INSTITUTEOFAERONAUTICALENGINEERING

(Autonomous)
Dundigal, Hyderabad-500043

ELECTRICAL AND ELECTRONICS ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**REACTIVE POWER COMPENSATION AND MANAGEMEN**				
Course Code	**BPEB07**				
Programme	M.Tech				
Semester	I	EPS			
Course Type	Elective				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Mr. P. Shivakumar, Assistant professor, EEE				
Course Faculty	Mr. P. Shivakumar, Assistant professor, EEE				

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):

CO 1	Understand objectives specifications of load compensation
CO 2	Analyze steady state reactive power compensation in transmission system.
CO 3	Understand reactive power coordination
CO 4	Understand demand side management
CO 5	Understand user side reactive power management

COURSE LEARNING OUTCOMES (CLOs):

BPEB07.01	Understand objectives specifications of load compensation
BPEB07.02	Examine how load compensator as a voltage regulator
BPEB07.03	Analyze phase balancing and power factor correction of unsymmetrical loads examples.
BPEB07.04	Understand types of compensation
BPEB07.05	Analyze examples transient state reactive power compensation in transmission systems
BPEB07.06	Understand objective, mathematical modeling, operation planning, transmission benefits
BPEB07.07	Understand basic concepts of quality of power supply, disturbances steady, state variations
BPEB07.08	Examine Effects of under voltages, frequency, harmonics, radio frequency and electromagnetic interferences.
BPEB07.09	Understand Load patterns, basic methods load shaping
BPEB07.10	Describe power tariffs KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels
BPEB07.11	Understand Distribution side reactive power management
BPEB07.12	Examine Economics planning capacitor placement, retrofitting of capacitor banks.
BPEB07.13	purpose of using capacitors, selection of capacitors, deciding factors, types of available capacitor, characteristics and Limitations
BPEB07.14	Understand Reactive power management in electric traction systems and are furnaces
BPEB07.15	Illustrate typical layout of traction systems, reactive power control requirements
BPEB07.16	Understand electric arc furnaces, basic operations- furnaces transformer, filter requirements

TUTORIAL QUESTION BANK

UNIT-I				
LOAD COMPENSATION				
Part - A (Short Answer Questions)				
S No	**QUESTIONS**	**Blooms Taxonomy Level**	**Course Outcomes**	**Course Learning Outcomes (CLOs)**
1	Define reactive power	Remember	CO 1	BPEB07.01
2	What are the applications of reactive power	Remember	CO 1	BPEB07.01
3	What are the advantages and disadvantages of reactive power	Remember	CO 1	BPEB07.01
4	Define contribution factor.	Understand	CO 1	BPEB07.02
5	Define load?	Understand	CO 1	BPEB07.02
6	What is the necessity of compensation?	Remember	CO 1	BPEB07.02
7	Write the objectives of load compensation	Remember	CO 1	BPEB07.02
8	What is an ideal compensating network?	Remember	CO 1	BPEB07.02
9	List out types of loads and give examples?	Remember	CO 1	BPEB07.02
10	Define load factor?	Remember	CO 1	BPEB07.03
11	What is Maximum demand?	Understand	CO 1	BPEB07.03
12	Define distribution system?	Understand	CO 1	BPEB07.03
13	Define loss factor?	Understand	CO 1	BPEB07.03
14	Write short notes on load management functions	Understand	CO 1	BPEB07.03
15	Define load diversity factor?	Understand	CO 1	BPEB07.03
Part - B (Long Answer Questions)				
1	Discuss the following objectives of load compensation: (i) Power factor correction	Remember	CO 1	BPEB07.01

