Kolhapur Institute of Technology's College of Engineering Kolhapur (Empowered Autonomous)

Department of Electrical Engineering

Curriculum and Syllabus for

B. Tech. Electrical Engineering

Scheme: 2025-26 (As Per NEP)

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<tr><td>9</td><td>MM</td><td>U**MM0***</td><td>Multi Disciplinary Minor-V</td><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>ESE</td><td>100</td><td>40</td><td>40</td></tr>
<tr><td></td><td></td><td></td><td colspan="4">Total:</td><td>29</td><td>23</td><td colspan="3">Total Marks: 800
Total Credit: 23</td><td></td></tr>
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PROGRAM ELECTIVE - III							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UELPE0711	Reactive Power Management	3	-	-	3	3
2	UELPE0712	Special Purpose Machines	3	-	-	3	3
3	UELPE0713	Electrical Vehicle Technology	3	-	-	3	3
		Total:				**3**	**3**

OPEN ELECTIVE - III							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UELOE0725	Sustainable Energy Systems	2	-	-	2	2
		Total:				**2**	**2**

Dr. M. K. Aalam
BoS, Chairman

Dr. Akshay Thorvat
Dean Academics

Kolhapur Institute of Technology's College of Engineering (Autonomous) Kolhapur
Dept. of Electrical Engineering

SEMESTER VIII												
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**	**Evaluation Scheme**			
									Component			
1	PEC	UELPE081X	Program Elective-IV	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
2	PEC	UELPE081X	Program Elective-V	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
3	RP	UELIL0871	Project - II	-	-	8	8	4	ISE	50	20	
									ESE (OE)	50	20	
4	OJT	UELIL0872	Internship	-	-	12	12	6	ISE I	75	30	
									ISE II	75	30	
5	CC	UELCC0831	Co -Curricular Activities-IV	-	-	2	2	1	ISE	50	20	
			Total:				**28**	**17**	**Total Marks: 500** **Total Credit: 17**			

PROGRAM ELECTIVE - IV							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UELPE0811	High Voltage Engineering	3	-	-	3	3
2	UELPE0812	Battery Management System	3	-	-	3	3
3	UELPE0813	Computer Aided Power System Analysis	3	-	-	3	3
		Total:				**3**	**3**

PROGRAM ELECTIVE - V							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UELPE0814	EHVAC	3	-	-	3	3
2	UELPE0815	Wide Area Measurement Systems	3	-	-	3	3
3	UELPE0816	Smart Grid	3	-	-	3	3
		Total:				**3**	**3**

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	L	T	P	Credit
Class: Final Year B. Tech Electrical Engineering **Title of the Course:** INDUSTRIAL AUTOMATION **Course Code:** UELPC0701	03 hours per week	-	-	03

Course Pre-Requisite: Basic Knowledge of digital electronics, control systems, microcontrollers, sensors, transducers etc.

Course Description: This course discusses the concepts of PLC and SCADA.

Course Objectives:

1. To introduce concepts of PLC, input/ output devices.
2. To understand different instructions in PLC programming.
3. To introduce different SCADA components.
4. To know different applications of SCADA system.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Understand the basics of automation.	Understand (L2)
CO.2	Understand the architecture of PLC.	Understand (L2)
CO.3	Develop ladder diagram programs based on different PLC functions/ instructions.	Creating (L6)
CO.4	Explain SCADA Component, architecture and its applications.	Apply (L3)

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	3	1			1							2	2
CO.2	3	1	2	2	1							2	2
CO.3	2	3	3	2	2			2	2			2	1
CO.4	2	2	1		2							1	

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/presentation, etc.
MSE is based on 50% of course content (first three units).
ESE is based on 100% course content with 60-70% weightage for course content (last three units) covered after MSE.

Course Contents		
Unit No.	**Unit Title and Contents**	**Hours**
1	**Unit 1: Introduction to Industrial Automation** Definition, Need and benefits of automation, History of Automation, General Structure of an Automated Process, Industrial Automation Hierarchy, Types of automation- Fixed, Programmable and Flexible, Industrial Automation Components: Smart Sensors, PLC, DCS and SCADA, Examples of Automated Systems.	06
2	**Unit 2: Basic of PLC** Technical Definition of a PLC, PLC vs Relay logic, Advantages of a PLC, Block diagram of PLC, Internal architecture of PLC, Input module, Output Module, PLC power supply and grounding basics, Scan cycle, Classification of I/O Modules, Discrete Input Module, Discrete Output module, Analog Input module, Analog Output Module, Special Input Modules, Input Field Devices, Output Field Devices, Sinking and Sourcing concept, Types of PLC, Selection criteria for PLC, PLC hardware safety & industrial environment considerations. Data sheet of any two PLC brands can be discussed [Example: S7-1200, DVP12SE, ABB AC500 series]	08
3	**Unit 3: Basic PLC Programming** Different programming languages used with PLC- Structured Text (ST), Instruction list method (IL), Sequential function charts (SFC)- only introduction, Ladder diagram method, Basic components & their symbols in ladder diagram, Rules to be followed to construct ladder diagram, Practical ladder programming standards (tag naming, comments)**,** Ladder diagrams of digital logic gates, PLC I/O addressing, Instructions- Latching, Multiple Outputs, industry-used blocks/ Function blocks, Internal relays, Battery backed relays, One shot operation, Set /Reset (Ladder programs based on basic instructions), IEC 61131-3 standard (overview).	08
4	**Unit 4: Intermediate PLC Functions** Jump, Subroutine, Timers- On delay, Off delay, Pulse timer, Retentive timer, Format of Timer Instructions, Counters- Up counter, down counter, Up/Down counter, Operation of a PLC Counter, Real-life applications using timers & counters, PLC Mathematical Instructions, PLC number comparison functions, Ladder diagrams for DOL starter, Star delta starter, Autotransformer starter, stepper motor control, Conveyer system, Introduction to fault handling logic, Motor interlocking and protection logic, process control examples.	07
5	**Unit 5: Advanced PLC Functions** Data Movement Instructions, Logical Instructions, Data Handling Instructions, Types of PLC analog modules and systems, PLC analog signal processing, Analog scaling (4–20 mA, 0–10 V), BCD or multibit data processing, PLC analog output application examples. PID controller Instructions, Programs based on advanced instructions.	08

6	**Unit 6: Introduction to SCADA** Objectives of DAS, Types of DAS, Analog to digital converter – Integrating type, Successive approximation type, SCADA components- Remote terminal unit (RTU), Intelligent electronic device (IED), Data concentrators and Merging units, Human Machine Interface (HMI), Block diagram of SCADA, benefits of SCADA, Evolution of SCADA, PLC–SCADA integration concept, SCADA network architecture (Levels, Purdue Model – basic), Communication technologies in SCADA, Introduction to industrial protocols: Modbus, Profibus / Profinet, OPCUA & MQTT (overview), IT-OT Integration, Utility Applications of SCADA- Transmission and distribution, Industrial applications- Oil, Gas and Water.	08

Textbooks:

1. Programmable logic controllers- Principles & Applications, 5th Edition, John W. Webb, Ronald A Reis, Pearson, 2016.
2. Programmable logic controllers, 2nd Edition, W. Bolton, PHI, 2010.
3. Introduction to Programmable Logic Controllers, 2nd Edition, Gary Dunning, Thomson, 2012.

Reference Books:

1. Programmable Logic Controllers Programming Methods and Applications, 4th Edition, John R. Hackworth, Frederick D., Hackworth Jr., McGraw Hill, 2007.
2. Programmable Controllers, 2nd Edition, Batten G. L, McGraw Hill Inc, 2008.
3. Power System Analysis, 1st Edition, Hadi Sadat, McGraw Hill, 2002.
4. SCADA-Supervisory Control and Data Acquisition 5th Edition, Stuart A. Boyer, Instrument Society of America Publications, USA,2004.

Unit wise Learning Objectives:

The students will be able to-

1. Understand the concept of automation.
2. Understand internal architecture of programmable logic controller and functions of each block.
3. Develop ladder programs based upon basic instructions.
4. Develop the ladder program based upon intermediate instructions.
5. Develop the ladder programs best upon advanced PLC instructions.
6. Use SCADA for different applications.

Unit wise Measurable Students Learning Outcomes:

The students will be able to

1. Understand basics of industrial automation.
2. Understand the block diagram & architecture of PLC.
3. Use different basic instructions in ladder diagram programming.
4. Use different intermediate instructions in ladder diagram programming.
5. Use different advanced instructions in ladder diagram programming.
6. Understand DAS and different components of SCADA system and applications of SCADA.

Class, Title, Course No.	L	T	P	Credits
Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Power Quality **Course No.:** UELPC0702	03 hours per week	-	-	03

Course Pre-Requisite:
Students should have the basic knowledge of the fundamentals of electrical engineering, power systems and signals and systems.

Course Description: This course will help students understand the different power quality issues prevalent in the grid. Students will learn about the adverse effects of such power quality issues on the performance of the power system. Methods to mitigate power quality related problems will also be discussed.

Course Learning Objectives: The students will be able to

1. Understand different types of power quality issues and their effects on power system performance.
2. Mathematically evaluate parameters describing power quality related issues.
3. Analyze different standards associated with power quality.
4. Apply different techniques to mitigate various power quality issues.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	**Understand** different types of power quality issues and their causes.	Understand (L2)
CO.2	**Analyze** power quality related standards.	Analyze (L4)
CO.3	**Apply** mitigation techniques using passive and active methods.	Apply (L3)
CO.4	**Analyze** different power quality monitoring systems.	Analyze (L4)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO. 1	1	1									2		
CO. 2		1				1						1	1
CO. 3	1	3	3	3	3	1						3	3
CO. 4	1				2								

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Introduction to Power Quality Desired features of Electrical Power supply, Power quality issues in the conventional grid, Power quality issues in the smart grid, Effects of poor power quality on power system performance.	09
Unit 2: Harmonic Analysis Sources of Harmonics, Voltage and current harmonics, Total Harmonic Distortion, Total Demand Distortion, Effect of harmonics at the Point of Common Coupling.	09
Unit 3: Power Quality Standards International Standards of power quality including IEEE and IEC, Computer Business Equipment Manufacturers Association Curve, ITIC curves.	06
Unit 4: Passive Compensation Techniques Shunt/Series compensators, analysis and design of passive shunt compensators, resonance of passive filters, load compensation, voltage regulation, power factor correction. Ferro-resonant transformers.	08
Unit 5: Active Compensation Techniques Fundamentals of active compensation techniques, Differences between active and passive compensation, Principle and working of Dynamic Voltage Restorer, Static Compensator, Shunt Active Power Filter.	09
Unit 6: Power Quality Monitoring and Measurement Monitoring considerations, Monitoring and diagnostic techniques, Power Quality measurement equipment, Role of AI in power quality applications.	06

Textbooks:

1. Dugan, R.C., Mc Granaghan, M.F., Santoso, S. and Beaty, H.W., 2004. *Electric power systems quality.* McGraw-Hill Publication.
2. Singh, B., Chandra, A. and Al-Haddad, K., 2015. *Power quality: problems and mitigation techniques*. John Wiley & Sons Publication.
3. Fuchs, E.F. and Masoum, M.A., 2011. *Power quality in power systems and electrical machines*. Academic press.
4. Kusko, A. and Thompson, M.T., 2007. *Power quality in electrical systems* (Vol. 23). New York: McGraw-Hill.

Reference Books:

1. Arrillaga, J., Watson, N.R. and Chen, S., 2000. *Power system quality assessment*. John Wiley & Sons.
2. Wakileh, G.J., 2019. *Power systems harmonics: fundamentals, analysis and filter design*. Springer Nature.
3. Baggini, A., 2008. *Handbook of power quality*. John Wiley & Sons.
4. Understanding FACTS: Concepts and Technology of Flexible AC Transmission System by Narain G. Hingorani, Lazlo Gyugyi, IEEE Publication December 1999.

