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

Department of Electrical Engineering
Curriculum and Syllabus for
T.Y. B. Tech. Electrical Engineering
Scheme: 2024-25 (As Per NEP)

SEMESTER V

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme Component			
1	PC	UELPC0501	Control Systems	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
2	PC	UELPC0502	Electrical Utilization & Traction	2	-	-	2	2	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
3	PC	UELPC0503	Power System Analysis	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
4	PEC	UELPE051X	Program Elective-I	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
5	OE	UELOE052X	Open Elective -I	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
6	HSSM	UELHS0501	Business Planning & Strategy	2	-	-	2	2	ESE	50	20	20
7	PC	UELPC0531	Control System Laboratory	-	-	2	2	1	ISE	25	10	
									ESE (POE)	25	10	
8	PC	UELPC0532	Power System Analysis Laboratory	-	-	2	2	1	ISE	25	10	
									ESE (OE)	25	10	
9	VSEC	UELVS0531	Python For Electrical Engineering	-	-	2	2	1	ISE	25	10	
10	CEP	UELIL0531	Community Engagement Project	-	-	2	2	1	ISE	25	10	
11	MM	U**MM0***	Multi-Disciplinary Minor -III	3	-	-	3	3	ESE	100	40	40
							Total: 28	23	**Total Marks: 800** **Total Credit: 23**			

PROGRAM ELECTIVE - I							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UELPE0511	Microcontroller & Microprocessor	3	-	-	3	3
2	UELPE0512	Material Science Engineering	3	-	-	3	3
3	UELPE0513	Renewable Energy Sources	3	-	-	3	3
					Total:	**3**	**3**

OPEN ELECTIVE - I							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UILOE0525	Agile Project Management	3	-	-	3	3
					Total:	**3**	**3**

Dr. M.K. Aalam
BOS Chairman

Department of Electrical Engineering

Dr. Akshay Thorvat
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Kolhapur

Title of the Course: Control Systems Course Code: UELPC0501	L	T	P	Credit
	03	-	-	03

Course Prerequisites:
1. Calculus and Transforms/Engineering Mathematics
2. Signals and Systems
3. Programming with MATLAB
4. Electric Circuits & Simulation Lab

Course Description:
This course deals with the fundamentals of classical control system and analysis which include both the practical and the theoretical aspects. This course provides an overview of classical control systems for undergraduate level and covers mathematical modeling of physical control systems in the form of differential equations and transfer functions, system performance indices of feedback control systems via class techniques such as root-locus and frequency-domain methods, state space analysis.

Course Objectives:
1. This course provides knowledge of time domain and frequency domain system analysis
2. This course helps in formulating mathematical models of physical systems.
3. This course intends to model a physical system that is useful control point of view.
4. This course intends to introduce various analysis techniques determining performance features of the systems.

COs	After the completion of the course the students will be able to	Bloom's Level	Descriptor
CO1	Interpret and analyze systems in time domain and frequency domain	4	Analyzing
CO2	Formulate the mathematical models of any physical systems	4	Analyzing
CO3	Determine the response of different order systems for various standard signal.	5	Evaluating
CO4	Develop, analyze and interpret the models.	6	Creating

PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	2	3						1	1	
CO2	3	3		2	2						1	1	
CO3	2	2	1	2							2	3	2
CO4	2	2	3	2	3						2	3	3

Assessments:

Teacher's assessment-

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

Assessment	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc. MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content. (Normally the last three modules) covered after MSE.

