Academic Program: PG

Academic Year 2023-24

Department of Electrical & Electronics Engineering

Power Systems Engineering

III & IV Semester M.Tech.

Syllabus

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)

Ph: 0836-2447465 Fax: 0836-2464638 Web: www.sdmcet.ac.in

SDM College of Engineering & Technology, Dharwad
Department of Electrical Engineering
*(Our motto: **P**rofessional **C**ompetence with **P**ositive **A**ttitude)*

College Vision and Mission

Vision:

To develop competent professionals with human values.

Mission:

1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

Department Vision and Mission

Vision:

To develop globally acceptable Electrical and Electronics Engineering professionals with human values.

Mission:

1. Adopting the state of the art curricula
2. Practicing effective and innovative teaching-learning methodologies
3. Initiating complementary learning activities to enhance competence
4. Inculcating positive attitude and commitment to society.

SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for I & II semester M.Tech in Power Systems Engineering is recommended by the Board of Studies of Electrical and Electronics Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2023-24 till further revision.

Chairman BoS & HoD **Principal**

Program Educational Objectives (PEOs):

The Program Educational Objectives (PEOs) :

I. To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit, and consulting firms.

II. To prepare graduates who will contribute to society as broadly educated, expressive, ethical, and responsible citizens with proven expertise.

III. To prepare graduates who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, research, design, and implementation skills.

IV. To prepare graduates who will thrive to pursue life-long reflective learning to fulfill their goals.

Program Outcomes (POs):

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: Student should be able to demonstrate a degree of mastery over the area of power systems engineering

PO4: Exposure to the state of the art practices in the domain of power systems engineering

Scheme of Teaching and Examination-2023-24
M. Tech. (Power Systems Engineering)
III Semester M. Tech.

Course Code	Course Title	Teaching		Examination				
				CIE	Theory (SEE)		Practical (SEE)	
		L-T-P (Hrs./Week)	Credits	Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
22PEPC300	Distribution System Design and Control	4-0-0	4	50	100	3		
22PEPEXXX	Elective 5	3-0-0	3	50	100	3		
22PEPEXXX	Elective 6	3-0-0	3	50	100	3		
22PEPEXXX	Elective 7	4-0-0	4	50	100	3	--	--
OR								
22PEPL301	Internship in Industry or R&D organization	** Min 4 weeks during vacation after 2nd sem.	4	50	--	--	100	3
22PEPL302	*** Project phase-I	0-0-6	6	50			50	3
Total		**14-0-6/10-4weeks-6)**	**20**	**250**	**400/300**		**50/150**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

***** SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

****** The students are expected to undergo training in industry for a period of ***four weeks*** during the vacation immediately after completion of II Semester examination. A faculty is to be allotted to guide the student. A committee consisting of three faculty members shall evaluate the work carried out and the knowledge the students have acquired. **OR** The students can take one elective course if they do not undergo internship**.**

*** Project phase-I: The students are expected to formulate the problem and carry out the intensive literature survey along with preliminary investigations supporting the project phase-II in IV semester.

Course Code	Elective (5 & 6)
22PEPE311	Planning & Management of Deregulated Power Systems
22PEPE312	Power Systems Reliability Engineering
22PEPE313	Programmable Logic Controllers and Applications
22PEPE314	Power Quality Issues and Mitigation Techniques

Course Code	Elective (7)
22PEPE314	Power Quality Issues and Mitigation Techniques

Scheme of Teaching and Examination-2023-24
M. Tech. (Power Systems Engineering)
IV Semester M. Tech.

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs./Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
22PEPL400	Project phase - II	0-0-22	18	100	--	--	100	3
22PEPOA1	***BOS recommended ONLINE course	-	Audit (PP)	-	-	-	-	-
22PEPOA2	***BOS recommended ONLINE course	-	Audit (PP)	-	-	-	-	-
Total		**0-0-22**	**18**	**100**	**--**	**--**	**100**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

***** SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

****** Project phase-II: The students are expected to work on a project for the full semester in an industry or an institution

*** Classes and evaluation procedures are as per the policy prescribed for online courses by the institution

Total Credits offered for the first year: **42**

Total Credits offered for the Second year: **38**

III – Semester M. Tech. (Power Systems Engineering)

