CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
EET398	OPERATION AND CONTROL OF POWER SYSTEMS	VAC	3	1	0	4

Preamble: This course introduces analysis techniques for the operation and control of power systems. Load dispatch and scheduling of energy are discussed. Power system security and state estimation are introduced. This course serves as the most important prerequisite of many advanced courses in power systems.

Prerequisite: Power Systems I

Course Outcomes: After the completion of the course the student will be able to:

CO 1	Analyse various methods of generation scheduling.
CO 2	Formulate hydro-thermal scheduling problems.
CO 3	Evaluate power exchange in interconnected power systems.
CO 4	Analyse security issues in power system networks.
CO 5	Analyse various state estimation methods.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	2								2
CO 2	3	3										2
CO 3	3	3										2
CO 4	3	3	2	2								2
CO 5	3	3										2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	10
Understand (K2)	20	20	40
Apply (K3)	20	20	50
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which students should answer any one question. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain economic dispatch and unit commitment (K1)
2. Problems on optimal load dispatch (K2, K3)

Course Outcome 2 (CO2):

1. Distinguish between the long term and short term scheduling. (K2)
2. Explain how scheduling of energy can be done with limited supply. (K2, K3)

Course Outcome 3 (CO3):

1. Discuss the advantages and disadvantages of power pools (K2).
2. Explain what do you mean by interchange evaluation with unit commitment (K2, K3).

Course Outcome 4 (CO4):

1. What is system security? Explain the major factors involved in system security (K2)
2. Explain the effects of generator outages in power systems. (K2, K3).

Course Outcome 5 (CO5):

1. Discuss in detail, what do you mean by network observability.(K1)
2. Explain any one method by which bad measurements can be detected. (K2).

Model Question paper

QP CODE:

PAGES: 2

Reg. No:_____
Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION,
MONTH & YEAR
Course Code: EET398

Course Name: OPERATION AND CONTROL OF POWER SYSTEMS

Max. Marks: 100.Duration: 3 Hours

PART A (3 x 10 = 30 Marks)

Answer all Questions. Each question carries 3 Marks

1. Explain what do you mean by economic dispatch.
2. Discuss the different constraints in unit commitment.
3. Differentiate between long range and short term generation scheduling.
4. Write short notes on pumped storage hydro plants
5. Explain what do you mean by power pools.
6. Write short notes on energy banking.
7. Illustrate the importance of power system security
8. What do you mean by contingency analysis?
9. Elaborate on the importance of state estimation in power system.
10. What are the sources of errors in state estimation?

PART B (14 x 5 = 70 Marks)

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. What do you mean by optimal load dispatch? Explain any one method by which optimal load dispatch can be done. (14)

12 a. With the help of a flowchart, explain the priority list method of unit commitment. (10)

b. Write notes on security constrained unit commitment. (4)

Module 2

13. a. Explain any one method by which short term hydrothermal co-ordination can be done. (7)

b. Explain how hydroelectric plants are modelled for scheduling problems. (7)

14. a. Explain how scheduling of energy can be done with limited supply. (7)

b. Explain any one method by which hydrothermal scheduling with storage limitation can be done. (7)

Module 3

15. a. Explain the advantages of economy interchange between interconnected utilities. (7)

b. Explain the different types of interchange contracts. (7)

16. a. Discuss the advantages and disadvantages of power pools (7)

b.Explain what do you mean by interchange evaluation with unit commitment. (7)

Module 4

17. With the help of a flowchart, explain contingency analysis using sensitivity factors. (14)

18. a. What is system security? Explain the major factors involved in system security (9)

b. Explain the effects of generator outages in power systems. (5)

Module 5

19. a) Explain how quantities which are not measured can be estimated. (7)

b) Discuss in detail, what do you mean by network observability. (7)

20. a) Explain any one method by which bad measurements can be detected. (10)

b)List out the advantages of state estimation in power systems. (4)

Syllabus

Module 1

Introduction- Optimum load dispatch - First order gradient method base point and participation factors.
Economic dispatch versus unit commitment.
Unit Commitment Solution Methods - Priority-List Methods – SecurityConstrained Unit Commitment.

Module 2

Generation with limited supply-Take or pay fuel supply contract- Introduction to Hydro-thermal coordination-Long range and short range scheduling

Hydro-electric plant models-scheduling energy problems - types of scheduling problems-Scheduling energy - The Hydrothermal Scheduling Problem - Hydro scheduling with storage limitation - Introduction to Pumped storage hydro plants

Module 3

Inter change evaluation and power pools- Interchange contracts – Energy interchange between utilities - Interchange evaluation with unit commitment - Energy banking- power pools.

Module 4

Power system security- Factors Affecting Power System Security - Contingency Analysis: Detection of Network Problems - Generation Outages - Transmission Outages - An Overview of Security Analysis

Module 5

Introduction to State estimation in power system, Maximum Likelihood Weighted Least-Squares Estimation - State Estimation of an AC Network - Sources of Error in State Estimation - Detection and Identification of Bad Measurements - Estimation of Quantities Not Being Measured - Network Observability and Pseudo-measurements - The Use of Phasor Measurement Units (PMUs) - Application of Power Systems State Estimation - Importance of Data Verification and Validation

Text books:

1. Allen J. Wood, Bruce F. Wollenberg&Gerald B. Sheblé, "Power Generation, Operation, and Control", 3rd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey.

2. John Gainger& William Stevenson, "Power System Analysis", McGraw-Hill, Inc, , 1994.

References:

1. Ali Abur,Antonio Gómez Expósito, Power System State Estimation:Theory and Implementation, CRC Press, 2004.

Course Contents and Lecture Schedule:

Sl. No.	Topic	No. of Lectures
1	**Load Dispatch (9 hours)**	
1.1	Review of economic load dispatch	1
1.2	Optimum load dispatch	2
1.3	First order gradient method base point and participation factors.	2
1.4	Economic dispatch versus unit commitment - Unit Commitment Solution Methods - Priority-List Methods	2
1.5	Security-Constrained Unit Commitment	2
2	**Generation Scheduling (9 hours)**	

2.1	Generation with limited supply-Take or pay fuel supply contract	2
2.2	Introduction to Hydro-thermal coordination-Long range and short range scheduling	1
2.3	Hydro-electric plant models	1
2.4	Scheduling energy problems - types of scheduling problems- Scheduling energy	2
2.5	The Hydrothermal Scheduling Problem	2
2.6	Introduction to Pumped storage hydro plants	1
3	**Interchange evaluation and power pools (9 Hours)**	
3.1	Interchange Contracts	2
3.2	Energy Interchange between Utilities	2
3.3	Interchange evaluation with unit commitment	1
3.4	Energy banking	2
3.5	Power pools	2
4	**Power system security (7 Hours)**	
4.1	Factors affecting Power System Security	2
4.2	Contingency Analysis	1
4.3	Detection of Network Problems	1
4. 4	Generation Outages	1
4. 5	Transmission Outages	1
4. 6	An overview of Security Analysis	1
5	**State estimation in power system (9 Hours)**	
5.1	State estimation in power system - Maximum Likelihood Weighted Least-Squares Estimation	2
5.2	State Estimation of an AC Network - Sources of Error in State Estimation	2
5.3	Detection and Identification of Bad Measurements	1
5.4	Estimation of Quantities Not Being Measured	1
5.5	Network Observability and Pseudo-measurements	1
5.6	The Use of Phasor Measurement Units (PMUS)	1
5.7	Application of Power Systems State Estimation - Importance of Data Verification and Validation	1