Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Electrical and Electronics Engineering
BEE047 POWER SYSTEM OPERATION AND CONTROL
Seventh Semester (Odd Semester)

Course (catalog) description

To understand the economics of power system operation with thermal and hydro units, To realize the requirements and methods of real and reactive power control in power system and to be familiar with the power system security issues and contingency

Compulsory/Elective course: Elective for EEE students

Credit & Contact hours : 3 and 45 hours

Course Coordinator : Dr.V.Jayalakshmi

Instructors **:** D.Purushothaman

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Dr.V.Jayalakshmi	Final year EEE	KS 303	04422290125	Jayalakshmi.eee@ bharathuniv.ac.in	12.30 PM-1.30 PM

Relationship to other courses:

Pre –requisites **:** BEE601Transmission And Distribution

Assumed knowledge : Fundamental concepts of operation of electrical power systems

Syllabus Contents

UNIT I INTRODUCTION **9**

An overview of power system operation and control - system load variation - load characteristics load curves and load-duration curve - load factor - diversity factor - Importance of load forecasting and quadratic and exponential curve fitting techniques of forecasting – plant level and system level controls.

UNIT II REAL POWER - FREQUENCY CONTROL **9**

Basics of speed governing mechanism and modelling - speed-load characteristics – load sharing between two synchronous machines in parallel - control area concept - LFC control of a single area system - static and dynamic analysis of uncontrolled and controlled cases - two-area system modelling - static analysis of uncontrolled case - tie line with frequency bias control - state variable model - integration of economic dispatch control with LFC.

UNIT III REACTIVE POWER–VOLTAGE CONTROL **9**

Generation and absorption of reactive power - basics of reactive power control - excitation systems – modelling - static and dynamic analysis - stability compensation - methods of voltage control: tap changing transformer, SVC (TCR + TSC) and STATCOM – secondary voltage control.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 9

Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve – coordination equations without and with loss (No derivation of loss coefficients) - solution by direct method and λ-iteration method - statement of unit commitment problem – priority-list method – forward dynamic programming.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Need for computer control of power systems - concept of energy control centre - functions – system monitoring - data acquisition and control - system hardware configuration – SCADA and EMS functions - network topology - state estimation – WLSE - Contingency Analysis - state transition diagram showing various state transitions and control strategies.

Text book(s) and/or required materials

T1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', Tata McGraw Hill Education Pvt.Ltd., New Delhi, 34th reprint, 2010.

T2. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.

T3.Abhijit Chakrabarti, SunitaHalder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

Reference Books:

R1. Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition,2011.

R2 Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi,10th reprint, 2010.

R3 HadiSaadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21streprint, 2010.

R4 http://nptel.ac.in/courses/108104052/

Computer usage: **Nil**

Professional component

General	·	0%
Basic Sciences	·	0%
Engineering sciences & Technical arts	·	0%
Professional subject		0%
Major elective		100%

Broad area : Electrical Machines | Electronics | **Power system** | Control & Instrumentation

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	August 1st week	Session 1 to 14	2 Periods
2	Cycle Test-2	September 2nd week	Session 15 to 28	2 Periods
3	Model Test	October 2nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

To understand the economics of power system operation with thermal and hydro units, To realize the requirements and methods of real and reactive power control in power system and to be familiar with the power system security issues and contingency	Correlates to program outcome		
	H	**M**	**L**
1. An overview of power system operation and control.	b	a,c,d,e,g,i,l	f,j,k,
2. Basics of speed governing mechanism, modelling and speed-load characteristics	a,b,e,i,	c,d,f,g,j,l	h,k
3. Generation and absorption of reactive power.	a,b,d,e,f,	c,g,h,i,j,l	k
4. Formulation of economic dispatch problem and incremental cost curve coordination equations without and with loss (No derivation of loss coefficients).	a,b,c,d,f,	g,h,j,l	i,k
5. Know the concept of energy control centre	a,b,c,d,	e,f,g,h,j,l	i,k