Unit wise Learning Objectives:

The students will be able to-

1. Understand the basics of power quality and different power quality issues prevalent in the modern grid.
2. Study the basics of harmonics, their effect on the power system and their calculation.
3. Study different power quality standards.
4. Analyze and design passive power filters for power quality improvement.
5. Analyze and design active power filters to mitigate different power quality issues.
6. Learn about different power quality monitoring and measurement techniques.

Unit Outcomes:

After completion of the unit, students will be able to,

1. Understand different power quality issues. (CO1)
2. Evaluate the amount of harmonic pollution in different current and voltage waveforms. (CO1).
3. Understand different power quality standards and the acceptable limits for good power quality as per different standards. (CO2)
4. Analyze and design passive power filters for mitigation of different power quality issues. (CO3)
5. Analyze and design active power filters for mitigation of different power quality issues. (CO3)
6. Learn about power quality monitoring systems. (CO4)

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** HVDC & FACTS **Course No.:** UELPC0703	**L**	**T**	**P**	**Credits**
	03 hours per week	-	-	03

Course Pre-Requisite:

- Electrical machines and power systems, especially basic operation principles of synchronous machines, power transmission and Power Electronics.

Course Description:

This course provides a new technology based on power electronics offers an opportunity to enhance controllability, stability and power transfer capability of ac transmission systems. This course includes concept and general system considerations of Flexible Alternating Current Transmission Systems (FACTS). This course deals operation and control scheme of various FACTS Controllers. General aspects of HVDC Techniques and its control are elaborated in this course.

Course Learning Objectives:

1. To state importance of HVDC & FACTS transmission.
2. To analyse the HVDC & FACTS system.
3. To design filters & compensators for transmission lines.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy
		Descriptor
CO.1	Understand importance of HVDC & FACTS transmission.	Understanding (L2)
CO.2	Analyse the HVDC & FACTS transmission system.	Analysing (L4)
CO.3	Design filters & compensators for transmission lines.	Creating (L4)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	3					2	2				2		1
CO.2	3	3	3								2		1
CO.3	3	3	3	2							2		1

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Fundamentals of HVDC Introduction of DC Power transmission technology, Comparison of AC and DC transmission, Application and Description of DC transmission system, Planning for HVDC transmission, Modern trends in DC transmission, Types of HVDC Systems.	7
Unit 2: Analysis of HVDC Converters Pulse Number-Choice of converter configuration, simplified analysis of Gratez circuit, and 12-pulse converter based HVDC systems and their characteristics, Control of Converters, Modelling of AC-DC converter.	8
Unit 3: Harmonics and Filters Introduction – Generation of Harmonics, Design of AC filters and DC filters HVDC light and HVDC PLUS (Power Universal Link), Series and Parallel operation of converters.	8
Unit 4: **Fundamentals of FACTS Devices** The concept of flexible AC transmission, reactive power control in electrical power transmission lines, uncompensated transmission line, Introduction to FACTS devices and its importance in transmission Network, Introduction to basic types of FACTS controllers, Comparison of HVDC and FACTS.	7
Unit 5: Shunt and Series Compensation Principles of series and shunt compensation, description of static var compensators (SVC), Thyristor Controlled Compensators (TSR, TSC, TSC-TSR), Static Phase Shifters (SPS), Static Synchronous Series Compensator (SSSC), STATCOM, SVC.	8
Unit 6: Hybrid FACTS Controllers Unified Power Flow Controller (UPFC), Unified Power Quality Conditioner (UPQC), Interline Power Flow Controller (IPFC), Principle of operation, modes of operation, applications, Modeling and analysis of FACTS Controllers- SVC, STATCOM, TCSC, SSSC, UPFC modelling, Real Time Applications.	7

Textbooks:

1. *HVDC Power Transmission Systems*, K. R. Padiyar, **fourth edition**, New Age International (P) Ltd. (published mid-2023).
2. *FACTS Controllers in Power Transmission and Distribution*, K. R. Padiyar, **Third edition**, New Age International (P) Ltd. (2022).

References:

1. Hingorani N. G "Understanding FACTS Concepts & Technology of FACTS Systems," IEEE PRESS, 2000.
2. Vijay K. Sood "HVDC and FACTS Controllers: Applications of Static Converters in Power Systems", Kluwer academic publisher, 2004.

Unit wise Learning Objectives:

The students will be able to-

1. Understand the basics of HVDC transmission and layout.
2. Study the basics control techniques of HVDC converters.
3. Classify the harmonics and mitigation techniques.
4. Understand the working of different FACTS devices
5. Learn about different control strategies for power flow using FACTS devices.
6. Understand the working of hybrid FACTS devices.

Unit wise Measurable students Learning Outcomes:
After completion of the course students will be able to:

1. Explain need for HVDC and layout.
2. Classify different control modes of HVDC and FACTS, and will be able to compare these to control schemes
3. Classify causes of harmonics and will be able to design cost effective filter for harmonic suppression which will meet reactive power requirements of the system as well.
4. Understand the working of different FACTS controllers.
5. Analyze the different control strategies for power flow using HVDC and FACTS devices.
6. Understand the working of hybrid FACTS devices.

	L	T	P	Credits
Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Reactive Power Management **Course No.:** UELPE0711	03 hours per week	-	-	03

Course Pre-Requisite:
Students shall have the basic knowledge of Power System, Power System Analysis & Power system operation and control.

Course Description:
The course provides a comprehensive knowledge and insight into the study of reactive power control, load compensation, and power flows from points of generation to points of consumption. Students will learn the concept of reactive power coordination and management and elucidates the demand side management in power system. These fundamentals apply to analyse and solve realistic problems in the distribution side and utility side reactive power management.

Course Learning Objectives:
1. Effectively impart fundamental concepts and necessity of reactive power.
2. Apply the requirement load compensation in the transmission lines.
3. Observe and apply various compensation methods in transmission lines
4. Construct model for reactive power coordination.
5. Study the characterize distribution side and utility side reactive power management.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Elucidate the concept of load compensation in electrical power system.	Understanding (L2)
CO.2	Illustrate the steady and transient state reactive power compensation in transmission system.	Applying (L3)
CO.3	Applying the performance tools for reactive power coordination and management.	Applying (L3)
CO.4	Analysing Demand side reactive power management and user side reactive power management based upon the dynamic characteristics of load and supply.	Analysing (L4)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	2	1	3	1	1	2				1	1	2	2
CO.2	2	2	2	2						1	1	1	1
CO.3	1	2			3	2						1	1
CO.4	1	1	2	1		2	3					1	1

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Load Compensation Objectives and specifications, reactive power characteristics, inductive and capacitive approximate biasing, Load compensator as a voltage regulator, phase balancing and power factor correction of unsymmetrical loads, Problems expected.	7
Unit 2: Steady – State Reactive Power Compensation in Transmission System: Uncompensated line, types of compensation, Passive shunt and series and dynamic shunt compensation, examples Transient state reactive power compensation in transmission systems: Characteristic time periods, passive shunt compensation, static compensation, series capacitor-compensation, compensation using synchronous condensers, Problems expected.	8
Unit 3: Reactive power coordination Objective, Mathematical modeling, Operation planning, transmission benefits, Basic concepts of quality of power supply, disturbances, steady –state variations, effects of under voltages, frequency, Harmonics, radio frequency, and electromagnetic interferences.	7
Unit 4: Demand Side Management Load patterns, basic methods load shaping, power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels Distribution side Reactive power Management: System losses, loss reduction methods, examples, Reactive power planning, Economics Planning capacitor placement, retrofitting of capacitor banks, Application of APFC panels for demand side management, Demand side management in EV charging.	7
Unit 5: Distribution side Reactive power Management User Side Reactive Power Management: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics. Discuss the realistic example of distribution side reactive power management implementations.	8
Unit 6: Reactive power management in electric traction systems and arc furnaces Typical layout of traction systems, reactive power control requirements, distribution transformers, Electric arc furnaces, basic operations, furnaces transformer, filter requirements, remedial measures, power factor of an arc furnace.	8

Text Books:

1. Reactive power control in Electric power systems by T.J.E. Miller, John Wiley and sons, 1982.
2. Reactive power Management by D. M. Tagare, Tata McGraw Hill, 2004.

Reference Books:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide, April 2012, Wiely publication.

Unit Learning Objectives:

To make students to

1. The students will be able to understand the concept of load compensation.
2. The students will be able to understand Steady and Transient state reactive power compensation in transmission system.
3. The students will be able to summarize the reactive power coordination.
4. The students will be able to explain reactive power management.
5. The students will be able to explain demand side management and user side reactive power management.
6. The students will be able to understand Reactive power management in electric traction systems and arc furnaces.

Unit Outcomes:

After completion of the unit, students will be able to,

1. Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads (CO1, CO2)
2. Observe and apply various compensation methods in transmission lines. (CO2, CO3, CO4).
3. Construct models for reactive power coordination (CO2, CO3, CO4).
4. Control and analysis demand side reactive power management in modern power system. (CO2, CO3, CO4).
5. Interpret user side reactive power management based upon the dynamic characteristics of load and supply. (CO2, CO3, CO4)
6. Implementation of the traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces, filter requirements – remedial measures –power factor of an arc furnace (CO2, CO3, CO4).

	L	T	P	Credits
Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Special Purpose Machines **Course No.:** UELPE0712	03 hours per week	-	-	03

Course Pre-Requisite: Electrical Machines.

Course Description: The course will provide understanding of Special Electrical Machines Concepts Construction, principle of operation and performance of special Machines.

Course Learning Objectives: The students will be able to

1. To learn the basics of stepper motor and switched reluctance motors.
2. To learn the switched reluctance motors.
3. To study the construction and working of Synchronous reactance motors.
4. To study the construction and working of permanent magnet brushless D.C. motors.
5. To impart knowledge of permanent magnet synchronous motors with their characteristics & applications.
6. To become Familiarize and understand various types of special purpose motors.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Explain the construction and principle of operation of stepper motors and switched reluctance motors	Understand (L2)
CO.2	Describe the construction and explain the principle of operation of synchronous reactance motors	Understand (L2)
CO.3	Understand the construction and operation of other special electrical machines	Understand (L2)
CO.4	Apply knowledge of construction and operation of PMBLDC motors and PMSM	Apply (L3)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	3	2	1			1	1					1	
CO.2	3	3	1	1		1	1						1
CO.3	1	3		1									
CO.4	3			2									1

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Stepper Motors: Constructional features, principle of operation, types, modes of excitation, Torque production in Variable Reluctance (VR) stepping motor, Static and Dynamic characteristics, Introduction to Drive circuits for stepper motor, suppressor circuits, Closed loop control of stepper motor- Applications.	08
Unit 2: Switched Reluctance Motors (SRM): Principle of Operation, Constructional features, Torque equation, Power Semi-Conductor Switching Circuits, frequency of variation of inductance of each phase winding - Control circuits of SRM- Torque - Speed Characteristics, Microprocessor based control of SRM Drive, Applications.	08
Unit 3: Synchronous Reluctance Motors: Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque - Phasor diagram, Speed torque characteristics, Applications.	07
Unit 4: Permanent Magnet Brushless Dc Motors: Commutation in DC motors, Electronic Commutation - Difference between mechanical and electronic commentators- Hall sensors, Optical sensors, Construction and principle of PMBL DC Motor, Torque and E.M.F equation, Torque-speed characteristics, Power Controllers-Drive Circuits, Applications.	08
Unit 5: Permanent Magnet Synchronous Motors: Construction and types, Principle of operation, EMF and Torque equation, Phasor diagram- Torque Speed Characteristics, Power controllers- Self-control, Vector control, Microprocessor Based Control, Applications.	08
Unit 6: Other Special Machines: Constructional features Principle of operation and Characteristics of Hysteresis motor, Linear Induction Motor-Repulsion motor- Applications.	06

