TEEGALA KRISHNA REDDY ENGINEERING COLLEGE

(Sponsored by TKR Educational Society, Approved by AICTE, Affiliated by JNTUH)
Medbowli, Meerpet, Saroornagar, Hyderabad – 500 097.
Phone: 040-24092838 Fax: +91-040-24092555
E-mail: tkrec@rediffmail.com Website: www.tkrec.ac.in

ACADEMIC CALENDER 2020-2021: SEMESTER-I

S.No	Description	Date& day	Duration
1.	Commencement of class work	01-09-2020	---
2.	1St spell of instructions (including Dussehra Recess)	01-09-2020 to 31-10-2020	9 weeks
3.	Dussehra Recess	19-10-2020 to 24-10-2020	---
4.	End Examinations preparation holidays- Previous Semester	02-11-2020 to 04-11-2020	3 days
5.	2nd spell of instructions(including I Mid Term examinations)	14-12-2020 to 13-02-2020	9 weeks
6.	I Mid Term examinations	21-12-2020 to 28.12-2020	1 week
7.	Submission of I Mid Term exam marks to university on or before	04-01-2021	---
8.	II Mid Term examinations	15-02-2021 to 20-02-2021	1week
9.	Practical Classes	22-02-2021 to 27-02-2021	1 week
10.	Preparation holidays and Practical Examinations	01-03-2021 to 06-03-2021	1 week
11.	Submission of II mid Term exam marks to university on or before	27-02-2021	
12.	End semester Examinations	08-03-2021 to 20-03-2021	2weeks

Month	Holidays		
SEPT	6, 13, 20, 27	Sundays	**Holidays are subjected to clearance from Telangana Government**
	12	Second saturday	
OCT	4, 11, 18, 25	Sundays	
	2	Gandhi Jayanthi	
	29	Milad-un-nabi	
	19 to 24	Dusserah	
NOV	1,8,15,22,29	Sundays	
	14	Diwali	
	30	Gurunanak Jayanthi	
DEC	6, 13, 20, 27	Sundays	
	25	Christmas	
JAN	3,10,17,24,31	Sundays	
	13,14,15	Sankranthi Holidays	
	26	Republic Day	
FEB	7,14	Sundays	

SUBJECT TIME TABLE

Name of the Faculty: Mr. N.RAMESH BABU **AY:** 2020-21 I Sem.
Subject: Power System Operation and Control **Class:** IV B. Tech. EEE – B

DAY	1 (9:40 AM - 10:30 AM)	2 (10:30 AM - 11:20 AM)	3 (11:20 AM - 12:10 PM)	12:10 - 1:00	4 (1:00 PM - 1:50 PM)	5 (1:50 PM – 2:40 PM)	6 (2:40 PM – 3:30 PM)	7 (3:30 PM – 4:20 PM)
MON	PSOC-IV-B							
TUE								
WED						PSOC-IV-B		
THU							PSOC-IV-B	
FRI		PSOC-IV-B						
SAT	PSOC-IV-B							

JAWAHARLAL NEHRU TECHNOLOGY UNIVERSITY, HYDERABAD

IV Year B. Tech., EEE – I Sem. **L T/P/D C**

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SYLLABUS

POWER SYSTEM OPERATION AND CONTROL

Course Objectives:

To understand real power control and operation

- To know the importance of frequency control
- To analyze different methods to control reactive power
- To understand unit commitment problem and importance of economic load dispatch
- To understand real time control of power systems

Course Outcomes:

After completion of this course, the student will be able to Analyze the optimal scheduling of power plants

- Analyze the steady state behavior of the power system for voltage and frequency
- fluctuations Describe reactive power control of a power system
- Design suitable controller to dampen the frequency and voltage steady state oscillations

UNIT-I:

Load –Frequency Control: Basics of speed governing mechanism and modeling - speedload 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. Integration of economic dispatch control with LFC. Twoarea system – modeling - static analysis of uncontrolled case - tie line with frequency bias control of two-area system - state variable model.

UNIT-II:

Reactive Power – Voltage Control: Basics of reactive power control. Excitation systems – modeling. Static and dynamic analysis - stability compensation - generation and absorption of reactive power. Relation between voltage, power and reactive power at a node - method of voltage control - tap-changing transformer. System level control using generator voltage magnitude setting, tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

UNIT-III:

Economic Load Dispatch: Statement of economic dispatch problem – cost of generation – incremental cost curve - co-ordination equations without loss and with loss, solution by direct method and λ-iteration method.

