Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electrical Engineering

(Applicable from the academic session 2018-2019)

Name of the course	**HVDC TRANSMISSION**
Course Code: PE-EE-601B	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Practical: hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To understand the basics of DC power transmssion system
2.	To analyse HVDC converters.
3.	To understand methods of control of HVDC system
4.	To understand causes of fault and protection against fault of converters.
5.	To understand function of smooting reactor and transient over voltage of DC line
6.	To understand methods of reactive power control.
7.	To solve numerical problems on the topics studied.
Pre-Requisite	
1.	Electric Circuit Theory (PC-EE-301)
2.	Power system-1 (PC-EE-502)
3.	Control system (PC-EE-503)
4.	Power Electronics (PC-EE-504)

Unit	Content	Hrs	Marks
1	**DC power transmission technology:** Introduction, Comparison of HVAC and HVDC transmission system, Applications of DC transmission, Description of DC transmission system, Configurations, Modern trends in DC transmission.	04	
2	**Analysis of HVDC converters:** Pulse number, Choice of converter configuration, Simplified analysis of Graetz circuit, Converter bridge characteristics, Characteristics of a twelve-pulse converter, Detailed analysis of converters with and without overlap	06	
3	**Converter and HVDC system control:** General, Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Current and extinction angle control, Starting and stopping of DC link, Power control, Higher level controllers.	06	
4	**Converter faults and protection:** Converter faults, Protection against over-currents, Overvoltages in a converter station, Surge arresters, Protection against over-voltages.	05	
5	**Smoothing reactor and DC line:** Introduction, Smoothing reactors, DC line, Transient over voltages in DC line, Protection of DC line, DC breakers, Monopolar operation, Effects of proximity of AC and DC transmission lines.	06	
6	**Reactive power control:** Reactive power requirements in steady state, Sources of reactive power, Static VAR systems, Reactive	06	

	power control during transients, Harmonics and filters, Generation of harmonics, Design of AC filters and DC filters.		
7.	**Component models for the analysis of ac/dc systems:** General, Converter model, Converter control, Modelling of DC network, Modelling of AC networks. **Power flow analysis in AC/DC systems:** General, Modelling of DC links, Solution of DC load flow, Discussion, Per unit system for DC quantities.	06	

Text book:

1. HVDC Power transmission systems , K.R. Padiyar , Third Edition, New Age International Publishers

Reference books

1. Power Transmission by Direct Current, Erich Uhlmann, Fourth Indian Reprint, Springer International Edition, 2012.
2. HVDC Transmission, S Kamakshaiah, V Kamaraju , 2nd Edition, Mcgraw Hill Education, 2020.
3. Direct Current Transmission, E.W.Kimbark, Wiley–Blackwell; Volume 1 edition (1 January 1971)
4. H.V.D.C Transmission , J Arrillaga , 1st Edition, The Institution of Engineering and Technology, 1998

Course Outcome:

After completion of this course, the learners will be able to

1. choose intelligently AC and DC transmission systems for the dedicated application(s).
2. identify the suitable two-level/multilevel configuration for high power converters.
3. select the suitable protection method for various converter faults.
4. identify suitable reactive power compensation method.
5. decide the configuration for harmonic mitigation on both AC and DC sides..
6. solve numerical problems related to converters, power flow analysis, reactive power control.

Special Remarks (if any)

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.