	(ii) Improvement of voltage regulation (iii)Load balancing.			
2	Draw and explain reactive power characteristics of a load compensation system	Understand	CO 1	BPEB07.01
3	Prove that an unbalanced three phase load can be transformed into a balanced load without changing the real power exchange between source and load, by connecting an ideal compensating network in parallel with unbalanced load. State the assumptions made.	Understand	CO 1	BPEB07.01
4	Explain the method of phase balancing and power factor correction of unsymmetrical loads.	Understand	CO 1	BPEB07.01
5	Explain the objectives of reactive power compensation.	Remember	CO 1	BPEB07.02
6	Illustrate with an example, how load compensator as a power factor correction of un symmetrical loads.	Remember	CO 1	BPEB07.02
7.	Explain how a Load Compensator works as a voltage regulator.	Remember	CO 1	BPEB07.02
8	How power factor correction and voltage regulation can be achieved by means of compensation in1-phasesystems.	Remember	CO 1	BPEB07.02
9.	List out the parameters that are needed to be considered while specifying a load compensator.	Remember	CO 1	BPEB07.01
10	Prove that any unbalanced linear ungrounded three phase load can be transformed into a balanced, real three-phase load without changing the real power exchange between source and load.	Understand	CO 1	BPEB07.01
11	Illustrate with an example, load compensator as a power factor correction of unsymmetrical loads	Understand	CO 1	BPEB07.03
12	Discuss about Acceptance standards for the quality of supply	Understand	CO 1	BPEB07.03
13	what are the specifications of a load compensator	Understand	CO 1	BPEB07.03
14	Explain load compensation in terms of symmetrical components	Understand	CO 1	BPEB07.03
15	Explain the effect of static shunt compensation on transient stability	Remember	CO 1	BPEB07.03
UNIT- II				
STEADY STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM				
Part-A(ShortAnswerQuestions)				
1	What do you mean by Ferranti effect?	Remember	CO 2	BPEB07.04
2	What do you mean by line-length compensation?	Remember	CO 2	BPEB07.04
3	What is Surge Impedance Loading?	Remember	CO 2	BPEB07.04
4	What is Natural loading?	Remember	CO 2	BPEB07.04
5	List the Type of reactive power compensators	Understand	CO 2	BPEB07.04
6	List out the disadvantages of low voltage of the system	Remember	CO 2	BPEB07.04
7	List out the disadvantages of low power factor of the system.	Understand	CO 2	BPEB07.04
8	Define rated voltage?	Understand	CO 2	BPEB07.04
9	Define voltage drop?	Remember	CO 2	BPEB07.05
10	List out the advantages of shunt compensation.	Understand	CO 2	BPEB07.05
11	Write advantages of series compensation.	Remember	CO 2	BPEB07.05
12	List the financial benefits due to voltage improvement	Remember	CO 2	BPEB07.05
13	Write the importance of power factor correction	Remember	CO 2	BPEB07.05
14	List out different sources of reactive power absorbers in a power system?	Understand	CO 2	BPEB07.05
15	Define steady state response?	Understand	CO 2	BPEB07.05
16	Define dynamic response.	Understand	CO 2	BPEB07.05
Part-B(LongAnswerQuestions)				
1	Discuss the advantages and disadvantages of different compensating equipment for transmission systems.	Remember	CO 2	BPEB07.04
2	Explain series capacitor compensation in transmission lines with and without shunt reactors.	Understand	CO 2	BPEB07.04
3	Explain how shunt compensation is obtained by means of Mid-point shunt reactor or capacitor in transmission lines.	Understand	CO 2	BPEB07.04
4	Explain in detail about the types of compensation	Understand	CO 2	BPEB07.05
5	Explain the switched shunt reactor compensation for uncompensated transmission line.	Remember	CO 2	BPEB07.05
6.	Explain the effect of TCR during a voltage depression and during a voltage rise	Understand	CO 2	BPEB07.05