22PEPC300 Distribution System Design and Control (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

To explain the principles of design and operation of electric distribution system. To apply analytic techniques pertaining to primary distribution systems. To use basic design principles for distribution substations and facilities. To examine primary distribution systems with capacitor compensation. To obtain the reliability indices related to the distribution system.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Design, Develop and Analyze primary and secondary distribution systems.	1	3	2
CO-2	Evaluate and suggest suitable power factor correction capacitors in the system.	1	3	2
CO-3	Develop reliability model and obtain reliability indices.	1	3, 4	2

PO's	PO- 1	PO-2	PO-3	PO-4
Mapping Level	3.0	1.0	2.0	2.0

Contents:

1) Distribution System Planning & Automation:

Introduction, distribution system planning; factors affecting system planning, present technique, role of computers in distribution planning. **05 Hrs.**

2) Distribution Substation:

Introduction, load characteristics, relationship between loss and load factor, maximum diversified demand, Load management. Substation location, rating a distribution substation, substation services area with 'n' primary feeders, comparison of four and six feeder patterns, derivation of K constant, substation application curves, present voltage drop formula. **12 Hrs.**

3) Primary and Secondary Distribution Systems:
Introduction, feeder types and voltage levels, feeder loading rectangular type development, radial type development application of the A, B, C, D general circuit constants to radial feeders, secondary banking. **10 Hrs.**

4) Voltage Drop and Power Loss Calculations:
Three phase balanced primary lines, single phase lines, Four-Wire multi grounded Common Neutral system, Methods to analyze Distribution Cost. Impact of charging stations on distribution system. **07 Hrs.**

5) Application of Capacitors in Distribution Systems:
Introduction, Power capacitors series and shunt power factor correction, economic power factor, applications of capacitors and installation, types of control, economic justification, practical procedure to determine the best location, mathematical procedure for optimum- allocation, dynamic behavior of distribution system. **08 Hrs.**

6) Distribution System Reliability:
Introduction, basic reliability concepts, series, parallel and series-parallel systems, Markov Processes, Distribution Reliability Indices: Sustained, Momentary, Load and Energy based indices, Usage of indices, Benefits of Reliability Modeling in system performance. **10 Hrs.**

Reference Books:

1) Turan Gonen, "Electric Power Distribution System Engineering", 2nd Edition, BSP Books Pvt. Ltd, 2010.

2) A. S. Pabla, "Electric Power Distribution System", 6thEdition, TMH, 2011.

3) Gorti Ramamurthy, "Hand book of Electrical Power Distribution", University Press, 2nd Edition, 2009.

22PEPE311 Planning & Management of Deregulated Power Systems (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about the competitive environment &current situation around the world and gaining importance of deregulation in power systems including the benefits & after effects of deregulation. The students are expected to have a focused insight of operating deregulated power systems under different market structures. Further, the different types of transmission open access and pricing issues practiced in various countries shall be studied in this course. The students also learn how power system reliability, security and power quality is achieved in deregulated systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the concept of Deregulation of the Electricity Supply Industry.		1	
CO-2	Demonstrate the knowledge of Economic Operation of Power systems.	1		4
CO-3	Analyze the Power systems Operation in Competitive Environment, Transmission Open Access and Pricing Issues.	3		
CO-4	Use the knowledge of Ancillary Services Management, reliability, and power quality aspects in deregulated scenario.	3	4	

PO's	**PO- 1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	2.5		3.0	1.5

Prerequisites:1) Power systems Analysis
2) Power Transmission &Distribution
3) Power systems Operation and Control
4) Power systems planning

Contents:

1) Deregulation of the Electricity Supply Industry
Introduction, meaning of deregulation, background to deregulation and the current situation around the world, benefits from a competitive electricity market, after effects of deregulation. **06 Hrs**.

