequisites	**: Power Transmission system, Power Electronics and Switchgear & Protection**		
Courses to which it is a prerequisite	**: Research**		

Course Outcomes (COs):

1	Understand & Analyze the complete operation of HVDC Converter stations
2	Understand the power flow control on HVDC Transmission system
3	Understand the Operation of the controller for HVDC in worst and normal operations
4	Analyze the AC / DC system interactions
5	Analyze & Design protection Equipment for HVDC System

Program Outcomes (POs):

A graduate of Electrical & Electronics Engineering will be able to

1	Be a professional workforce in the area of Static Power Electronics Converters and power electronic converter fed electrical drives and power quality issues.
2	Apply soft computing techniques for Power Electronic Systems and Electric Drives.
3	Understand large scale Power Electronic Converter Systems, Electric Drives and issues involved through modeling, analysis and simulation.
4	Apply present day techniques and tools to solve Power electronic and electric drives problems relevant to india and other countries.
5	By using state-of-the-art simulation tools such as PLEXIM, SABER, OPAL-RT Lab, dSPACE, MULTISIM , LABVIEW and other Tools.
6	Collaborate with industries on problems of relevance to them while formulating graduate dissertations.
7	Improvise soft skills to students through seminars and organization of technology workshops, writing research/project reports as a part of graduate education
8	Engage in life-long learning through professional bodies such as IEEE. Institute of Engineers (India) ,etc.
9	Imbibe social responsibilities and ethical practices prevailing in a society through professional institutions.

Course Outcome Versus **Program Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO-1	S	S	S	S	S	M	S	S	M
CO-2	S	S	S	S	S	S	S	S	M
CO-3	S	S	M	S	S	S	S	S	M
CO-4	S	S	M	S	S	S	S	S	M
CO-5	S	S	M	S	S	S	S	S	M

S - Strongly correlated, *M* - *Moderately* correlated, *Blank* - *No correlation*

Assessment Methods:	Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	**Sample questions**	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	Evolution of HVDC Transmission. Comparison of HVAC and HVDC systems. Type of HVDC Transmission systems. Components of HVDC transmission systems.	CO-1	Compare HVAC and HVDC in all aspects Types of HVDC Systems What are the different components of HVDC Systems Modern Trends HVDC Systems	▫ Lecture through Black Board & LCD ▫ Discussion	Seminar/Mid Test (Week 9-10)
2	Analysis of simple rectifier circuits. Required features of rectification circuits for HVDC transmission	CO-1	Required Features of HVDC Converter	▫ Lecture through Black Board & LCD ▫ Discussion	Seminar/Mid Test (Week 9-10)
3	Analysis of HVDC converter. a. Different modes of converter operation. b. Output voltage waveforms and DC voltage in rectification.	CO-1	Analyze the Greatz Circuit Analyze the Rectifier Voltage and Valve Voltages	▫ Lecture through Black Board & LCD ▫ Problem solving	Seminar/Mid Test (Week 9-10)
4	Analysis of HVDC converter a. Output voltage waveforms and DC in inverter operation. b. Thyristor voltages. Equivalent Electrical Circuit of HVDC	CO-1	Analyze the 12 Pulse Converter With necessary Diagrams and equations derive the Equivalent Circuit of HVDC System	▫ Lecture through Black Board & LCD Problem solving	Seminar/Mid Test (Week 9-10)
5	Smoothing reactor and DC Lines. Reactive power requirements.	CO-2 & CO-3	What is the need for Requirement of Reactive Power Write about different types of Reactive Power sources	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 9-10)
6	Harmonic analysis. Filter design	CO-2 & CO-3	How harmonics are generated and what are the different Harmonics present in HVDC system and how are they eliminated	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 9-10)
7	HVDC system control features. Control Modes. Control Schemes. Control comparisons	CO-2 & CO-3	Explain the different control Strategies applied for HVDC system Explain and differentiate about the IPC and EPC modes of Firing	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 9-10)
8	Need of Interaction between HV AC and DC System Strength	CO-4	What is the need of interaction between HV AC/DC Systems Write a short note non System Strength	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 9-10)
9	Seminar by the Students				Seminar (Week 9)
10	Mid-Test 1				22-11-2013 to 28-11-2013
11	Interaction between HV AC and DC Voltage Interaction Power Flow Modulation	CO-4	What do infer by the word Voltage Interaction How power flow takes place in HVDC system What are the different Harmonic Instabilities in HVAC/DC interaction	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 17-18)
12	Multi-terminal HVDC system. Advances in HVDC transmission.	CO-2 & CO-3	what is the need for Multi Terminal DC System what are the different Types of MTDC systems Compare Series & Parallel MTDC Systems in Detail.	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 17-18)
13	HVDC system application in wind power generation	CO-2 & CO-3	How can we integrate HVDC System with Wind Generation	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 17-18)
14	Transient over voltages in HVDC systems Dc side over voltages Ac side over voltages.	CO-5	How can we protect HVDC System from Over Voltages	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 17-18)

15	Converter mal-operations. Commutation failure. Starting and shutting down the converter bridge	CO-5	What are the different Converter Mal-operation in Detail Wht is the Procedure for Starting and shutting down the converter bridge	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 17-18)
16	Over Current Protection Converter protection. Surge Arrestors	CO-5	How can we protect HVDC System from Over Currents. Write a short note on DC Breakers	▫ Lecture through Black Board & LCD Discussion	Seminar/Mid Test (Week 17-18)
17	STUDENTS SEMINAR				Seminar (Week 17)
18	Mid-Test 2				17-01-2014 to 23-01-2014
19/20	END EXAM				After 24-01-2014