	at the midpoint bus of a symmetrical line.			
7.	What are the main objectives of series compensation?	Remember	CO 2	BPEB07.04
8	Explain about passive and active compensators.	Understand	CO 2	BPEB07.04
9.	Discuss the objectives and limitations of series compensators.	Remember	CO 2	BPEB07.05
10	Explain in details of transient state reactive power compensation in transmission system by using shunt and series compensation.	Understand	CO 2	BPEB07.05
11	Explain briefly the following a) Vitual-Z_0 (Surge impedancecompensation) b) Virtual-θ (Line-lengthcompensation) c) Compensationby "Sectioning".	Understand	CO 2	BPEB07.05
12	Explain uniformly distributed fixed compensation in transmission lines and how it effectsthe i) voltage control ii) Line-charge reactive power iii) Maximum power of the line?	Understand	CO 2	BPEB07.04
13	Explain how shunt compensation is obtained by means of Mid-point shunt reactor or capacitor intransmissionlines.	Understand	CO 2	BPEB07.05
14	Write short noteson: a) Explain the advantages and disadvantages of Flicker compensationtechniques. b) TCR-FC (Thyristor Controlled Reactor with Fixed Capacitor) in transient state reactivepowercompensation.	Remember	CO 2	BPEB07.05
15	Explain the approximate reactive powercharacteristics.	Remember	CO 2	BPEB07.05
16	Explain how shunt compensation is obtained by means of Midpoint shunt reactor or capacitor in transmissionlines.	Understand	CO 2	BPEB07.05
17	A 200 km line with $B_c/Y_o=X_l/Z_o=\theta=0.4054$ pu. For 100% compensation of the line capacitance $B_\gamma=B_c/2 = 0.2027$ per-unit of Y_o. At 500 kV with $Z_o=250$ Ω, calculate the required compensating shunt reactance and midpoint voltage.	Understand	CO 2	BPEB07.04
18	Explain briefly surge impedance and natural loading of an uncompensated transmission line.	Understand	CO 2	BPEB07.04
19	Discuss the different types of compensation in detail.	Understand	CO 2	BPEB07.05
20	discuss uniformly distributed fixed compensation in transmission lines and how it effects the i) voltage control ii) Line-charge reactive power iii) Maximum power of the line?			BPEB07.05
21	Discuss the passive shunt compensation in detail?	Understand	CO 2	BPEB07.04
22	discuss how shunt compensation is found by means of Mid-point shunt reactor or capacitor in transmission lines.	Understand	CO 2	BPEB07.04
24	Discuss the objectives and limitations of series compensator	Remember	CO 2	BPEB07.05
25	Draw the voltage and current characteristics of power system and static compensator	Remember	CO 2	BPEB07.04
26	Explain how the compensator can improve the dynamic performance of the system	Understand	CO 2	BPEB07.05
UNIT III				
REACTIVE POWER COORDINATION				
Part-A(Short Answer Questions)				
1	Define reactive power management.	Understand	CO 3	BPEB07.06
2	What do you mean by Reconfiguration of distributionnetworks?	Remember	CO 3	BPEB07.06
3	What are the Objectives of Reactive Power compensation. ?	Understand	CO 3	BPEB07.06
4	What are the types of reactive power flows in a power system	Understand	CO 3	BPEB07.06
5	What are the conditions of reactive powermanagement?	Understand	CO 3	BPEB07.07
6	What is reactive power planning	Remember	CO 3	BPEB07.07
7	What is operations planning	Understand	CO 3	BPEB07.07
8	What is reactive power dispatch and control	Understand	CO 3	BPEB07.08
9	What is the cause of telephone interference?	Remember	CO 3	BPEB07.08
10	What are the applications of static compensator	Remember	CO 3	BPEB07.08