2) Power systems Economic Operation Overview
Introduction, economical load dispatch, optimal power flow as a basic tool, unit commitment and formation of power pools. **06 Hrs.**

3) Power systems Operation in Competitive Environment
Introduction, role of independent system operator (ISO), operational planning activities of ISO, Operational planning activities of a Genco. **06 Hrs.**

4) **Transmission Open Access and Pricing Issues**
Introduction, power wheeling, transmission open access, cost components in transmission, pricing of power transactions, security management in deregulated environment and congestion management in deregulation. **06 Hrs.**

5) **Ancillary Services Management**
Ancillary services and management in various countries and reactive power as an ancillary service. **06 Hrs.**

6) **Reliability and Deregulation**
Terminology, reliability analysis, network model, reliability costs, hierarchical levels, reliability and deregulation, performance indicators. **05 Hrs.**

7) **Power Quality**
Terminology, interest in power quality, events, and variations. Power quality issues. **04 Hrs.**

Reference Books:

1) Kankar Bhattacharya, Math H J Bollan, Jaap E Daalder, "Operation of Restructured Power systems", Kluwer Academic Publishers, 2001.

2) Loi Lei Lai, "Power systems Restructuring and Deregulation; Trading, Performance and Information Technology", John Wiley and Sons, Ltd, 2002.

22PEPE312 Power Systems Reliability Engineering (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

To give the students' knowledge on how to use reliability analysis as a tool for decision support during planning, design, operation, and maintenance of electric power systems in particular electrical distribution systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe adequacy and security and evaluate reliability indices using probabilistic processes	1,2	4	3
CO-2	Perform reliability analysis of the power systems such as generators and transmission lines, using analytical simulation tools.	1,2	4	3

CO-3	Evaluate reliability indices for distribution systems.	1	1,2	4
CO-4	Analyze the system modes of failure to enhance the power systems reliability and evaluate reliability worth.		1,2	3,4

PO's	PO- 1	PO-2	PO-3	PO-4
Mapping Level	3.0	2.0	3.0	2.0

Prerequisites: Power systems Engineering, Graph Theory

Contents:

1) **Basic Concepts**
   Adequacy and Security, System Analysis, Reliability Cost and Reliability Worth. **03 Hrs.**
2) **Generating capacity**
   Basic Probability Methods, generation system model, Loss of load indices, Equivalent forced outage rate, scheduled outages, evaluation methods, load forecast and forced outage rate uncertainty, Loss of Energy indices. Frequency and Duration Methods: generation model, system risk indices. **06 Hrs**.
3) **Interconnected Systems**
   Probability array method in two and three interconnected systems, factors assisting emergency assisting systems. Frequency and Duration approach. **06 Hrs**.
4) **Composite Generation and Transmission Systems**
   Conditional probability approach, network configurations, state selection, system and load point indices, data requirements for composite system reliability evaluation. **06 Hrs.**
5) **Distribution Systems**
   Basic techniques and radial networks, Additional interruption indices, application to radial system, probability distribution of reliability indices. Plant station availability. Parallel and meshed networks: - basic evaluation techniques, inclusion of busbar failures, scheduled maintenance, temporary and transient failures, common mode failures etc. **06 Hrs.**
6) **Monte Carlo simulation**
   Concept, application to generation capacity reliability evaluation, application to composite generation and transmission systems, application to distribution systems. **06 Hrs.**

7) Evaluation of Reliability worth

Implicit/explicit evaluation of reliability worth, customer interruption cost evaluation, basic approaches, and customer damage functions. **06 Hrs.**

Reference Books:

1) Roy Billington, "Reliability Evaluation of Power systems Reliability", Springer India, 1996.

2) R. Billington and A.N. Allen, "Reliability Evaluation of Engineering Systems; Concepts and Techniques" Springer, 1992.

3) Hammersley J. M., Handscomb D. C, "Monte Carlo Methods", John Wiley and Sons Inc. NY, 1964.

4) Roy Billington, "Reliability Assessment of Large Electric Power systems", Kluwer Academic Press/Springer India, 2008.

22PEPE313 Programmable Logic Controllers and Applications (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The automation in the power systems and in many of the industrial applications has gained lots of importance in the recent times. The Programmable Logic Controllers (PLC) is one of the important resources of automatic process control systems. The complex control strategies can be effectively realized by means of PLCs. The students shall be able to understand the concept of PLC based systems, the general architecture of PLCs and the operation of PLCs. Apart from this the students shall know the different controllers used in PLC applications.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	Recite the various aspects programming logic controllers.			3
CO-2	Construct the ladder diagrams for different process control applications using PLC.		3	
CO-3	Comprehend the operation of PLC registers, timers, and counters.		3	
CO-4	Use the different controllers for the PLC applications in process control..			4