Textbooks:

1. Switched Reluctance Motor Drives, R. Krishnan, CRC Press, New York, 2001.
2. Permanent Magnet and Brushless DC Motors, S.K.Sahadev, Clarendon Press, London, 1998.
3. Brushless Permanent-Magnet and Reluctance Motor Drives,T. J. E. Miller,Oxford University Press,1989.
4. Special Electrical Machines, R. Srinivasan, Lakshmi Publications, 2013
5. Special Electrical Machines, K. Venkataratnam, Universities Press (India) Private Limited, 2008

Reference Books:

1. Miller, T. J. E., Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science Publications, 1989.
2. Kenjo, T., and Sugawara, A., Stepping Motors and their Microprocessor Controls, Oxford Science Publications, 1984.
3. Venkataratnam K., Special Electrical Machines, CRC Press, 2009. 3. Krishnan, R., “Permanent Magnet and BLDC Motor Drives”, CRC Press, 2009. 2. Chang liang, X., "Permanent Magnet Brushless DC Motor Drives and Controls", Jun 2012

Unit wise Learning Objectives:

At the end of the course the student will be able to:

1. Explain the construction, principle of operation, control methods, and applications of stepper motors.
2. Analyze the construction, operating principle, torque production, and control strategies of switched reluctance motor drives.
3. Explain the construction, operating principle, torque characteristics, and applications of synchronous reluctance motors.
4. Explain the construction, electronic commutation, performance characteristics, and applications of permanent magnet brushless DC motors.
5. Analyze the construction, operating principle, control techniques, and performance characteristics of permanent magnet synchronous motors.
6. Explain the construction, operating principles, characteristics, and applications of other special electrical machines.

Unit Outcomes:

After completion of the unit, students will be able to,

1. Understand principle operation and various types of Stepper Motor.
2. Understand principle operation and various types of Switched Reluctance Motor.
3. Understand principle operation of various types of Synchronous Reluctance Motor.
4. Understand principle operation of various types of Permanent Magnet Brushless Dc Motors.
5. Understand principle operation of various types of Permanent Magnet Synchronous Motor.
6. Understand principle of operation of other special Machines.

	L	T	P	Credits
Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Electric Vehicle Technology **Course No.:** UELPE0713	03 hours per week	-	-	03

Course Pre-Requisite: Basic knowledge about electric motors, batteries, power electronics.

Course Description: This course discusses the fundamental concepts and analysis of hybrid and electric vehicles. This course discusses the various EV subsystems such as electric motors, energy storage devices, charging technology etc. Analytical exercises in vehicle dynamics, battery parameters and charging technology are included as a preparatory base for designing an EV.

Course Learning Objectives: The students will be able to

1. To impart knowledge about electric vehicles and hybrid vehicles.
2. To give exposure for Electrical Engineering students to various interdisciplinary areas related to electric and hybrid vehicles.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Understand the correlation between HEV, EV and environment, infrastructure and policies of a nation.	Understand (L2)
CO.2	Explain the performance parameters of various subsystems in EV.	Understand (L2)
CO.3	Analyze the role of various subsystems and components in EV and HEV.	Analyze (L4)
CO.4	Evaluate the performance parameters of EV subsystems.	Evaluate (L5)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1			1	1		1					1	2	3
CO.2	1	2	2	1		1					1	2	2
CO.3	3	2		2		1					1	2	2
CO.4	3	3		2		1					1	2	2

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Fundamentals of vehicles and powertrains: History of fall and rise of electric vehicles, ICEV – power train operation and the need of gears and clutch, EV- powertrain, introduction to HEV, comparison between ICEV, HEV, EV, Vehicle terminology and architectures. Subsystems in different types of vehicles.	6
Unit 2: Vehicle dynamics: dynamic performance features of the vehicle, traction force components and their calculations. Factors affecting components, Traction power, energy consumption, fuel efficiency, Drive cycle, examples of drive cycles.	8
Unit 3: Hybrid Electric Vehicle: Hybridization of energy sources, Hybridization of propelling devices, Goals and challenges in HEV design, Degree of hybridization, Classification based on degree of hybridization and the features therein, hybrid drive-train topologies- series, parallel, series- parallel, complex hybrid. Power flow in various modes.	8
Unit 4: Motors for Electric Vehicle and control: Construction, working and speed control of BLDC motor, Synchronous motor, Induction motor, Switched reluctance motor, Synchronous reluctance Motor, Axial flux motor, Concept of MTPA, trapezoidal bipolar drive for BLDC motor, Unipolar drive for synchronous reluctance motor, Introduction to vector control of induction motor and synchronous motor, Introduction to motor and vehicle control, HMI.	8
Unit 5: Energy Storage for Electric vehicles: Battery performance parameters and design of battery pack (numerical treatment), Li ion cell- structure, Different types and comparison of batteries, Other advanced batteries for EV, Structure and working of Fuel Cell energy storage, Super Capacitor, Necessity of hybridization of energy sources.	8
Unit 6: Charging technology: Constant voltage (CV) charging, Constant current (CC) charging, Conductive charging technologies, charging standards in India, Connectors, Concepts of inductive charging, Vehicle to Grid (V2G), Vehicle to Vehicle (V2V) charging, Battery swapping and bulk charging, Impact of uncontrolled fast charging on grid, charging protocols, EV policies and schemes of Indian government.	7

Textbooks:

1. Tom Denton “Electric and Hybrid Vehicles” Routledge, 2016.
2. C.C. Chau and K.T. Chau Modern Electric Vehicle Technology OXJORD UNIVERSITY PRESS.
3. Ali Emadi Advanced Electric Drive Vehicles CRC press, 2014.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, 3rd Edition (2018) Published by CRC Press / Taylor & Francis.
2. Chris Mi, M. A. Masrur and D. W. Gao “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives” 3rd Edition John Wiley & Sons, 2025.
3. S. Onori, L. Serrao and G. Rizzoni “Hybrid Electric Vehicles: Energy Management Strategies” Springer, 2016.
4. Jiuchung Juaing, Caiping Zhang Fundamentals & Applications of Li-ion Batteries in Electric Drive Vehicles- Wiley publications, 2015

Unit wise Learning Objectives:

At the end of the course the student will be able to:

1. Recall the basic terms and architecture of vehicles.
2. Explain the components of traction force.
3. Compare various types of HEVs.
4. Explain the working of various types of motors used in EV.
5. Recall various battery parameters.
6. Explain various charging techniques and standards.

Unit Outcomes:

After completion of the unit, students will be able to,

1. Recall the basic terms and architecture of vehicles (CO1).
2. Explain the components of traction force (CO2).
3. Compare various types of HEVs (CO2).
4. Analyze the working of various types of motors used in EV (CO3).
5. Recall various battery parameters (CO3).
6. Evaluate various charging techniques and components of EV subsystems (CO4).

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** OE-III Sustainable Energy Systems **Course No.:** UELOE0725	**L**	**T**	**P**	**Credits**
	02 hours per week	-	-	02

Course pre-requisite:
Basic Physics, Electrical Engineering Fundamentals, Introduction to Energy Systems, Conventional Energy Environmental Sciences, Power generation from conventional sources.

Course Description:
This course provides a comprehensive introduction to renewable energy sources, focusing on solar and wind energy systems. Students will explore the global and Indian renewable energy scenarios, the need for alternative energy, and the advantages and disadvantages of various energy sources. The course delves into the technical aspects of solar energy covering photovoltaic power generation, along with the design, analysis, and operation of solar photovoltaic systems.
Additionally, the course examines wind energy principles, including energy conversion, site selection, and economic and environmental factors. Students will gain hands-on knowledge of wind turbine technologies, including various types of turbines and generators, and the analysis of wind data for energy estimation. By the end of the course, students will be equipped to design and evaluate solar and wind energy systems, conduct resource assessments, and apply advanced theories to optimize energy generation and system performance.

Course Learning Objectives:
At the end of the course students will be able to
1. Understand renewable energy sources.
2. Explain and analyze Solar Photovoltaic systems.
3. Explain and analyze wind energy conversion systems.
4. Understand the basics of Hydrogen energy and fuel cell technology.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Understanding Renewable Energy Sources	Understand (L2)
CO.2	Understand the basics of Hydrogen energy and fuel cell	Understand (L2)
CO.3	Explain and analyze Solar Photovoltaic systems.	Analyse (L4)
CO.4	Explain and analyze wind energy conversion systems.	Analyse (L4)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	3	2	2	1	1	1	3					3	2
CO.2	3	3	3	1	3	1	2					3	3
CO.3	3	3	2	1	1	2	3					3	3
CO.4	3	3	2	2	1	2	3					3	3

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Sustainability Concepts: Sustainable Development Goals for Clean Energy (SDGS), Emerging Issues in Energy Access, Technologies, Economics. Sustainability Concepts of Energy Generation Technologies, Worldwide Energy Resource and Utilization. Fundamental and social implications energy, Renewable energy availability in India and global, Carbon accounting & Carbon credit certification.	07
Unit 2: Solar Photovoltaic: Fundamentals of Solar Radiation, Solar radiation Measurements using Pyrheliometers, Pyrometer. Basics of PV cell, materials used for PV cell, efficiency of PV cell, equivalent electrical circuits, open circuit voltage and short circuit current, I-V & P-V Curves, effects of different electrical parameters on I-V & P-V curves. Configuration of PV power generation system-off-grid and on-grid system, Introduction to MPPT technique.	07
Unit 3: Wind Energy Wind resources, Nature and occurrence of wind, Wind Energy Scenario, World and India, Power in the wind, Wind characteristics, Principles of wind energy conversions, Components of wind energy conversion system (WECS), Classification of WECS, Advantages and disadvantages of WECS. Wind Turbine: - Torque speed characteristics, Pitch angle control, Stall control, Power electronic control, Yaw control, Control strategy, Wind speed measurements, Wind speed statistics, Site and turbine selection. Introduction to MPPT technique.	07
Unit 4: Hydrogen: Basics in Production Techniques Hydrogen, Physical and chemical properties, Salient characteristics, Production of hydrogen technologies (electrolysis method only), Benefits of hydrogen, Economic and environmental analysis on usage of hydrogen, Hydrogen Storage Techniques. **Green Energy:** Fuel Cells: -- Principle, Working, Types of Fuel Cells, Thermodynamics and kinetics process performance evaluation of fuel cell, Comparison on battery Vs fuel cell, Application of Fuel Cell.	09

Textbooks:

1. Boyle, Godfrey, "Renewable Energy", 2nd edition, Oxford University Press, 2004.
2. G. S. Sawhney, "Non-Conventional Resources of Energy", PHI Publication 2012.
3. Chetan Singh Solanki "Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers, and Engineers" PHI Learning Pvt. Ltd., Delhi, New Delhi, India.

Reference Books:

1. Gary-L. Johnson Wind Energy Systems Tata Mc-Graw-Hill Book Company.
2. James Manwell, J.F. Manwell Wind Energy Explained: Theory, Design and Application.

Unit wise Learning Objectives:

The students will be able to understand

1. Sustainable Development Goals for Clean Energy.
2. Fundamentals & Working of Solar Photovoltaic System.
3. Fundamentals & Working of Wind Energy systems.
4. Fundamentals & Working of Hydrogen & Green Energy conversion systems.

Unit Outcomes:

After completion of the unit, students will be able to,

1. Understand the global and local renewable energy scenarios and critically assess RES needs.
2. Explain the principles of solar energy, including photovoltaic systems and their efficiency.
3. Understand the principles of wind energy conversion systems and basics of wind turbines, assess wind energy scenarios and their economic/environmental impacts.
4. Understand the principles of hydrogen and green energy systems.

