REACTIVE POWER COMPENSATION AND MANAGEMENT

PEC- II: EPS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPSB07	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

I. COURSEOVERVIEW:

The purpose of this course is to make the students understand about load compensation and how to select various types of reactive power compensation devices in transmission systems both during steady state and transient state operation. The course also enables the students about the management of reactive power on demand side, distribution side, and utility side of the power system.

II.COURSE OBJECTIVES:

This course should enable the students to:

I. Explain the necessity of reactive power compensation
II. Describe load compensation
III. Understand the various types of reactive power compensation in transmission systems
IV. Illustrate reactive power coordination system
V. Discuss distribution side and utility side reactive power management.

III.COURSEOUTCOMES:

After successful completion of the course, students will be able to:		
CO 1	**Discuss** the objectives and specifications of reactive compensation for designing the compensating equipment.	Apply
CO 2	**Describe** the characteristics of an uncompensated line and a compensated line which are used for evaluating the performance of lines.	Analyze
CO 3	**Examine** the mathematical modeling, operation planning and transmission benefits in reactive power coordination.	Analyze
CO 4	**Describe** the load patterns, power tariffs, flicker and harmonic voltage levels used in billing the power consumers.	Apply
CO 5	**Explain** the use of different types of capacitors, their characteristics which are used in user side reactive power management.	Analyze
CO 6	**Discuss** the impact of electric traction systems and furnaces on the reactive power and suggest the user side reactive power management techniques.	Analyze

IV. SYLLABUS

UNIT-I	LOAD COMPENSATION	Classes: 09

Objectives and specification: Reactive power characteristics, inductive and capacitive approximate biasing, load compensator as a voltage regulator, phase balancing and power factor correction of unsymmetrical loads examples.

UNIT-II	STEADYSTATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM	Classes: 09

Uncompensated line: Types of compensation, passive shunt and series and dynamic shunt compensation, examples transient state reactive power compensation in transmission systems: Characteristic time periods, passive shunt compensation, static compensations, series capacitor compensation, compensation using synchronous condensers, examples.

UNIT-III	REACTIVE POWER COORDINATION	Classes: 09

Objective, mathematical modeling, operation planning, transmission benefits, basic concepts of quality of power supply, disturbances steady, state variations.

Effects of under voltages, frequency, harmonics, radio frequency and electromagnetic interferences.

UNIT-IV	DEMAND SIDE MANAGEMENT	Classes: 09

Load patterns, basic methods load shaping, power tariffs KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels; Distribution side reactive power management: System losses, loss reduction methods, examples, reactive power planning, objectives, economics planning capacitor placement, retrofitting of capacitor banks.

UNIT-V	USER SIDE REACTIVE POWER MANAGEMENT	Classes: 09

Requirements for domestic appliances, purpose of using capacitors, selection of capacitors, deciding factors, types of available capacitor, characteristics and Limitations; Reactive power management in electric traction systems and are furnaces: Typical layout of traction systems, reactive power control requirements, distribution transformers, Electric arc furnaces, basic operations- furnaces transformer, filter requirements, remedial measures, power factor of an arc furnace.

Text Books:

1. TJE Miller, "Reactive power control in Electric power systems", Wiely Publication, 1st Edition,1982.
2. D M Tagare, "Reactive power Management", by Tata McGraw Hill, 1st Edition,2004.

Reference Books:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide", Wiely publication, 4th Edition, 2012.

Web References:

1. http://www.academia.edu/9885014/SPECIAL_ELECTRICAL_MACHINES_NPTEL_NOTES
2. http://een.iust.ac.ir/profs/Arabkhabouri/Electrical%20Drives/Books/
3. https://ktu.edu.in/eu/att/attachments.htm?download=file&id=156232

E-Text Books:

1. https://www.digital-library.theiet.org/content/books/po/pbpo022e
2. http://www.leeson.com/documents/PMAC_Whitepaper.pdf