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level			2.5	1.0

Prerequisites: Digital Electronics, Microcontrollers, Control System

Contents:

1) PLC Basics

PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules. **06 Hrs.**

2) PLC Programming

Input instructions, outputs, operational procedures, programming examples using contacts and coils, drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system. **06 Hrs.**

3) PLC Registers

Characteristics of Registers, module addressing, holding registers, input registers, output registers. **07 Hrs.**

4) PLC Functions

Timer functions and Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions**.** **07 Hrs.**

5) Data handling functions

SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions. **07 Hrs.**

6) Analog PLC operation:

Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions. **06 Hrs.**

Reference Books:

1) Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI

2) Programmable Logic Controllers – Programming Method and Applications by J. R. Hackworth and F.D. Hackworth Jr. – Pearson, 2004.

3) Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning.

4) Programmable Logic Controllers –W. Bolton-Elsevier publisher

22PEPE314 Power Quality Issues and Mitigation Techniques (4-0-0)4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) The basic concept of power quality phenomenon occurring in a power system.
2) The causes of power quality phenomena and their effects
3) Behavior of electronics devices, variable speed ac/dc drives and power system components due to power quality phenomenon
4) The performance evaluation of power system and analysis methods
5) Mitigation of power quality phenomenon in power system.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the basic concept of power quality phenomenon occurring in a power system	1	3	2
CO-2	Comprehend behavior of electronics devices, variable speed ac/dc drives and power system components due to power quality phenomenon	3, 4		2
CO-3	Analyze performance of power system using different analysis methods	4	3	2
CO-4	Compare different methods of mitigation of power quality phenomenon in power system	1	3	2

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	1.0	2.25	3.0

Prerequisites: Basics of power quality issues

Contents:

1) Introduction:

Introduction to power quality, overview of power quality phenomena, power quality and EMC standard. **06 Hrs.**

2) Long Interruptions and Reliability Evaluation:

Introduction, observation of system performance, standards and regulations, overview of reliability evaluation, reliability evaluation techniques, cost of interruptions, comparison of observation and reliability evaluation, examples. **08 Hrs.**

3) Short Interruptions:

Introduction, terminology, origin of short interruptions, monitoring of short interruptions, influence on equipment, single phase tripping, stochastic prediction of short interruptions. **08 Hrs.**

4) Voltage Sags - Characterization:

Introduction, voltage sag magnitude, voltage sag duration, three phase unbalance, phase angle jumps, magnitude and phase angle jump for three phase unbalanced sags, other characteristic of voltage sags, load influence on voltage sags, sag due to starting of induction motors. **09 Hrs.**

5) Voltage Sags – Equipment Behavior:

Introduction, computers and consumer electronics, adjustable speed AC drives, adjustable speed DC drives and sensitive load. **07 Hrs.**

6) Voltage Sags – Stochastic Assessment:

Compatibility between equipment and supply, voltage sag coordination chart, power quality monitoring, method of fault positions, method of critical distances. **08 Hrs.**

7) Mitigation of Interruptions and Voltage Sags:

Overview of mitigation methods, power system design – redundancy through switching and parallel operation, system equipment interface. **08 Hrs.**

Reference Books:

1) Math H J Bollen, “Understanding Power Quality Problems; Voltage Sags and Interruptions”, Wiley India, 2011.

2) Roger C Dugan, et. el, “Electrical Power Systems Quality”, 3rd Edition, TMH, 2012.

3) G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publication, 1991.

4) Ewald F Fuchs, et al, “Power Quality in Power System and Electrical Machines”, Academic Press, Elsevier, 2009.

22PEPL301	Internship	4 Credits

Duration: 4 weeks

Course Learning Objectives (CLOs):

Internship provides the opportunity for the students to get exposure to the real time systems that include personal training, time and stress management, presentations, marketing, liability and risk management, maintenance and

responding to emergencies etc. Further they learn to relate theory and practice. They also learn the significance of adhering to the professional standards in the field**.**

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	Know the industrial environment.		3	1
CO-2	Acquire knowledge and skill to use in professional career.		3	1
CO-3	Acquire the ability of report preparation and presentation skills.	2		
CO-4	Follow the code of practice in power system related activities.		4	

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	1.0	3.0	2.0	2.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value-added information.