Class- Final Year B. Tech Electrical Engineering **Title of the Course:** INDUSTRIAL AUTOMATION LAB **Course Code:** UELPC0731	**L**	**T**	**P**	**Credit**
	-	-	2	1

Course Pre-Requisite: Basic Knowledge of PLC instructions and PLC architecture.

Course Description: This course discusses about different PLC softwares and their use hands on training through laboratory experiments.

Course Objectives:

1. To introduce PLC and its wiring.
2. To introduce different types of PLC programming software's to students.
3. To learn PLC ladder programming.
4. To know the use of PLC as a one of SCADA element through simple applications.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Configure PLC architecture, wire discrete I/O modules, and implement basic logic operations using simulation tools and physical switches.	Apply (L3)
CO.2	Develop and execute ladder logic programs utilizing different PLC instructions.	Analyse (L4)
CO.3	Implement complex control solutions involving analog signal processing (temperature/motor control/HMI)	Creating (L6)

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	2										2	
CO2		3	3	2	2							1	1
CO3		2	2	1	1								

Assessment Scheme:

Assessment Component	Marks
ISE	25
ESE	50 (POE)

ISE is based on practical performed in laboratory, Journal writing and Oral based on programs executed in the laboratory sessions.

List of Experiments:

Expt. No	Name of experiment	Hours
1	Study of PLC architecture, types of different I/O's and wire up a PLC.	02
2	Connect PLC to PC and test execution of ladder programs for basic logic operations. Develop a ladder diagram for Logic Gates.	02

3	Simulate a latching circuit, interlock logic and multiple output programmes using PLC.	02
4	Develop ladder logic program using timer instructions.	02
5	Develop ladder logic program using Up/Down counter instruction for Industrial sequence control (conveyor / batching example)	02
6	Develop a ladder programme using comparison instructions.	02
7	Use PLC for ON/OFF Temperature control. Demonstrate the same using PID control instruction.	02
8	Write a PLC programme to – 1) Control speed of DC motor 2) Speed of AC motor by VFD	02
9	Interface HMI with PLC.	02
10	Develop a ladder logic program using Jump instruction and subroutine instructions.	02
11	Write a ladder logic program using move, arithmetic and data processing instructions in PLC.	02
12	Experiment to have PLC communication with SCADA (basic tag mapping) and PLC I/O troubleshooting & fault diagnosis (Case study / visit)	02

Textbooks:

1. Programmable logic controllers- Principles & Applications, 5th Edition, John W. Webb, Ronald A Reis, Pearson,2012
2. Programmable logic controllers, 2nd Edition, W.Bolton, PHI,2010
3. Introduction to Programmable Logic Controllers, 2nd Edition, Gary Dunning, Thomson, 2001

Reference Books:

1. Programmable Logic Controllers Programming Methods and Applications, 4th Edition, John R. Hackworth, Frederick D., Hackworth Jr., McGraw Hill, 2016
2. Programmable Controllers, 2nd, Batten G. L, McGraw Hill Inc.,2008
3. SCADA-Supervisory Control and Data Acquisition, 5th Edition, Stuart A. Boyer, Instrument Society of America Publications, USA, 2004

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Power Quality Laboratory **Course No.:** UELPC0732	**L**	**T**	**P**	**Credits**
	-	-	2	01

Course Pre-Requisite:
Students should have the basic knowledge of the fundamentals of electrical engineering, power systems and signals and systems.

Course Description: This laboratory course will help students understand the different power quality issues prevalent in the grid. Students will monitor electrical waveforms using power quality analyzers and perform offline analysis on the obtained data. Students will also simulate power quality issues on different simulation platforms. Students will also model and analyze different active and passive filters for power quality improvement.

Course Learning Objectives: The students will be able to

1. Simulate different power quality issues using a simulation software.
2. Use Power Quality Analyzer for monitoring power quality of different types of loads
3. Design passive and active filters for power quality improvement.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Understand different power quality issues and their causes.	Understand (L2)
CO.2	Analyze power quality issues using power quality analyser.	Analyze (L4)
CO.3	Design active and passive filters for power quality improvement.	Create (L6)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	1	1											
CO.2				2	3	2							
CO.3		2	3	3	3	2	2					2	2

Assessments:

Assessment	Weightage (Marks)
ISE	25
ESE (OE)	25

1. ISE is based on the continuous assessment of the student in the laboratory.
2. ESE is based on the performance in practical conduction and oral exam at the end of the semester.

List of Experiments:	
Exp 1: Write a script file generating waveforms with voltage sag and voltage swell.	02
Exp 2: Design a simulation model with an AC source supplying a linear and non-linear load.	02
Exp 3: Perform harmonic analysis of different loads (Resistive, Inductive & Capacitive).	02
Exp 4: Study of Power Quality Analyzer (PQ3100).	02
Exp 5: Measurement of electrical parameters of a three-phase induction motor using a Power Quality Analyzer.	02
Exp 6: Total Harmonic Distortion calculation for a non-linear load using Power Quality Analyzer.	02
Exp 7: Power Quality inspection using Power Quality Analyzer- a case study.	02
Exp 8: Power factor correction for an inductive load using a capacitor bank.	02
Exp 9: Harmonic suppression using a passive filter.	02
Exp 10: Harmonic current compensation using a simulation/-based Shunt Active Power Filter (SAPF).	02
Exp 11: Voltage sag and swell compensation using a Dynamic Voltage Restorer (DVR). (Simulation)	02

Textbooks:

1. Dugan, R.C., Mc Granaghan, M.F., Santoso, S. and Beaty, H.W., 2004. *Electric power systems quality*. McGraw-Hill Publication.
2. Singh, B., Chandra, A. and Al-Haddad, K., 2015. *Power quality: problems and mitigation techniques*. John Wiley & Sons Publication.
3. Fuchs, E.F. and Masoum, M.A., 2011. *Power quality in power systems and electrical machines*. Academic press.
4. Kusko, A. and Thompson, M.T., 2007. *Power quality in electrical systems* (Vol. 23). New York: McGraw-Hill.

Reference Books:

1. Arrillaga, J., Watson, N.R. and Chen, S., 2000. *Power system quality assessment*. John Wiley & Sons.
2. Wakileh, G.J., 2019. *Power systems harmonics: fundamentals, analysis and filter design*. Springer Nature.
3. Baggini, A., 2008. *Handbook of power quality*. John Wiley & Sons.

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Project-I **Course No.:** UELIL0717	**L**	**T**	**P**	**Credits**
	-	-	08	04

Course Pre-Requisite: Knowledge of courses in Electrical engineering studied till sem VI Hands on skills for working with circuits and machines, aptitude to learn in varied environments.

Course Description:

Project is an activity of developing solutions to a problem statement involving complex problems relevant to core engineering field. The implementation requires use of engineering knowledge for problem analysis, conduct investigations, design and develop the solution. This may include software, and other related processes. It expects teamwork and management of resources and activities.

1. A group consisting of not more than 4 students will work on one project. The theme/ problem statement of the project will be identified by the group. Approval of the theme will be as per defined rubrics by a faculty level committee. The project work will be carried out in two phases. Phase I will be carried out as this course Project – I
2. Under this course the group will submit the synopsis of project, complete literature survey, methodology, prepare a detailed system design, layout etc.
3. The group will maintain a logbook of progress of the project activities. The logbook should have entries related to the work done, problems faced, solutions evolved etc. duly signed by internal guide.
4. Each student in the project group will deliver a seminar on latest topics related to proposed project and submit a joint seminar report consisting of Literature survey, basic proposed project work. Size of the report should be at least 30 pages. (Refer to the evaluation document on the institute website for further details.)

Course Objectives: The course aims to develop following abilities of a student-

1. To apply engineering knowledge in practical problem solving
2. To think in innovative/ creative way, conduct investigations in design of products, processes or systems while in finding engineering solutions to societal and/or professional problems.
3. To function effectively as a member of heterogeneous team and in multidisciplinary environment.
4. To communicate effectively, observe/follow ethics while working, use management techniques in carrying out a work.
5. Lifelong learning.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Taxonomy Descriptor**
CO. 1	Identify, formulate, review research ideas, research question or a complex Engg. problem to formulate a hypothesis for its solution	Analysing (L4)
CO. 2	Design research methodologies for a complex engineering problem after conducting investigations	Creating (L6)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	3	3	3	2	2	2	2	3	3	3	2	2	1
CO.2	3	3	3	2	2	2	2	3	3	3	2	2	1

Assessments: Teachers' assessment-

In Semester Evaluation (ISE), and End Semester Examination (ESE) have weightage as follows.

Assessment	Marks
ISE I	50
ESE(POE)	50

ISE I is based on at least two of the assessment tools. ISE marks shall be based on the report covering Literature Survey, Problem identification, Objectives and Methodology and Seminar presentation and the logbook records.

ESE Assessment is based on performance in an oral test at the end of the semester.
(Refer to the evaluation document on the institute website for further details.)

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Applications of Robotics & Automation **Course No.:** UELMM0741	**L**	**T**	**P**	**Credits**
	03 hours per week	-	-	03

Course Pre-Requisite:
Students shall have the basic knowledge of: Mathematics, Robot Kinematics and dynamics, Basics of Robotics

Course Description:
Applications of Robotics & Automation is an introductory course that explores how robots and automated systems are designed and used in real-world industries. Students learn the fundamentals of robotics, including sensors, actuators, control systems, and basic programming. The course highlights practical applications such as manufacturing, healthcare, agriculture, transportation, and service robotics. Through hands-on activities, case studies, and problem-solving exercises, students develop an understanding of how automation improves efficiency, safety, and productivity, while also considering ethical, social, and future impacts of robotic technologies.

Course Learning Objectives: The students will be able to

1. Effectively impart fundamental concepts of robotics and automation, including robotic components, sensors, actuators, and control systems.
2. Properly analyze and implement basic robotic programming and automation tasks.
3. Deliberate rational approaches for selecting and applying robotic and automation solutions to real-world engineering problems.
4. Understand the impact, limitations, and ethical considerations associated with the use of robotics and automation in modern industries.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Taxonomy Descriptor**
CO.1	Analyze the operational principles and applications of industrial robots for material handling, welding, and assembly tasks.	Understanding (L2)
CO.2	Evaluate the technologies and challenges involved in developing intelligent vehicles and autonomous systems, including ADAS and road scene understanding.	Applying (L3)
CO.3	Assess the role and application of robotics in challenging environments such as agriculture, construction, mining, and disaster response scenarios.	Applying (L3)
CO.4	Examine core concepts, technologies, and applications within medical robotics, computer-integrated surgery, surveillance, and security domains.	Analysing (L4)

CO-PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO.1	3	2											
CO.2	3	2	2	2									
CO.3				1	1	1							
CO.4			2	2	1	1							

Assessments:

Assessment	Weightage (Marks)
ESE	100 Marks

- **ESE:** Assessment is based on 100% course content.