11	What is radio frequency interference?	Understand	CO 3	BPEB07.06
12	Compute the need for voltage and frequency regulation in power system?	Understand	CO 3	BPEB07.06
13	List the utility objectives	Understand	CO 3	BPEB07.06
14	What are the drawbacks of power management system?	Understand	CO 3	BPEB07.06
15	Write the transmission benefits	Understand	CO 3	BPEB07.07
16	How does reactive power dispatching effect present equipment?	Remember	CO 3	BPEB07.07
17	Draw the optimal power flow algorithm	Remember	CO 3	BPEB07.08
18	Define harmonics	Remember	CO 3	BPEB07.08
19	What are the benefits of shunt capacitor?	Remember	CO 3	BPEB07.08
20	What are the benefits of series capacitor?	Remember	CO 3	BPEB07.08
	Part–B(Long Answer Questions)			
1	Give a detailed algorithm for optimum dispatch of reactive power with the help of a flow chart.	Understand	CO 3	BPEB07.06
2	Explain the need of reactive power management.	Understand	CO 3	BPEB07.06
3	Explain the problems in the quality of electrical supply.	Understand	CO 3	BPEB07.06
4	Explain how Reactive Power Management or Planning is obtained by means of mathematical modeling. Define Reactive Power Management.	Remember	CO 3	BPEB07.06
5	Derive the expression for line voltage profile and current profile of an uncompensated line on open circuit. Draw the voltage and current profiles.	Understand	CO 3	BPEB07.07
6	Explain the transmission benefits to an electric utility on the application of reactive power dispatching strategy.	Understand	CO 3	BPEB07.07
7	Draw the reactive power characteristics and also explain with neat figures and circuit diagrams?	Understand	CO 3	BPEB07.07
8	What is Reactive power planning? What are the transmission benefits when reactive power dispatching strategy is applied to improve power system operation?	Understand	CO 3	BPEB07.08
9	Give the objectives of Reactive power planning?	Understand	CO 3	BPEB07.08
10	discuss how Reactive Power Management or Planning is found by means of mathematical modeling	Understand	CO 3	BPEB07.08
12	What is electromagnetic interference? Explain its significance in power systems.	Understand	CO 3	BPEB07.06
13	Discuss the causes and effects of under and over frequencies.	Understand	CO 3	BPEB07.06
14	Explain in detail the concepts of Effects of harmonica and how to compensate it.	Understand	CO 3	BPEB07.06
15	Explain in detail the concepts of Effect of electromagnetic interferences.	Understand	CO 3	BPEB07.07
16	Explain the need of reactive power management	Understand	CO 3	BPEB07.07
17	Define harmonics. What are the harmful effects ofharmonics?	Understand	CO 3	BPEB07.07
18	Describe the effects of harmonics and radio frequency on reactive power compensation	Understand	CO 3	BPEB07.08
19	Give a detailed economic justification of reactive power planning	Remember	CO 3	BPEB07.08
19	Describe the effect of harmonies and radio frequency on reactive power compensation.	Understand	CO 3	BPEB07.08
20	Draw algorithmic circuit for determining instantaneous reactive power	Understand	CO 3	BPEB07.08
	UNIT IV			
	DEMAND SIDE MANAGEMENT			
	Part – A (Short Answer Questions)			
1	Define KVAR	Understand	CO 4	BPEB07.09
2	What are the different types of system losses?	Understand	CO 4	BPEB07.09
3	Define tariff	Understand	CO 4	BPEB07.09
4	List the different types of loss reduction methods	Understand	CO 4	BPEB07.10
5	What is reactive power planning	Understand	CO 4	BPEB07.10
6	What are the causes of voltage flicker	Understand	CO 4	BPEB07.10
7	What are the effects of voltage flicker	Understand	CO 4	BPEB07.10
8	What are the advantages of capacitor banks	Understand	CO 4	BPEB07.11