UNIT-IV:

Unit Commitment: Statement of Unit Commitment problem – constraints; spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints. Solution methods - Priority-list methods - forward dynamic programming approach. Numerical problems on priority-list method using full-load average production cost and Forward DP method.

UNIT-V:

Computer Control of Power Systems: Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Network topology – Importance of Load Forecasting and simple techniques of forecasting.

Text Books:

T-1 1. D. P. Kothari and I. J. Nagrath, 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.

T-2. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Ltd, New Delhi, 30th reprint, 2007.

Reference Books:

R-1. Chakrabarti & Haldar, "Power System Analysis: Operation and Control", Prentice Hall of India, 2004 Edition.

R-2. C. L. Wadhwa , 'Power System Analysis', New Age International-6th Edition, 2010, ISBN : 978-81-224-2839-1

R-3. Robert Miller, James Malinowski, 'Power System Operation', Tata McGraw Hill Publishing Company Ltd, New Delhi, 3rd Edition 2009.

R-4. P. Kundur, Neal J. Balu, 'Power System Stability & Control', IEEE, 1998

Outcome:

After going through this course the student gets a thorough knowledge on Analyze the Economic Operation of power systems with and without considering the line losses. Schedule the Hydrothermal system operation under economic considerations. Model various power system components such as Turbine, Generator, Excitation System and Load using the knowledge Control systems and interconnect them.Understand the Load Frequency Problem for single area and Two Area cases. Develop and validate Load Frequency controllers. Understand the concepts of Reactive power Compensation and related Topics.

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Year & Branch	**: IV B. Tech. EEE - B.**
Academic Year	**: 2020 - 21 I Semester**
Name of the Subject	**: POWER SYSTEM OPERATION AND CONTROL**
Name of the Faculty	**: Mr. N RAMESH BABU.**
Designation	**: Assistant Professor.**
Department	**: Electrical & Electronics Engineering.**

GENERAL OBJECTIVES:

This course is an extension of Power System – I, II and CMPS. After getting sound knowledge about Power Generation, Transmission and Distribution action of Power Systems, it is important to understand the operation and control characteristics of Power Systems. This course covers all these aspects in detail.

Design and Modeling of Turbine, Generator and Automatic Controllers also control of Reactive Power of various Lines will be covered in this course.

Load Frequency control is necessary to transmit and distribute the power in bulk. Most of the industrial applications are carried out by Speed Governing System. Therefore, it is the custom of an electrical engineer to understand the Load Frequency control Area which works on the principle of Speed Governing Mechanism.

SPECIFIC OBJECTIVES:

UNIT – I: Load –Frequency Control:

- To know the necessity of keeping frequency constant.
- To know the concept of control area – single area control.
- To draw the block diagram representation of isolated power system.
- Ability to express the steady state analysis & dynamic response of uncontrolled case in single area control.
- To know the concept of load frequency control of two area system.
- Ability to express the steady state analysis & dynamic response of uncontrolled case in two area system.
- Ability to express the steady state analysis & dynamic response of controlled case in two area system.
- Understand the concept of tie-line bias control.
- To know the concept of proportion plus integral control and its block diagram representation.
- Ability to express Load Frequency Control and Economic Dispatch Control.
- To know the concept of State space model of LFC-1 and LFC-2.

UNIT – II: Reactive Power – Voltage Control:

- To know the Reactive Power compensation in transmission system.
- Ability to express the load compensation and its specifications.
- To know about the uncompensated and compensated transmission lines.
- Discuss about series and shunt compensation.

UNIT – III: Economic Load Dispatch:

- To know the Optimal operation of Generators in Thermal Power Stations
- To understand the - heat rate Curve – Cost Curve – Incremental fuel and Production costs, input-output characteristics.
- Optimum generation allocation with line losses neglected.
- Optimum generation allocation with line losses neglected -algorithm & flowchart.
- Optimum generation allocation including the effect of transmission line losses.
- To determine the Loss Coefficients
- To derive the General transmission line loss formula
- Optimum generation allocation including the effect of transmission line losses-algorithm & flowchart

UNIT –IV: Unit Commitment:

Optimal scheduling of hydrothermal system.

- To know the Hydroelectric power plant models
- To determine Scheduling problems
- To understand the Short term hydrothermal scheduling problem.