Course Contents:	Hours
Unit 1: Industrial Robots Material Handling: pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly.	08
Unit 2: Intelligent Vehicles Motivation and Approaches to Intelligent Vehicles, Enabling Technologies, Road Scene Understanding, Advanced Driver Assistance, Driver Monitoring, Towards Fully Autonomous Vehicles, Future Trends and Prospects, Conclusions.	08
Unit 3: Robotics in Agriculture and Construction **Agriculture**: Section Scope, Challenges and Opportunities, Case Studies. **Construction:** Overview Offsite Applications of Robotics in Construction Onsite, Applications of Single Task Construction Robots, Integrated Robotized Construction Sites Currently Unsolved Technical Problems.	07
Unit 4: Robotics in Hazardous Applications & Mining **Hazardous Applications:** Operation in Hazardous Environments: The Need for Robotics Solution Applications, Enabling Technologies, Conclusions and Further Reading, **Mining:** Modern Mining Practice, Surface Mining, Underground Mining, Challenges and Industry Acceptance, Challenges, Outlook and Conclusion.	07
Unit 5: Robot Surveillance and Security and Disaster robotics **Surveillance and Security**: Overview, Application Domains, Enabling Technologies, Active Research. **Disaster robotics:** Overview, Disaster Characteristics and Impact on Robots Actually Used at Disasters, Robots at the Power Plant Accident (Case Studies), Lessons Learned, Challenges, and Novel Approaches.	07
Unit 6: Medical Robotics and Computer-Integrated Surgery **Medical Robotics:** Core Concepts, Technology, Systems, Research Areas, and Applications, Conclusion and Future Directions, Robotics Competitions and Challenges.	08

Handbook:

1. Springer Handbook of Robotics, Bruno Siciliano and Oussama Khatib (Eds.), Springer-Verlag, Berlin Heidelberg, 2008.

Reference Books:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987. https://www.robots.com/applications.
3. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).
4. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rdedition, 2017.

Unit Learning Objectives:

To make students to

1. Learn the fundamentals of robotics and automation, including robot anatomy, degrees of freedom, and classification of robots.
2. Understand various sensors and actuators used in robotic systems and their working principles.
3. Identify different types of robot control systems and basic programming methods used in automation.
4. Learn the concepts of industrial automation, including PLCs and automated manufacturing systems.
5. Study the applications of robotics in industries such as manufacturing, healthcare, agriculture, and service sectors.
6. Understand safety standards, ethical issues, and future trends in robotics and automation.

Unit Outcomes:

After completion of the unit, students will be able to,

1. Differentiate between various types of robots and explain their structure, motion, and applications. (CO1, CO2)
2. Identify and select appropriate sensors and actuators for specific robotic and automation tasks. (CO2, CO3)
3. Apply basic programming and control techniques to operate simple robotic and automated systems. (CO3, CO4)
4. Analyze industrial automation systems and explain the role of robotics in modern manufacturing processes. (CO2, CO4)
5. Compare different application areas of robotics and evaluate their advantages and limitations. (CO1, CO4)
6. Interpret safety requirements and ethical considerations related to the deployment of robotic and automation technologies. (CO3, CO4)

Class: Final year B. Tech Electrical Engineering **Title of the Course:** High Voltage Engineering **Course Code:** UELPE0811	L	T	P	Credits
	03 hours per week	-	-	03

Course Pre-Requisite: For this course study of properties of various dielectric materials, electrical field calculation in each medium, measurement techniques of voltages and currents is necessary.

Course Description:

This course introduces the importance and applications of high-voltage engineering in electrical power systems. It covers electrical insulating materials, their properties, and methods of high-voltage generation and measurement. The course also examines the causes of abnormal over voltages and the necessity of testing power system equipment before installation. It aims to develop competency in high-voltage technology and insulation protection challenges.

Course Learning Objectives:

1. To comprehend breakdown phenomenon in air, solid and liquid insulation
2. To understand the basic generation and measurement of High voltage and High current for testing purposes
3. To test high voltage electrical Equipment with various testing devices

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Understand the breakdown in gases, solid and liquid dielectric mediums.	Understanding (L2)
CO.2	Analyze the generation of High Voltage and current	Analysing (L4)
CO.3	Analyze the measurement of High Voltage and current	Analysing (L4)
CO.4	Test the HV equipment with various testing devices	Evaluating (L5)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	3			2							2		1
CO.2	3		3	2	3				1		2		1
CO.3	3		3	2	3				1		2		1
CO.4	3			2					1		2		1

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1:--- Electrostatic fields and field stress control Electrical field distribution and breakdown strength of insulating materials - fields in homogeneous, isotropic materials - fields in multi-dielectric, isotropic materials - numerical method: Finite Element Method (FEM), charge simulation method (CSM).	6
Unit 2:--- Electrical breakdown in gases Gases as insulating media, Townsend first ionization coefficient, photoionization, ionization by interaction of metastable with atoms, thermal ionization, photoelectric emission, electron emission by positive ion and excited atom impact, Townsend second ionization coefficient, secondary electron emission by photon impact, The streamer or 'kanal' mechanism of spark, Paschen's law, penning effect, the breakdown field strength, breakdown in non-uniform fields.	8
Unit 3:--- Breakdown in liquid and solid dielectrics Liquid as insulators, breakdown in liquids - electronic breakdown, suspended solid particle mechanism, cavity breakdown, examples - static electrification in power transformers, transformer oil filtration, transformer oil test, alternative liquid insulations like vegetable oils, esters and silicon oils Breakdown in solids- intrinsic breakdown, streamer breakdown, electromechanical breakdown, edge breakdown and treeing, thermal breakdown, tracking breakdown of solid dielectrics in practice, partial discharges in solid insulation, solid dielectrics used in practice.	8
Unit 4:--- **Generation of high voltages** Generation of high direct voltages, half and full wave rectifier circuits, voltage multiplier circuits, Van de Graff generators, electrostatic generators, Generation of alternating voltages, testing transformers, cascaded transformers, resonant transformers, Impulse voltages, Standard lightning and switching surge, impulse voltage generator circuits, Marx circuit, operation, design and construction of impulse generators, Impulse current generator.	8
Unit 5:--- Measurement of high voltages High direct voltage measurement, peak voltage measurements by spark gaps, sphere gaps, uniform field gaps, rod gaps, examples - electrostatic voltmeters - ammeter in series with high ohmic resistors and high ohmic resistor voltage dividers - generating voltmeters, The measurement of peak voltages, the Chubb–Fortescue method, high-voltage capacitors for measuring circuits - voltage dividing systems and impulse voltage measurements.	8
Unit 6: --- Over voltages, testing procedures and insulation coordination The lightning mechanism, laboratory high-voltage testing procedures, examples - insulation coordination, insulation level, modern power systems protection devices- MOA – Metal Oxide Arresters. High voltage testing: Testing of insulators, bushings, isolators, circuit breakers, cables, transformers, surge diverters, radio interference measurements, Design, planning and layout of high voltage laboratory.	7
Textbooks: 1. **M. S. Naidu and V. Kamaraju**, *High-Voltage Engineering*, **6th Edition**, McGraw-Hill Education India, New Delhi, 2020. 2. Rakosh Das Begamudre, "High Voltage Engineering, Problems and Solutions", New Age International Publishers, New Delhi, 2010.	

References:

1. **E. Kuffel, W. S. Zaengl & J. Kuffel**, *High Voltage Engineering: Fundamentals*, **2nd Edition**, Butterworth-Heinemann (A Division of Reed Educational & Professional Publishing Ltd), Oxford, U.K., 2000 — widely accepted as the standard edition.
2. **Dieter Kind & Kurt Feser**, *High Voltage Test Techniques*, **2nd Edition**, Elsevier/Newnes (Reed Educational & Professional Publishing Ltd), New Delhi, 2001 — this remains the latest revised edition.
3. **M. Khalifa**, *High Voltage Engineering — Theory and Practice*, Marcel Dekker, Inc., New York and Basel, **1990** — no widely recognized later edition.
4. **Hugh M. Ryan (Ed.)**, *High-Voltage Engineering and Testing*, **3rd Edition**, The Institution of Engineering and Technology (IET), London, U.K., **latest edition available** (supersedes 2nd edition).
5. **C. L. Wadhwa**, *High Voltage Engineering*, **4th Edition**, New Age International Publishers, New Delhi, **latest edition available** (updated from 3rd).

Unit Learning Objectives:

Students should be able to-

1. Study the electrical field distribution and breakdown strength of insulating materials.
2. Understand the Breakdown phenomenon in gases.
3. Study the Breakdown phenomenon in solid and liquid insulation.
4. Understand the basic generation of High voltage and High current for testing purposes
5. Learn the basic measurement of High voltage and High current for testing purposes.
6. Study the importance of different types of testing of highnd discuss the overvoltage phenomena and insulation coordination in power system.

Unit wise Measurable students Learning Outcomes:

After completion of the course students will be able to:

1. Analyse the electrical field distribution and breakdown strength of insulating materials.
2. Comprehend Breakdown phenomenon in gases.
3. Comprehend Breakdown phenomenon in solid and liquid insulation.
4. Understand the basic generation of High voltage and High current for testing purposes
5. Understand the basic measurement of High voltage and High current for testing purposes.
6. Compare importance of different types of testing of high voltage plant and discuss the overvoltage phenomena and insulation coordination in power system.

Class: Final year B. Tech Electrical Engineering Title of the Course: Battery Management System Course No.: UELPE0812	L	T	P	Credits
	03 hours per week	-	-	03

Course Pre-Requisite: Basic knowledge of electrical circuits and components. Understanding of battery technology and electrochemistry. Familiarity with control systems and software interfaces is recommended.

Course Description:
This course introduces the concept of Battery Management Systems (BMS) and their role in maintaining battery health throughout charging and discharging cycles using appropriate control strategies. It explains the architecture of BMS for enhancing battery lifespan through effective planning and monitoring of key parameters. The course also highlights the importance of BMS in electric vehicles and discusses efficient end-use technology alternatives that improve overall performance, safety, and energy utilization.

Course Learning Objectives:
The students will be able to
Explain battery fundamentals including structure, components, active materials, battery types, and performance characteristics.
Analyze the functional blocks of a Battery Management System including sensing, filtering, charge–discharge control, balancing, estimation, communication, and power management.
Integrate and evaluate BMS and system-level components through practical installation and integration.
Apply BMS architectures, estimation algorithms, software interfaces, and protection strategies for safe and reliable battery operation.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Explain battery fundamentals including structure, components, active materials, battery types, and performance characteristics.	Understand (L2)
CO.2	Analyze the functional blocks of a Battery Management System including sensing, filtering, charge–discharge control, balancing, estimation, communication, and power management	Analyze (L4)
CO.3	Integrate and evaluate BMS and system-level components through practical installation and integration.	Evaluate (L5)
CO.4	Apply BMS architectures, estimation algorithms, software interfaces, and protection strategies for safe and reliable battery operation.	Apply (L3)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1		1											
CO.2		3	2	2									
CO.3	1	2	2	3	2							1	1
CO.4	2	3	1	2			1	1					

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Battery Fundamentals Basic Structure of Batteries, Components, Active Material Types of Batteries: Primary, Secondary, Reserve Batteries Battery Characteristics: Theoretical Voltage, Capacity, Energy Density, Power Density, Cycle Life, Shelf Life, Battery waste management.	08
Unit 2: Functions of Battery Management Systems Sensing and Measurement Functions: Voltage, Current, and Temperature, Filtering Circuit: RC Filters, Battery Balancing Circuits: Passive and Active Balancing, Charge and Discharge Control, Estimation, Communication, and Power Management.	08
Unit 3: BMS Integration Cell Integration, Charger Integration, Load Integration, Pack Integration of Temperature Sensors, Current Sensors, Communication Modules Practical Session: BMS Installation and Integration	07
Unit 4: BMS Hardware Teardown Voltage Sensing, Temperature Sensing, Current Sensing, Communication, Charge Control, Discharge Control, Balancing, Power Management, Safety Management Control and Computation, Thermal Management	08
Unit 5: BMS Classification & Topology Types of BMS: Analog, Smart, Wireless, FET-based, and Contactor-based BMS Topologies: Centralized, Modular, and Distributed	07
Unit 6: Battery Parameter Estimation and Protection Features SOC Estimation: Methods, Pros and Cons SOH Estimation: Methods, Pros and Cons Cell Balancing: Passive and Active Algorithms BMS Software GUI: Parameter Monitoring, Configuration, and Testing Battery Protection Features: Over-voltage, Under-voltage, Overcurrent, Temperature Alarms, Short Circuit Protection	07

Text Books:

1. Davide Andriea, Battery Management Systems for Large Lithium-lon Battery Packs, Artech House Publishe. Unabridged edition (30 September 2010).
2. Rui Xiong, Weixiang Shen, Advanced Battery Management Technologies for Electric Vehicles, Wiley Publications, February 2019.
3. Battery Management Systems for Large Lithium-lon Battery Packs 1st Edition, Kindle Edition by Davide Andrea.
4. Thermal Management of Electric Vehicle Battery Systems (Automotive Series) 1st Edition, Kindle Edition give me links by Ibrahim Dinçer.