9	What are the causes of harmonics	Understand	CO 4	BPEB07.11
10	What is the aim of load pattern	Understand	CO 4	BPEB07.11
11	Define harmonic voltage distortion	Understand	CO 4	BPEB07.11
12	Define total harmonic distortion	Understand	CO 4	BPEB07.11
13	List the types of filters	Understand	CO 4	BPEB07.12
14	What is the function of filter?	Understand	CO 4	BPEB07.12
15	What is the function of synchronous condenser	Understand	CO 4	BPEB07.12
	Part – B (Long Answer Questions)			
1	What are the different types of system losses? Explain different loss reduction methods used in reactive power demand side management.	Understand	CO 4	BPEB07.09
2	Explain the concept of quality of power supply with reactive power coordination.	Understand	CO 4	BPEB07.09
3	List and explain briefly the basic methods of load shaping in demand side.	Understand	CO 4	BPEB07.09
4	Explain the various System losses and the loss reduction methods used in Demand side management.	Understand	CO 4	BPEB07.10
5	Explain about : a) Retrofitting of capacitor banks b) Deciding factors	Understand	CO 4	BPEB07.10
6	Explain the demand side management load shaping.	Understand	CO 4	BPEB07.10
7	Discuss the various power tariffs.	Understand	CO 4	BPEB07.10
8	Discuss in detail of the various methods for loss reduction.	Understand	CO 4	BPEB07.10
9	Write short noteson: a) Explain the different types of PowerTariffs. b) Explain the load patterns in demand sidemanagement.	Understand	CO 4	BPEB07.11
10	Briefly explain the method of retrofitting of capacitorbanks.	Understand	CO 4	BPEB07.11
11	Explain Reconfiguration methods and Optimizing power flows method used for reduction of losses in powersystems.	Understand	CO 4	BPEB07.11
12	What are the different load patterns available and also explain the basic methods ofload shaping?	Understand	CO 4	BPEB07.11
13	Explain the remedial measures for voltage flicker.	Understand	CO 4	BPEB07.12
14	Discuss the KVAR Requirements	Understand	CO 4	BPEB07.12
15	Explain different power tariffs and penalties for voltage flickers	Remember	CO 4	BPEB07.12
	UNIT V			
	USER SIDE REACTIVE POWER MANAGEMENT			
	Part - A (Short Answer Questions)			
1	What are the flicker compensation equipments?	Understand	CO 5	BPEB07.13
2	Draw the diagram of TCR compensator	Understand	CO 5	BPEB07.13
3	What are the benefits of compensation?	Understand	CO 5	BPEB07.13
4	Draw the V-I characteristic o saturated reactor compensator	Understand	CO 5	BPEB07.13
5	List different types of railway electric system	Understand	CO 5	BPEB07.14
6	What are the different types of capacitors used in reactive power management?	Understand	CO 5	BPEB07.14
7	What are the deciding factors for the selection of capacitors?	Understand	CO 5	BPEB07.14
8	What are the advantages of thyristor controlled reactor?	Understand	CO 5	BPEB07.14
9	Define compensation ratio	Understand	CO 5	BPEB07.15
10	Define suppression ratio	Understand	CO 5	BPEB07.15
11	What are the disadvantages of thyristor controlled reactor?	Understand	CO 5	BPEB07.15
12	What are the advantages of thyristor –switched capacitor	Understand	CO 5	BPEB07.15
13	What are the advantages of tapped reactor	Understand	CO 5	BPEB07.16
14	What are the advantages of harmonic-compensated saturated reactor	Understand	CO 5	BPEB07.16
15	Define resonance	Understand	CO 5	BPEB07.16
	Part - B (Long Answer Questions)			
1	What is the purpose of using capacitors on user side for reactive power management? What are the deciding factors for the selection of capacitors?	Understand	CO 5	BPEB07.13
2	Discuss about different types of capacitor available in the market and explain their characteristics and limitations.	Understand	CO 5	BPEB07.13
3	Explain the remedial measures for voltage flicker.	Understand	CO 5	BPEB07.13
4	Explain the filter requirements for reactive power management in electric traction systems and furnaces.	Understand	CO 5	BPEB07.13

5	What is the purpose of using capacitors on user side reactive power management and also explain in detail the types of available capacitors with their characteristics and limitations?	Understand	CO 5	BPEB07.14
6	Draw typical layouts of Ac traction systems and explain its operation.	Understand	CO 5	BPEB07.14
7	Explain how the harmonics are produced in an electric arc furnace.	Understand	CO 5	BPEB07.14
8	What are the purposes of using capacitors as compensators.	Understand	CO 5	BPEB07.14
9	Briefly discuss how to select a capacitor for user side reactive power management.	Understand	CO 5	BPEB07.15
10	Discuss the various types of railway electric system with neat diagrams.	Understand	CO 5	BPEB07.15
11	Explain how a user side reactive power management is obtained by means of capacitors.	Understand	CO 5	BPEB07.15
12	Explain the deciding factors in selection of acapacitor.	Understand	CO 5	BPEB07.15
13	What is the purpose of using capacitors on user side for reactive power management?	Understand	CO 5	BPEB07.16
14	Discuss the power factor of an arc furnace in detail.	Understand	CO 5	BPEB07.16
15	discuss how a user side reactive power management is found by means of capacitors	Understand	CO 5	BPEB07.16

Prepared by:

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