UNIT – V: Computer Control of Power Systems:

- To draw the block diagram representation of turbine model.
- To draw the block diagram representation of generator load model.
- To draw the block diagram representation of speed governor.
- Modeling of Excitation System and its block diagram representation.

PROGRAM OUTCOMES (POs) & PROGRAM SPECIFIC OUTCOMES (PSOs):

PO. No.	Description
PO 1	**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Program Specific Outcomes	
PSO 1	Students will be able to demonstrate an ability to analyze, design and provide engineering solutions in the areas related to Electrical Drives, Electrical Machines, Power Electronics, Control Systems and Power Systems.
PSO 2	Students of EEE are able to develop and design the electrical and electronic circuits using simulation software's such as PSpice, MATLAB and will be able to utilize the techniques and participate to succeed in competitive examinations like GATE, TOFEL, GRE and GMAT etc.

COURSE OUTCOMES:

1) Analyze the Economic Operation of power systems with and without considering the line losses.
2) Schedule the Hydrothermal system operation under economic considerations.
3) Model various power system components such as Turbine, Generator, Excitation System and Load using the knowledge Control systems and interconnect them.
4) Understand the Load Frequency Problem for single area and Two Area cases.
5) Develop and validate Load Frequency controllers.
6) Understand the concepts of Reactive power Compensation and related Topics.

Relationship of Course Outcomes to Program Outcomes:

Course Name: POWER SYSTEM OPERATION AND CONTROL (C414) for academic year 2020-21(IV-I)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C414.1	3	3	2	2	2	2	1	1	1	1	1	2
C414.2	3	3	3	2	2	2	1	1	1	1	1	2
C414.3	3	3	3	2	3	2	1	1	1	1	1	2
C414.4	3	3	3	3	3	1	1	1	1	1	1	2
C414.5	3	3	3	3	3	1	1	1	1	1	1	2
C414.6	3	3	3	3	2	2	1	1	1	1	1	2
Average	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**

Relationship of Course Outcomes to Program Outcomes:

Course Name: POWER SYSTEM OPERATION AND CONTROL (C414) for academic year 2020-21 (IV-I)

CO	PSO 1	PSO 2
C414.1	3	2
C414.2	3	3
C414.3	3	2
C414.4	3	3
C414.5	3	3
C414.6	3	3
Average	**3**	**3**

Faculty In-charge **HOD / Dept. of EEE.**

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TEACHING PLAN

Year & Branch	**: IV B. Tech. EEE – B**
Academic Year	**: 2020 - 21. I Semester**
Name of the Subject	**: POWER SYSTEM OPERATION AND CONTROL.**
Name of the Faculty	**: Mr. N RAMESH BABU**
Designation	**: Assistant Professor.**
Department	**: Electrical & Electronics Engineering.**

Text Books:

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R-3. Robert Miller, James Malinowski, 'Power System Operation', Tata McGraw Hill Publishing Company Ltd, New Delhi, 3rd Edition 2009.

R-4. P. Kundur, Neal J. Balu, 'Power System Stability & Control', IEEE, 1998

Other Text Books:

O –1 Power System Operation and Control by D.Viajy Kumar Scitech.

Unit/ Item No.	.Topic (s)	Book Reference	Page (s)		Proposed No. of Periods	Proposed Date
			From	To		
I	**Load Frequency Controllers**				**14**	
1.1	Necessity of keeping frequency constant. Definitions of Control area – Single area control	O - 1	3-3		01	02/09/2020
1.2	Block diagram representation of an isolated power system	O - 1	3-10		01	03/09/2020
1.3	Steady state analysis	T - 2	297	300	01	04/09/2020
1.4	Dynamic response – Uncontrolled	T - 2	301	303	01	06/09/2020