Reference Books:

1. Battery Management System for Future Electric Vehicles by Dirk Söffker.
2. Gregory Plett, "Introduction to battery-management systems" 2021
   https://www.coursera.org/learn/batterymanagement-systems 5
3. Plett, Gregory L. Battery management systems, Volume I: Battery modeling. Artech House, 2015.
4. Plett, Gregory L Battery management systems, Volume II: Equivalent-circuit methods. Artech House, 2015.
5. Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010
6. Pop, Valer, et al. Battery management systems: Accurate state-of-charge indication for battery-powered applications. Vol. 9. Springer Science & Business Media, 2008. .
7. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L "Battery Management Systems -Design by Modeling" Philips Research Book Series 2002

Unit Learning Objectives:

Students should be able to-

1. Describe the basic structure, components, and active materials used in batteries.
2. Analyze charge–discharge control, estimation, communication, and power management functions in BMS
3. Assess the integration of temperature sensors, current sensors, and communication modules in BMS.
4. Examine charge control, discharge control, balancing, and power management hardware components
5. Classify Battery Management Systems into analog, smart, wireless, FET-based, and contactor-based types
6. Apply battery protection strategies for over-voltage, under-voltage, over-current, temperature faults, and short circuits.
7. Either one ISE should be a simulation

Unit Outcomes:

By the end of this course, students will be able to:

1. CO1: Explain the functions and components of a Battery Management System, including sensing, control, and power management. {L2} {PO1, PO2, PO3}
2. CO2: Analyze different BMS topologies such as centralized, modular, and distributed, and understand their applications. {L3} {PO1, PO2, PO3}
3. CO3: Perform teardown and integration of BMS components, including voltage, temperature, and current sensing. {L3} {PO5, PO7}
4. CO4: Estimate battery parameters like SOC and SOH using various methods and algorithms and evaluate the protection features and safety mechanisms of BMS, including overvoltage, over-temperature, and short-circuit protection. {L4} { PO2, PO3, PO4 PO6, PO7, PO8}

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Computer Aided Power System Analysis **Course No.:** UELPE0813	**L**	**T**	**P**	**Credits**
	03 hours per week	-	-	03

Course Pre-Requisite: Students shall have the basic knowledge of:
Circuits and Networks, Power Systems I & Power Systems II

Course Description:
A Computer-Aided Power System course teaches electrical engineers to use software for analyzing, designing, and simulating power grids, covering load flow, fault analysis, stability, and optimization (like economic dispatch) using algorithms and tools such as PSCAD, focusing on computational methods for modern, reliable energy systems.

Course Learning Objectives:

1. Equipping students to model, analyze, and simulate power systems computationally.
2. Covering key areas like Y-bus/ Z-bus formation, load flow analysis, short circuit/ fault analysis, transient stability, state estimation, and optimal power flow, enabling them to use commercial software.
3. Develop their own algorithms for efficient system operation and security.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Develop the model of power system networks	Understanding (L2)
CO.2	Solve linear systems using computationally efficient methods	Applying (L3)
CO.3	Solve load flow problem to analyze the state of power systems	Applying (L3)
CO.4	Analyze power system under short circuit conditions and infer the results to design a protective system	Analysing (L4)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	3	1	3		1								
CO.2	3	1	1	2	3								
CO.3	3	2	2	1	2								
CO.4	1	3	3	3	2								

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Y bus and Z bus matrix Formation: Network Equation, Concept of Linear Graph, tree, cotree, Bus Incidence matrix, A, Formation of Y bus and Z bus by singular transformation, Z bus building algorithm without mutual coupling.	08
Unit 2: Solution of linear equations using Numerical method Solution of linear system of equations by Gauss Jordan method and Gauss elimination method, Triangular factorization, LDU factors, Inversion of the YBUS matrix for large systems, Tinney's Optimally Ordering. (Numerical Expected)	08
Unit 3: Load Flow Analysis Review of Load Flow, Newton-Raphson method, Fast Decoupled Load Flow, DC Load Flow. (Numerical Expected)	07
Unit 4: Economic Load Dispatch Analysis Review of Economic Load Dispatch, Economic dispatch of generation without and with transmission line losses, Concept of optimal power flow, formulation with equality and inequality constraints (with active power cost minimization), Solution of OPF using Gradient and Newton method, Security Constrained Optimal Power Flow.	08
Unit 5: Fault Analysis Symmetrical and Unsymmetrical fault calculations using ZBUS, Symmetrical faults up to 3 bus systems, Algorithm for SC calculations for balanced 3 phase networks, Three phase to ground fault only. (Numerical Expected).	07
Unit 6: Contingency Analysis and State estimation: Contingency calculation using Z bus and Y bus table factors, State estimation, least square and weighted least square estimation method for linear system.	07

Textbooks:

1. Stagg and E l Abiad, "Computer Methods in Power System Analysis", McGraw Hill, 1968.
2. G. L. Kusic, Computer Aided Power System Analysis, PHI, 1989.
3. John J. Grainger, William D. Stevenson, Jr., Power System Analysis, Tata McGraw-Hill Series in Electrical and Computer Engineering.
4. D P Kothari and I J Nagrath, Modern Power System Analysis, Tata Mc Graw Hill, Fourth Edition, 2013

Reference Books:

1. I.J. Nagrath and D. P. Kothari, "Modern Power System Analysis", Tata McGraw Hill, 1980.
2. J. Arrillaga and N.R. Watson, Computer Modelling of Electrical Power Systems, 2/e, John Wiley, 2001
3. L. P. Singh, "Advanced Power System Analysis and Dynamics", 3/e, New Age Intl, 1996.
4. M. A. Pai, Computer Techniques in Power Systems Analysis, Tata McGraw-Hill, Second edition 2005.
5. Arthur R. Bergen, Vijay Vittal, Power Systems Analysis (English) 2nd Edition, Pearson Higher Education
6. Wood, Allen J., Bruce F. Wollenberg, and Gerald B. Shuble. Power generation, operation, and control. John Wiley & Sons, 2013

Unit Learning Objectives:
To make students to

1. Implement contingency analysis using network sensitivity methods.
2. Analyse power system faults (symmetrical & unsymmetrical) using computer METHOD.
3. Apply symmetrical components for fault calculations
4. Understand power system stability concepts through computational models
5. Develop programs for various power system operations and analysis tasks
6. Perform state estimation to monitor real-time system conditions and detect bad data.

Unit Outcomes:
After completion of the unit, students will be able to,

1. Develop mathematical models for power system components and networks (e.g., Y-bus matrix).
2. Solve power flow problems using methods like Gauss-Seidel, Newton-Raphson, and Fast Decoupled Load Flow (FDLF) to determine system states.
3. Analyze symmetrical and unsymmetrical faults (short circuits) using techniques like Z-bus matrix formation.
4. Formulate and solve problems related to economic dispatch and optimal system operation.
5. Implement algorithms for real-time state estimation and bad data detection in power systems.
6. Develop and apply computer programs/algorithms for various power system studies.

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** PE-V EHVAC **Course No.:** UELPE0814	**L**	**T**	**P**	**Credits**
	03 hours per week	-	-	03

Course Pre-Requisite:
Students shall have basic knowledge of Power Systems Operation, Stability & Control

Course Description: The course provides EHVAC Transmission Lines and its increasing demand, different types of losses in HVAC Transmission components. Voltage gradient and Corona Loss, In-depth knowledge of Travelling Waves and Standing Waves. Insulation Coordination and Lightning Phenomenon in High Voltage Equipment's, Overvoltage's and Surges in EHV Transmission caused during switching operations, Power Frequency Voltage Control and Overvoltage's.

Course Learning Objectives:
At the end of the course students will be able to:

1. Explain calculation of EHVAC line parameters.
2. Explain voltage gradients and corona effects.
3. Determine over-voltages and protection.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Understand the various Extra High Voltage levels power handling capacities and line losses.	Understand (L2)
CO.2	Understand multiconductor lines, corona losses, and heat losses.	Understand (L2)
CO.3	Determine Different Travelling Waves and Standing Waves.	Evaluate (L5)
CO.4	Determine Insulation Coordination, Power Frequency Voltage Controls, Over Voltages & Lightning Protection.	Evaluate (L5)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	3	2							1		1	1	1
CO.2	3	2							1		1	1	1
CO.3	3	2							1		1	1	1
CO.4	3	3							1		1	1	1

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Fundamentals of EHVAC Transmission: Fundamentals of construction of EHVAC transmission, lines Standard transmission voltages, growth of EHVAC Transmission line, trends and preliminaries, power handling capacity and line losses, calculation of line and ground parameters, transient stability limit, and surge impedance loading. Resistance of conductor and power loss, temperature rise and current carrying capacity of conductor, properties of bundled conductors, calculation of inductance and capacitance of bundled conductor, calculation of sequence inductances and capacitances, line parameters for modes of propagation.	07
Unit II- Voltage gradients of conductor and corona loss: Charge-potential relations for multi-conductor lines, surface voltage gradient on conductor, distribution of voltage gradients on sub conductors of bundle. I^2R and corona loss, corona-loss formulae, charge-voltage diagram and corona loss, attenuation of traveling waves due to corona loss, Audible noise, corona pulses: their generation and properties, limits for radio interface fields.	07
Unit III- Theory of the Traveling waves and standing waves: Travelling and standing waves at the power frequency, differential equations, and solutions for general case, standing waves and natural frequencies, open ended line: double exponential response and response to sinusoidal Excitation, line energization with trapped charge voltage, reflection, and refraction of traveling waves.	08
Unit IV- Lightning and lightning protection & Insulation Co-ordinations: Lightning strokes to lines, their mechanism, General principle of the lightning protections problems, tower footing resistance, lightning arrestor's and protective characteristics, Insulation level, Voltage withstands levels of protected equipment and insulation coordination based on lightning.	07
Unit V- Over voltage in EHV system caused by switching operations: Origin of over-voltages and their types, short circuit current and circuit breaker, recovery voltage and circuit breaker, over-voltages caused by interruption of low inductive and capacitive currents, Ferro-resonance over-voltages, calculation of switching surges- single phase equivalents.	08
Unit VI- Power frequency voltage control and over voltages: Generalized constants, no load voltage conditions and charging current, power circle diagram and its use, cascade connection of components: shunt and series compensation, sub-synchronous resonance in series capacitor Generalized constants, charging current, Voltage control shunt components, Voltage control series components, Sub synchronous resonance in series capacitor compensated lines, static reactive compensating systems.	08
Textbooks: 1. Rakosh Das Begamudré," Extra high voltage AC transmission engineering", New Age Publication. EHV -AC and HVDC transmission system engineering analysis and design: John Wiley& sons. 2. EHV –AC and HVDC Transmission Engineering & Practice: S. Rao, Khanna Publishers, 3rd Edition, 2012.	
Reference Books: EHV -AC and HVDC Transmission System Engineering Analysis and Design: John Wiley & Sons. Introduction to the Smart Grid: Concepts, Technologies and Evolution, S. K. Salman, IET Energy Engineering Series, 2017, 1st Edition.	