Contents:

1) The students are expected to undergo industrial training in power system engineering or related domain. They are required to know the functions of Engineers in managing the floor. The skills required in installation, commission, operation, service, and maintenance shall be studied and obtained. The organizational behavior and management need to be understood. The above skills obtained need to be documented and presented.
2) Know the current challenges to power system engineers and try suggesting solutions.

Reference materials/books:

1) Industrial reference manuals
2) Data sheets.
3) Software packages.
4) Product information brochures.

5) Interaction with industrial experts.
6) Internet

22PEPL302	Project Phase – 1	(0-0-6) 6

Contact Hours: 100

Course Learning Objectives (CLOs):

The students are expected to learn carrying out literature survey to locate the state of the art technology while formulating/defining the project problem in power systems engineering domain. The students are expected to select a topic from an emerging area relevant to electrical power systems and/or other relevant branches/Electrical industry related real time problems and define the problem for the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The same work shall be continued in the next phase in IV semester.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	Carry out the literature survey to locate the state-of-the-art technology in Power systems Engineering field.		1	4
CO-2	Define/formulate the problem for the project work		1	3
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code, prepare report, etc. relevant to his/her project work		3	
CO-4	Summarize the work into a project report and present	2		

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	3.0	1.5	1.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous semesters and relevant value-added information.

Contents:

1) The students are expected to locate the state of the art technology in power systems engineering domain through proper literature survey and select a topic from an emerging area relevant to electrical power systems engineering and/or other relevant branches and define the problem for the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase.
2) Know the current challenges to power systems engineers and try suggesting technical solutions.

Reference materials/books:

1) Engineering books pertaining to their work.
2) International reputed Journals.
3) Manuals and data sheets.
4) Software packages.
5) Previous project reports.
6) Product information brochures.
7) Interaction with academia and industrial experts.
8) Internet Material.

IV-Semester M. Tech. (Power Systems Engineering)

22PEPL400	Project Phase – 2	(0-0-22)18

Course Learning Objectives (CLOs):

The students are expected to find out solutions individually for the power systems related problems preferably. They are expected to carry out the intensive literature survey to locate the state-of-the-art technology in power systems engineering. They must learn to formulate/define/locate real time problem for the project work. They will also learn to design, develop, analyze, test, interpret the results, fabricate, simulate, write code, and convert report into papers for publication in journals to add value to the existing literature. They are also expected to acquire the skills of summarizing the work into a project report and present the same.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level(2)**	**Slight Level (1)**
CO-1	Carry out the literature survey to locate the state-of-the-art technology in power systems engineering.		1	4
CO-2	Define/formulate/locate real time problem for the project work		1	3
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code, prepare papers etc.	3		
CO-4	Summarize the work into a project report and present the same	2		

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	3.0	2.0	1.0

Prerequisites:

Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value-added information.

Contents:

The students are expected to continue the work with real time power systems operation and control related challenges and providing feasible solutions.

Reference materials/books:

1) Engineering books pertaining to their work.
2) International reputed Journals.
3) Manuals and data sheets.
4) Software packages.
5) Previous project reports.
6) Product information brochures.
7) Interaction with academia and industrial experts.
8) Internet Material.

22PEPOA1	BOS recommended ONLINE course	Audit

Contact Hours: As Specified by the Organization

Course Learning Objectives (CLOs):

The students are expected to identify their field of interest and undergo learning by taking ONLINE courses and attending classes.

Classes and evaluation procedures are as per the policy prescribed for online courses by the respective organizations and PP is a must for the award of the Degree**.**

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify his/her field of interest.	1		3
CO-2	Demonstrate the knowledge acquired in the selected course/field.	1		3

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	3.0	-	1.0	-

22PEPOA2	BOS recommended ONLINE course	Audit

Contact Hours: As Specified by the Organization

Course Learning Objectives (CLOs):

The students are expected to identify their field of interest and undergo learning by taking ONLINE courses and attending classes.
Classes and evaluation procedures are as per the policy prescribed for online courses by the respective organizations and PP is a must for the award of the Degree**.**

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify his/her field of interest.	1		3
CO-2	Demonstrate the knowledge acquired in the selected course/field.	1		3

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0		1.0	