Unit/ Item No.	.Topic (s)	Book Reference	Page (s)		Proposed No. of Periods	Proposed Date
			From	To		
	case.					
1.5	Numerical problems	O - 1	3-19	3-29	01	08/09/2020
1.6	Load frequency control of 2-area system	O - 1	4-1	4-5	01	09/09/2020
1.7	Steady state & dynamic analysis for uncontrolled case	O - 1	4-6	4-8	01	10/09/2020
1.8	Steady state & dynamic analysis controlled case	O - 1.	4-8		01	11/09/2020
1.9	tie-line bias control	O - 1	4-8	4-9	01	15/09/2020
1.10	Numerical problems	O - 1	4-9	4-15	01	16/09/2020
1.11	Proportional plus Integral control of single area and its block diagram representation	O - 1	3-15	3-17	01	17/09/2020
1.12	steady state response	O - 1	3-17	3-18	01	18/09/2020
1.13	Load Frequency Control and Economic dispatch control	T - 2	305	307	01	21/09/2020
1.14	Numerical problems.	O - 1	3-19	3-29	01	22/09/2020
2	**Reactive Power Control**				**14**	
2.1	Overview of Reactive Power control	O - 1	5-1	5-2	01	23/09/2020
2.2	Reactive Power compensation in transmission systems	O - 1	5-2	5-4	01	24/09/2020
2.3	advantages and disadvantages of different types of compensating equipment for transmission systems	O - 1	5-4	5-5	02	25,28/09/2020
2.4	load compensation – Specifications of load compensator	O - 1	5-5	5-7	02	29,30/09/2020
2.5	Uncompensated transmission lines	O - 1	5-7	5-10	01	01/10/2020
2.6	compensated transmission lines	O - 1	5-10	5-12	03	02,03,05/10/2020
2.7	Shunt Compensation, Series Compensation.	O - 1	5-13	5-14	02	07,09/10/2020
2.8	Numerical problems.	O - 1	5-24	5-32	02	16,31/10/2020
3	**Economic Load Dispatch**				**10**	
3.1	Optimal operation of Generators in Thermal Power Stations.	T - 2	243	246	01	02/11/2020
3.2	- heat rate Curve – Cost Curve – incremental fuel and Production costs, input-output characteristics	T - 1	426	428	01	03/11/2020
3.3	Optimum generation allocation with line losses neglected.	T - 1	431	432	01	04/11/2020
3.4	Optimum generation allocation with line losses neglected. Algorithm & flowchart	T - 1	438	439	01	06/11/2020
3.5	Numerical problems	O - 1	1-22	1-47	01	10/11/2020
3.6	Optimum generation allocation including the effect of transmission	T - 1	444	447	01	12/11/2020

Unit/ Item No.	.Topic (s)	Book Reference	Page (s)		Proposed No. of Periods	Proposed Date
			From	To		
	line losses					
3.7	Loss Coefficients.	T - 2	265	268	01	13/11/2020
3.8	General transmission line loss formula.	T - 2	265	268	01	20/11/2020
3.9	Optimum generation allocation including the effect of transmission line losses algorithm & flowchart	T - 1	451	452	01	14/12/2020
3.10	Numerical problems	T - 1	447	451	01	15/12/2020
4	**Unit Commitment**				7	
4.1	Optimal scheduling of Hydrothermal System	T - 1	480	481	01	16/12/2020
4.2	Optimal scheduling of Hydrothermal System- Algorithm	T - 1	129	130	01	17/12/2020
4.3	Hydroelectric power plant models	O - 1	1-17	1-18	01	18/12/2020
4.4	Scheduling problems	O - 1	1-18	1-20	01	19/12/2020
4.5	Short term Hydrothermal scheduling problem	T - 1	485	487	01	04/01/2021
4.6	Numerical problems	O - 1	1-22	1-47	02	06,08/01/2021
5	**Computer Control of Power Systems**				17	
5.1	Modeling of Turbine: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models.	T - 1	220	222	02	08,09/01/2021
5.2	Modeling of Generator (Steady State and Transient Models):Description of Simplified Network Model of a Synchronous Machine (Classical Model), Description of Swing Equation (No Derivation)	T - 2	296	297	03	10,12,18/01/2021
5.3	State-Space II-Order Mathematical Model of Synchronous Machine.	O - 1	1248	1250	03	20,21,23/01/2021
5.4	Modeling of Governor.	T - 1	219	220	01	27/01/2021
5.5	Mathematical Modeling of Speed Governing System – Derivation of small signal transfer function.	T - 2	292	295	03	30,04,05/01/2021
5.6	Modeling of Excitation System: Fundamental Characteristics of an Excitation system, Transfer function, Block Diagram Representation of IEEE Type-1 model	T – 1	701	705	03	06,08,10/02/2021
5.7	Numerical problems.	T - 2	300	301	02	12,13/02/2021
	TOTAL				**58**	

Faculty In-charge **HOD / Dept. of EEE.**