Unit wise Learning Objectives:

Unit Learning Objectives:

To make students to

1. Learn the Extra High Voltages Levels and Gradual rise of Extra High Voltage Transmission lines.
2. Understand the Voltage Gradients and phenomenon of Corona Loss.
3. Understand the theory of Travelling waves.
4. Understand the Insulation Coordination and Lighting Protection of Power System Equipment's.
5. Understand Overvoltage's in EHV System components.
6. Explain Power Circle Diagrams and generalized constants for different conditions.

Unit Outcomes:

After completion of the unit, students will be able to,

1. Understand the various Extra High Voltage levels power handling capacities and line losses, Calculation of line and ground parameters, resistance of conductor, calculation of inductance and capacitance of bundled conductors. (CO1, CO2).
2. Understand multiconductor lines, corona losses, and heat losses. (CO2).
3. Determine Different Travelling Waves and Standing Waves. (CO3).
4. Determine Insulation Coordination, Lightning Protection (CO1, CO4).
5. Power Frequency Voltage Controls and Over Voltages (CO1, CO4).
6. Power Circle Diagrams (CO1, CO4).

	L	T	P	Credits
Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Wide Area Measurement Systems **Course No.:** UELPE0815	03 hours per week	-	-	03

Course Pre-Requisite:
Students should have basic knowledge of power systems, instrumentation and measurements.

Course Description:

Course Learning Objectives:
At the end of the course students will be able to
1. Understand the need for WAMS.
2. Apply different methods for phasor computation and communication.
3. Analyze the Synchrophasor standards and the changes to the standards over the years.
4. Use WAMS data for power system monitoring and control applications.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Understand the structure and need for WAMS.	Understand (L2)
CO.2	Apply different techniques to compute and communicate power system variables.	Apply (L3)
CO.3	Analyze different Synchrophasor standards.	Analyse (L4)
CO.4	Evaluate different applications of WAMS data.	Evaluate (L5)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1		2	2									2	1
CO.2			2	2	3	2						1	1
CO.3						1	3				2	1	1
CO.4				2	2							1	1

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Introduction to the WAMS Architecture and structure of WAMS, Need for WAMS, WAMS vs SCADA, Synchrophasor, frequency, Rate of change of frequency	07
Unit 2: Phasor Measurement Units Steady state and dynamic conditions in power systems, History of PMUs, PMU Algorithms, Importance of the Model used for Phasor Estimation, Accuracy indices, Optimal placement of PMUs, Simulation-based demos.	08
Unit 3: International Standards for PMUs IEEE Synchrophasor standards, IEEE 1344-1995, IEEE C37.118, IEEE C37.118.1, IEC IEEE 60255-118-1, Basics of PMU testing procedures, Static tests, Dynamic tests, Compliance requirements as per different IEEE standard.	08
Unit 4: Phasor Data Concentrators and Communication links Structure of a PDC, types of PDC, software and PDC, Application of PDC, Communication structure for WAMS, IEEE C37.118.2 for data transfer in WAMS.	07
Unit 5: WAMS data applications Offline, Online and Real-time applications of WAMS, Voltage stability assessment, Wide-Area Voltage and Frequency Monitoring, State Estimation, Post-Mortem analysis, Power System Stability control using WAMS data.	07
Unit 6: Wide Area Monitoring Protection and Control Basics of WAMPAC, Structure of WAMPAC, Structure of WAMS in control and Management systems, Managing Oscillations in power systems using WAMS, Managing disturbances using WAMS, Constraint Relief in transmission and distribution systems using WAMS, Real life examples of Wide Area Measurement Systems.	08

Textbooks:

1. Phasor Measurement Units and Wide Area Monitoring Systems-“From the Sensors to the System”
    a. Antonello Monti, Carlo Muscas and Ferdinanda Ponci, Copyright © 2016 Elsevier Inc
2. Synchronized Phasor Measurements and Their Applications, Arun G. Phadke and James S Thorp, Springer International Publishing AG 2017.
3. Wide Area Power Systems Stability, Protection, and Security, Hassan Haes Alhelou, Almoataz Y. Abdelaziz, Pierluigi Siano, Springer Cham 2020.

Reference Books:

1. Securing Wide Area Measurement Systems, M.D Hadely, J.B Mc Bride, T.W. Edgar, L.R. O’Neil, J.D. Johnson, PNNL, US Department of Energy, 2007

Unit wise Learning Objectives:

The students will

1. Understand the need for the upgradation of the present power system measurement and communication infrastructure. (CO1)
2. Learn about the different components of the WAMS, including PMUs, PDCs and communication links. (CO2)
3. Analyze different standards associated with the Phasor Measurement Units measurement accuracy. (CO3)
4. Analyze different standards associated with WAMS communication. (CO3)
5. Use WAMS data for offline, online and real-time applications. (CO4)
6. Apply WAMS data for Wide Area Monitoring Protection and Control systems. (CO4)

Unit Outcomes: After completion of each unit the students will be able to

1. Explain the architecture, structure, and need for Wide Area Measurement Systems, and differentiate WAMS from conventional SCADA systems.
2. Analyze PMU operation under steady-state and dynamic power system conditions, evaluate phasor estimation algorithms and accuracy indices, and determine optimal PMU placement.
3. Interpret and apply international synchrophasor standards (IEEE 1344, IEEE C37.118 series, IEC/IEEE 60255-118-1) to assess PMU performance, testing procedures, and compliance requirements.
4. Describe the structure and functionality of Phasor Data Concentrators and analyze WAMS communication architectures, including data transfer mechanisms as per IEEE C37.118.2.
5. Apply WAMS data for offline, online, and real-time power system applications such as voltage stability assessment, state estimation, wide-area monitoring, and post-event analysis.
6. Analyze Wide Area Monitoring, Protection, and Control (WAMPAC) schemes and evaluate the use of WAMS for oscillation damping, disturbance management, constraint relief, and real-world power system applications.

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Smart Grid **Course No.:** UELPE0816	**L**	**T**	**P**	**Credits**
	03 hours per week	-	-	03

Course Pre-Requisite:
Students should have the basic knowledge of power system generation, transmission and distribution.

Course Description: The students will learn about the basics of the smart grid including its design, components and working. This course will help students understand the need for the upgradation of the conventional grid.

Course Learning Objectives:
At the end of the course students will be able to
1. Understand the importance of the smart grid.
2. Apply different tools for evaluating the performance of the smart grid.
3. Analyse the role of DERs in the smart grid architecture.
4. Analyse smart grid measurement technologies.
5. Evaluate the performance and advantages of different methods used for control of power in smart grids.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Taxonomy Descriptor
CO.1	Understand the basics of Smart grid architecture	Understand (L2)
CO.2	Analyze the role of DERs in the smart grid architecture.	Analyse (L4)
CO.3	Analyze measurement and communication technologies employed in Smart grid.	Analyse (L4)
CO.4	Evaluate methods used for the control of power in Smart Grid.	Evaluate (L5)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO.1	2	3	3		3	3							
CO.2		2	2	2	2								
CO.3					2	3						2	
CO.4			2	3	3							1	2

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc.
- **MSE:** Assessment is based on 50% of course content (Based on first three units).
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:	Hours
Unit 1: Introduction to the Smart Grid Working definitions of Smart Grid, Smart grid Functions, Traditional Power Grid versus Smart Grid, Indian Smart Grid, Key challenges for Smart Grid.	07
Unit 2: Smart Grid Architecture Components and architecture of smart grid design, Fundamental components of Smart designs, Transmission and Distribution automation, Renewable Integration.	07
Unit 3: Tools and Techniques for Smart Grid Computational techniques, Static and Dynamic Optimization techniques, Computational intelligent techniques, Evolutionary algorithms, artificial intelligence techniques.	08
Unit 4: Distributed Generation Technologies Renewable Energy Technologies, Micrografts, Storage technologies, Allocation of Energy Storage systems, Electric vehicles and plug-in hybrids, Environmental impact and climate change.	08
Unit 5: Communication Technologies of Smart Grid Wide Area Measurement Systems, Phasor Measurement Units, IEEE Standard for Synchrophasor Measurements, Communication links, Communication protocols and standards in smart grids, Phasor Data Concentrators (PDC) functions and applications.	08
Unit 6: Control of Power in Smart Grid Demand Response, Demand Side Management, Energy Consumption Scheduling, Load Frequency Control (LFC) in Microgrid System, Voltage Control in a Microgrid System.	07

Textbooks:

1. Power System SCADA and Smart Grid, Mini S Thomas and J. D Mac-Donald, CRC Press, 2015, 1st Edition.
2. Smart Grid Applications and Developments, D. Mah, P. Hills, Victor O.K. Li, R. Balme, Springer-Verlag London, 2014, 1st Edition.
3. Smart Grid: Technology and Applications, J. Ekanayake, N. Jenkins, K. Liyanage, J. Wu, A. Yokoyama, John Wiley & Sons, 2015, 1st Edition.

Reference Books:

1. Smart Grid: Fundamentals of Design and Analysis, J. Momoh, Wiley-IEEE Press, 2012, 1st Edition.
2. Introduction to the Smart Grid: Concepts, Technologies and Evolution, S. K. Salman, IET Energy Engineering Series, 2017, 1st Edition.
3. Power System Stability and Control, Prabha Kundur, McGraw Hill Education, 2006, 1st Edition.
4. Synchronized Phasor Measurements and Their Applications, Arun G. Phadke and James S Thorp, Springer International Publishing AG 2017.
5. Wide Area Power Systems Stability, Protection, and Security, Hassan Haes Alhelou, Almoataz Y. Abdelaziz, Pierluigi Siano, Springer Cham 2020.

Unit wise Learning Objectives:

The students will

1. Understand the need for smart grids. (CO1)
2. Understand basics of smart grid architecture. (CO1)
3. Apply mathematical tools for smart grid analysis. (CO1)
4. Analyze the role of DERs in the smart grid architecture. (CO2)
5. Analyze measurement and communication technologies employed in Smart grid. (CO3)
6. Compare different methods used for the control of power in the smart grid. (CO4)

Unit Outcomes:

After completion of the unit, students will be able to,

1. Explain the concept, functions, and objectives of the Smart Grid and differentiate it from the traditional power grid. (CO1)
2. Describe and analyze the architecture and fundamental components of Smart Grid systems, including transmission and distribution automation and renewable energy integration. (CO1)
3. Apply computational, optimization, and artificial intelligence–based techniques to solve planning, operation, and control problems in Smart Grid systems. (CO1)
4. Analyze distributed generation technologies, microgrids, energy storage systems, and electric vehicles, and evaluate their environmental impact and role in Smart Grid operation. (CO2)
5. Explain the role of communication technologies in Smart Grids, including WAMS, PMUs, Synchro phasor standards, communication protocols, and PDCs. (CO3)
6. Analyze and implement control strategies for reliable operation of Smart Grid and microgrid systems. (CO4)

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Project-II **Course No.:** UELIL0871	**L**	**T**	**P**	**Credits**
	-	-	08	04

Course Pre-Requisite: Knowledge of courses in Electrical engineering studied till sem VII Hands on skills for working with circuits and machines, aptitude to learn in varied environments.

Course Description:

Project is an activity of developing solutions to a problem statement involving complex problems relevant to core engineering field. The implementation requires use of engineering knowledge for problem analysis, conduct investigations, design and develop the solution. This may include, software, and other related processes. It expects teamwork and management of resources and activities.

