

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	POWER QUALITY AND FACTS
Course Code: PE-EE-602B	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:

1. To understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
2. To understand the working principles of FACTS devices and their operating characteristics.
3. To understand the basic concepts of power quality.
4. To understand the working principles of devices to improve power quality.
5. To solve numerical problems on the topics studied

Pre-Requisite

1. Power system-I (PC-EE-502)
2. Control system (PC-EE-503)
3. Power Electronics (PC-EE-504)

Unit	Content	Hrs	Marks
1	Transmission Lines and Series/Shunt Reactive Power Compensation: Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.	04	
2	Thyristor-based Flexible AC Transmission Controllers (FACTS): Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.	06	
3	Voltage Source Converter based (FACTS) controllers: Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.	08	

4	Application of FACTS : Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.	04	
5	Power Quality Problems in Distribution Systems : Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.	04	
6.	DSTATCOM: Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques for DSTATCOM.	06	
7.	Dynamic Voltage Restorer and Unified Power Quality Conditioner: Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.	06	

Text book:

- FACTS Controllers in Power Transmission and Distribution, N K. R. Padiyar, New Age International (P) Ltd. 2007.

Reference books

- Understanding FACTS: Concepts and Technology of FACTS Systems, N. G. Hingorani and L. Gyugyi Wiley-IEEE Press, 1999.
- Reactive Power Control in Electric Systems, T. J. E. Miller, John Wiley and Sons, New York, 1983.
- Electrical Power Systems Quality”, R. C. Dugan, McGraw Hill Education, 2012.
- Electric Power Quality, G. T. Heydt , Stars in a Circle Publications, 1991

Course Outcome:

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

- analyse uncompensated AC transmission line.
- explain the working principles of FACTS devices and their operating characteristics.
- apply FACTS devices for power flow control and stability.
- identify different issues of power quality in distribution system.
- apply different compensation and control techniques for DSTATCOM
- explain working principle of dynamic voltage restorer and UPQC