

REACTIVE POWER COMPENSATION AND MANAGEMENT

I Semester: EPS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P		C	CIA	SEE
BPEB07	Elective	3	-	-	3	30	70	100
		Contact Classes:45			Tutorial Classes: 15		Practical Classes: Nil	

COURSE OBJECTIVES:

The 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.

COURSE OUTCOMES (COs):

- CO1: Understand objectives specifications of load compensation
 CO2: Analyze steady state reactive power compensation in transmission system
 CO3: Understand reactive power coordination
 CO4: Understand demand side management
 CO5: Understand user side reactive power management

COURSE LEARNING OUTCOMES (CLOs):

1. Understand objectives specifications of load compensation.
2. Examine how load compensator as a voltage regulator.
3. Analyze phase balancing and power factor correction of unsymmetrical loads examples.
4. Understand types of compensation.
5. Analyze examples transient state reactive power compensation in transmission systems.
6. Understand objective, mathematical modeling, operation planning, transmission benefits.
7. Understand basic concepts of quality of power supply, disturbances steady, state variations.
8. Examine Effects of under voltages, frequency, harmonics, radio frequency and electromagnetic interferences.
9. Understand Load patterns, basic methods load shaping.
10. Describe power tariffs KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.
11. Understand Distribution side reactive power management.
12. Examine Economics planning capacitor placement, retrofitting of capacitor banks.
13. purpose of using capacitors, selection of capacitors, deciding factors, types of available capacitor, characteristics and Limitations.
14. Understand Reactive power management in electric traction systems and arc furnaces.
15. Illustrate typical layout of traction systems, reactive power control requirements.
16. Understand electric arc furnaces, basic operations- furnaces transformer, filter requirements.

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 arc 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:		
<ol style="list-style-type: none"> 1. TJE Miller, "Reactive power control in Electric power systems", Wiley Publication, 1st Edition, 1982. 2. D M Tagare, "Reactive power Management", by Tata McGraw Hill, 1st Edition, 2004. 		
Reference Books:		
<ol style="list-style-type: none"> 1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide", Wiley publication, 4th Edition, 2012. 		
Web References:		
<ol style="list-style-type: none"> 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:		
<ol style="list-style-type: none"> 1. https://www.digital-library.theiet.org/content/books/po/pbpo022e 2. http://www.leeson.com/documents/PMAC_Whitepaper.pdf 		