H: high correlation, M: medium correlation, L: low correlation

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I	**INTRODUCTION**		
1.	An overview of power system operation and control	No	T1
2.	system load variation	No	
3.	load characteristics load curves and load-duration curve	Yes	
4.	load factor	Yes	
5.	diversity factor	Yes	
6.	Importance of load forecasting and quadratic and exponential curve fitting techniques of forecasting	Yes	
7.	Importance of load forecasting and quadratic and exponential curve fitting techniques of forecasting	Yes	
8.	plant level and system level controls.	No	
9.	plant level and system level controls.	No	
UNIT II	**REAL POWER - FREQUENCY CONTROL**		
10.	Basics of speed governing mechanism and modelling	No	T2
11.	speed-load characteristics	No	
12.	load sharing between two synchronous machines in parallel	Yes	
13.	control area concept	Yes	
14.	LFC control of a singlearea system	Yes	
15.	static and dynamic analysis of uncontrolled and controlled cases	Yes	
16.	two-area system modelling	Yes	
17.	static analysis of uncontrolled case	Yes	
18.	tie line with frequency bias control - state variable model - integration of economic dispatch control with LFC	Yes	
UNIT III	**REACTIVE POWER–VOLTAGE CONTROL**		
19.	Generation and absorption of reactive power	No	T2
20.	basics of reactive power control - excitation systems	No	
21.	modelling	No	
22.	static and dynamic analysis	Yes	
23.	stability compensation	No	
24.	methods of voltage control: tap changing transformer	No	
25.	methods of voltage control: tap changing transformer	No	
26.	SVC (TCR + TSC) and STATCOM	No	
27.	SVC (TCR + TSC) and STATCOM	No	
UNIT IV	**UNIT COMMITMENT AND ECONOMIC DISPATCH**		
28.	Formulation of economic dispatch problem	Yes	T3
29.	I/O cost characterization	Yes	
30.	incremental cost curve	Yes	
31.	coordination equations without and with loss (No derivation of loss coefficients)	Yes	
32.	solution by direct method and λ-iteration method	Yes	

33.	statement of unit commitment problem	Yes	
34.	priority-list method	Yes	
35.	forward dynamic programming	Yes	
36.	forward dynamic programming	Yes	
UNIT V	**COMPUTER CONTROL OF POWER SYSTEMS**		
37.	Need for computer control of power systems	No	T3
38.	concept of energy control centre	No	
39.	concept of energy control centre Functions	No	
40.	system monitoring	No	
41.	system monitoring	No	
42.	data acquisition and control	No	
43.	data acquisition and control	No	
44.	system hardware configuration – SCADA and EMS functions - network topology - state estimation – WLSE	No	
45.	Contingency Analysis - state transition diagram showing various state transitions and control strategies.	Yes	

Draft Lecture Schedule

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by: Dr.V.Jayalakshmi **Dated :**

Addendum

ABET Outcomes expected of graduates of B.Tech / EEE / program by the time that they graduate:

a) An ability to apply knowledge of mathematics, science, and engineering fundamentals.

b) An ability to identify, formulate, and solve engineering problems.

c) An ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d) An ability to design and conduct experiments, as well as to analyze and interpret data.

e) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

f) An ability to apply reasoning informed by the knowledge of contemporary issues.

g) An ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

h) An ability to understand professional and ethical responsibility and apply them in engineering practices.

i) An ability to function on multidisciplinary teams.

j) An ability to communicate effectively with the engineering community and with society at large.

k) An ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.

l) An ability to recognize the need for,and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION
Electrical Engineering Graduates are in position with the knowledge of Basic Sciences in general and Electrical Engineering in particular so as to impart the necessary skill to analyze and synthesize electrical circuits, algorithms and complex apparatus.

PEO2: CORE COMPETENCE
Electrical Engineering Graduates have competence to provide technical knowledge, skill and also to identify, comprehend and solve problems in industry, research and academics related to power, information and electronics hardware.

PEO3: PROFESSIONALISM
Electrical Engineering Graduates are successfully work in various Industrial and Government organizations, both at the National and International level, with professional competence and ethical administrative acumen so as to be able to handle critical situations and meet deadlines.

PEO4: SKILL
Electrical Engineering Graduates have better opportunity to become a future researchers/ scientists with good communication skills so that they may be both good team-members and leaders with innovative ideas for a sustainable development.

PEO5: ETHICS
Electrical Engineering Graduates are framed to improve their technical and intellectual capabilities through life-long learning process with ethical feeling so as to become good teachers, either in a class or to juniors in industry.

Course Teacher	Signature
D.Purushothaman	

Course Coordinator **HOD/EEE**

(Dr.V.Jayalakshmi) ( )