1. A group consisting of not more than 4 students will work on one project. The theme/ problem statement of the project will be identified by the group. Approval of the theme will be as per defined rubrics by a faculty level committee. The project work will be carried out in two phases. Phase 2 will be carried out as this course Project – II
2. Under this course the group will submit the synopsis of project, complete literature survey, methodology, prepare a detailed system design, layout etc.
3. The group will maintain a logbook of progress of the project activities. The logbook should have entries related to the work done, problems faced, solutions evolved etc. duly signed by internal guide.
4. Each student of the project group will deliver a seminar on latest topics related to proposed project and submit a joint seminar report consisting of Literature survey, basic proposed project work. Size of the report should be at least 30 pages.
   (Refer to the evaluation document on the institute website for further details.)

Course Objectives: The course aims to develop following abilities of a student-

1. To apply engineering knowledge in practical problem solving
2. To think in innovative/ creative way, conduct investigations in design of products, processes, or systems while in finding engineering solutions to societal and/or professional problems.
3. To function effectively as a member of heterogeneous team and in multidisciplinary environment.
4. To communicate effectively, observe/follow ethics while working, use management techniques in carrying out a work.
5. Lifelong learning

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Taxonomy Descriptor**
CO1	Practice ethical principles and work effectively in a team	Applying (L3)
CO2	Implement management techniques while executing a complex task in multidisciplinary environment.	Applying (L3)

CO-PO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO.1	3	3	3	3	2	2	2	2	3	3	3	2	2
CO.2	3	3	3	3	2	2	2	2	3	3	3	2	2

Assessments: Teachers' assessment-

In Semester Evaluation (ISE), and End Semester Examination (ESE) having weightage as follows.

Assessment	Marks
ISE	50
ESE(OE)	50

ISE is based on at least two of the assessment tools. ISE marks shall be based on the report covering Literature Survey, Problem identification, Objectives and Methodology and Seminar presentation and the logbook records.

ESE Assessment is based on performance in an oral test at the end of the semester.
(Refer to the evaluation document on the institute website for further details.)

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Internship **Course No.:** UELIL0872	**L**	**T**	**P**	**Credits**
	-	-	**12**	**6**

Course Pre-Requisite: Ater the completion of VII semester students are eligible for Internship.

Course Description:

Internship is an integral part of the academic curricula. Its satisfactory completion is a mandatory requirement for the degree to be awarded by the College. Further, considering the curriculum structure approved by the college, multiple internships modes are possible, and are assigned academic credits within the curricula. The general structure of the internship requires the students to undertake an immersive assignment within the assigned organizations for a limited period. The internship offers the students an opportunity to gain hands-on industrial or organizational exposure; to integrate the knowledge and skills acquired through the coursework; interact with professionals and other interns; and to improve their presentation, writing, and communication skills. Internship often acts as a gateway for final placement for many students. The internship will benefit students by getting real time industry experience and exposure, exploring the career opportunities, add values, skills, and experience to their CV and learn company culture.

Course Objectives:

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. Following are the intended objectives:

- To expose the students to industrial environment (viz. various materials, processes, products and their applications along with relevant aspects of quality control which cannot be simulated in the classroom) for application of existing engineering knowledge in industrial situations
- To provide possible opportunities to learn and sharpen the real time technical and managerial skills required for professional career
- Understand the social, environmental, economic and administrative considerations that influence the working environment [PO 6, 7]
- To expose students to the engineer’s responsibilities and ethics [PO 8]
- To get acquainted with the working styles of industries at different hierarchy and learn to work in a team [PO 9] To gain experience in all types of professional communications (viz. pre internship applications, during internships people skills and documentation skills and post internship reports/projects writing skills) [PO 10]
- To demonstrate the impact of the internship on their lifelong learning and professional development [PO 12]
- To provide the linkages of future job/research opportunities to students in the organization [PO 12]

Mode of Execution

Internship may be done through following verticals through offline /online mode

I. Full time Industry Internship cum project (4 to 6 months)

II. Full time research internship at research organization/ Indian University/ Foreign University (4 to 6 months)

III. Short duration (2 to 3 months) internship in industry within house project.

IV. Internship accounted through incubation Centre (Project Prototype through entrepreneur development and start-up)

Assessments:

Assessment	Weightage (Marks)
ISE-1	75
ISE-2	75

- **ISE-1 and ISE-2:** Assessment is based on Evaluation done by industry person & Presentations at department level.

For detailed policy documents & all formats related to Internships kindly refer (KIT Internship Policy Document-2024-25.pdf).

Class: Final Year B. Tech Electrical Engineering **Title of the Course:** Co-Curricular Activities-IV **Course No.:** UELCC0831	**L**	**T**	**P**	**Credits**
	-	-	**2**	**01**

Course Pre-Requisite: This course is open to all second-year engineering students interested in enhancing their personal and professional development through co-curricular activities.

Course Description:

Co-Curricular activities are an integral part of curriculum which provides educational activities to the students and thereby help in broadening their experiences. Co-Curricular activities can be defined as the activities that enhance and enrich the regular curriculum during the normal college hours. All Co- Curricular activities are organized with specific purpose which may according to the nature and form of activities. This course introduces students to a variety of co-curricular activities aimedat enhancing their professional and personal development within the field of engineering and technology. Through practical projects, competitions, workshops, and community engagement, students will develop teamwork, leadership, communication, and technical skills essential for success in their careers.

Course Objectives:

1. To encourage students to show case their intellectual and independent thinking skills.
2. To imbibe sense of confidence and managerial capabilities among students.
3. To promote the ability to work in team, organize and analyze available resources.
4. To build responsiveness among students about the social and cultural responsibilities.

Course Outcomes:

COs	After the completion of the course the students will be able to
CO.1	**Demonstrate** the ability to critically analyze information and apply independent judgment in decision-making within the context of the activity.
CO.2	**Apply** principles of management and organizational skills to plan, coordinate, and execute tasks related to the co-curricular activity.
CO.3	**Collaborate** effectively with peers to achieve common goals and objectives within the co-curricular activity.
CO.4	**Reflect** on the in roles and responsibilities as members of a diverse community, fostering empathy and inclusivity.

Assessments:

Assessment	Weightage (Marks)
ISE	50

- **ISE:** Assessment is based on the student's participation in various Co-Curricular Activities and Guidelines given in "Rules for Assigning Activity Points: Activity – Event Grade Point Scheme" Policy Document.

Course Guidelines:

1. Students are entitled to gain academic knowledge in this fast-paced environment, but it is also necessary for them to develop their personalities in both internal and external situations.
2. Co-curricular activities help students grow and develop their personalities. These activities contribute to a student's total personality development.
3. Not every student is intellectually inclined. Similarly, not all pupils are interested in co-curricular activities.

Therefore, there is a need to provide a solid balance of co-curricular and extra-curricular activities in order to achieve the course learning objectives.

4. It primarily refers to intellectual, physical, emotional, and social growth that can be attained by a careful mix of academic, co-curricular, and extra-curricular activities.
5. So, keeping the course learning objectives the "Rules for Assigning Activity Points: Activity–Event Grade Point Scheme" Policy Document is proposed.
6. Student participation is assessed and reflected in the final activity performance report in order to get most students involved in extra-curricular activities (Group A) and co-curricular activities (Group B) as shown in Table 1 in the Policy Document.
7. All undergraduate students must choose at least ONE activity/event from each group i.e. (Group A and B).
8. Students shall choose one activity/ event from Group A and One from Group B that take place on- campus or off-campus.
9. Freedom shall be given to the students to take part in more than one activity under the group.
10. Students are expected to actively participate in activities, participate in contests, and earn grade points.
11. One student in each group must earn up to 50 grades in one semester so that they can achieve up to 100 grades in one year.
12. Grades for each semester are awarded based on the points achieved by the student, as shown in Table 2 in the Policy Document.

Course Structure: ***(Refer Rules for Assigning Activity Points: Activity –Event Grade Point Scheme)***

Sr. No.	**Initiatives**	**Criteria, Activities and Assignments**
1	Introduction to Co- Curricular Activities	Orientation, Induction, Course Overview
2	National Initiatives Participation	Participation, Achievement Levels and Assigned Activity Points in NCC, NSS, Unnat Bharat/ Unnat Maharashtra Abhiyan, Ek Bharat Shreshtha Bharat (EBSB)
3	Sports and Games Participation	Participation, Achievement Levels and Assigned Activity Points in Sports and Games
4	Cultural Activities Participation	Participation, Achievement Levels and Assigned Activity Points in Music, Performing Arts, Literary Arts
5	Professional Self Initiatives	Participation, Achievement Levels and Assigned Activity Points in 1. Technical Events/ Quiz/ Paper Contest/ Project Contest/ Model Making etc. 2. MOOC/NPTEL/SWAYAM/Coursera etc. 3. Competitions/EventsConductedbyProfessionalSocieties (ISTE, IEI, CSI, IEEE, IETE, SAE, ISRO-IIRS, SWE, ISHRAE, ASM, ISNT etc.) 4. Attending Full time Conference/ Seminars/ Exhibitions/ 5. Workshop/ STTP Conducted at IITs/ NITs/ Reputed Institutes/ Universities 6. Attending Full time Conference/ Seminars/ Exhibitions/ Workshop/ STTP Conducted at KITCoEK 7. Paper Presentation in National/ International Conference of High Repute 8. Poster Presentation in National/ International Conference of High Repute

		9. Paper Publication in National/ International Journal of High Repute 10. Industrial Training/ Internship(at least for 04Weeks) 11. Participation in Institute Level Student Clubs
6	Entrepreneurship and Innovation	Participation, Achievement Levels and Assigned Activity Points in 1. Prototype Developed and Tested 2. Awards for Products Developed 3. Innovative Technologies Developed and Used by Industries 4. Got Funding from Government/ Industry for Innovative Ideas 5. Patent-Filed/ Published/ Approved/ Licensed 6. Social Innovations
7	Leadership& Management of Clubs/ Activities	Participation, Achievement Levels and Assigned Activity Points in 1. Elected Student Representative of Student Council (University Representative, General Secretary, Cultural, Sports, NSS 2. Secretary, Ladies Representative, Academic Toppers, Invitee Members) 3. Office Bearer of Professional Society Chapter (ISTE,IEI,CSI, IEEE, IETE, SAE, ISRO-IIRS, SWE, ISHRAE, ASM, ISNT 4. etc.) 5. Office Bearer of Institute Level Student Club (Developer Student Club, Gaganvedhi, Walk With World, Team 6. Mavericks, Cultural Club, Aura, Amateur Write Club, Rotaract Club of KIT Sunshine, Women Development and Gender 7. Equality Cell, Shourya, Lead India etc.) 8. Office Bearer of Departmental Student Association 9. Office Bearer of ECell, Digital Content Lab etc. 10. Student Ambassador for Mayura AICTE IDEA Lab/ NIDHI iTBI etc. 11. Editorial Board Member of Annual Magazine 12. Editorial Board Member of E-Newsletter 13. Member of Governance Committee/Statutory Committee
8	Culminating Event and Reflection	Final Presentations, Course Reflection, Documentation, Assessment and Evaluation

Participation Levels:

1. Level: I — College Level Events
2. Level: II — District/ Central/ Zonal Level Events
3. Level: III — State Level Events
4. Level: IV — National Level Events
5. Level: V — International Level Events

Approval Documents:

1. Certificate
2. Letter from Authorities
3. Appreciation recognition letter
4. Documentary evidence
5. Legal Proof

Grading Scheme:

Grade Range	Grade	Academic Performance
90-100	O	Outstanding
71 to 90	A+	Excellent
68-71	A	Very Good
65-68	B+	Good
60-65	B	Average
55-60	C	Below Average
50-55	D	Marginal
<50	F1	Fail due to Poor Performance

Dr. M. K. Aalam
BoS, Chairman

Dr. Akshay Thorvat
Dean Academics

Kolhapur Institute of Technology's College of Engineering (Autonomous) Kolhapur
Dept. of Electrical Engineering