Course Contents:	
Unit I: Introduction to Control Engineering Feedback principle, examples of open-loop and closed-loop systems, Classification of feedback control systems, Effects of feedback, Introduction to stability of a system.	**06Hrs**
Unit II: Components of Control Systems Mathematical representation of simple mechanical, electrical, thermal, hydraulic system. Block diagram representation and reduction. Signal flow graph. Transfer function of these systems. Pole zero concepts, Real world application	**08Hrs**
Unit III: Modeling of Systems and their Representations Transfer function of typical control- system devices. Block diagram, Signal flow graphs, State-variable representation and state-diagram. Different Canonical forms, Eigenvalues Controllability, Observability. MATLAB assignments, Real world application	**08Hrs**
Unit IV: Time Domain Analysis Servo specifications intime domain, type0,1, 2systemsanderrorcoefficients.Analysis of steady state error, Type of system and steady state error, Time response specifications. Stability: Routh Hurwitz Criterion. Root locus techniques, Real world application	**07Hrs**
Unit V: Frequency Response Analysis Correlation between Time Response and Frequency Response, Graphical Representation-Bode plot and relative stability criteria, Stability, Gain Margin and Phase Margin via Bode plots [Numerical Treatment], Polar plots and Nyquist stability criterion, Nichols's chart, Lead- Lag Compensators [Numerical Treatment].	**08Hrs**
Unit VI: Discrete Control Systems: Digital Control System Basics, Z-Transform Analysis, Controller and Compensator Design, Deadbeat Control	**08Hrs**

Textbooks:

1. Control System Engineering, Norman S. Nise,6thEdition, JohnWileyandSons,2012
2. Control Systems, M. Gopal, 4thEdition, AnshanPublishers,2012.
3.ControlSystems,2ndEdition, N.C. Jagan, BS Publications
4.Advanced Control Engineering, R.S. Burns, Butterworth Heinemann,2001.

Reference Books:

1.Basic Control Systems Engineering, Paul H. Lewis &Chang Yang, Pentice Hall
2.Modern Control Engineering, Eastern Economy, K. Ogata,5thEdition, 2010.

Title of The Course: Electrical Utilization and Traction Course Code: UELPC0502	L	T	P	Credit
	02	-	-	02

Course Pre-Requisite: Knowledge of Electrical Machines, Power Electronics, Drives and Power System.

Course Description:

This course primarily deals with utilization of electrical energy generated from various sources. It is important to understand the technical reasons behind selection of motors for electric drives based on the Characteristics of loads. Electric heating, welding and illumination are some important loads in the industry in addition to motor/drives.

Course Objectives:

- This Course provides an introduction to the principles of electrical drives and their applications in daily life.
- This course provides basic knowledge of Heating and Welding.
- This course deals with the fundamentals of illumination and its classification.
- This course provides knowledge on electrical traction systems and their controlling.

Course Outcomes:

COs	After the completion of the course the students will be Able to	Blooms level	Descriptor
CO1	To understand the operating principles and characteristics of traction motors with respect to speed, temperature and loading condition	1	Remember
CO2	To acquaint with the different types of heating and welding techniques	2	Understand
CO3	To study the basic principles of illumination and its measurement	3	Applying
CO4	To understand and analyze the basic principle of electric traction including speed–time curves of different traction services	4	Analyze

PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2	3	1								3
CO2	3			3		3						2	
CO3	3	3	3		3	3						2	
CO4	3	3		3			3	3					2

Assessments:

Teachers' assessment-

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

Assessment	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

ISE 1 and ISE 2 are based on assignment / declared test/quiz/seminar/Group Discussions etc. MSE: Assessment is based on 50% of course content. (Normally first three modules)

ESE: Assessment is based on100% course content with 60-70% weightage for last three modules covered after MSE.

Course Contents:	
Unit 1: Electrical Drives: Type of electric drives, choice of motor, starting and running characteristics, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization, Applications of electrical motors in textiles mills, Mines cranes, Lifts, Excavators, Refrigerators & air conditioning, Heating, IOT based Lighting system.	**6Hrs.**
Unit 2: Electric Heating & Welding: **Heating**: Advantages of electrical heating, Resistance heating, Design of heating element in resistance oven, Control of temperature in resistance oven, Electric arc furnaces, Induction furnaces, Dielectric heating, Infrared heating and Microwave heating, **Welding**: Advantages of Electric Welding, welding methods, principle of resistance welding, types–spot, projection seam and butt welding, welding equipment used, principle of arc production, electric arc welding, characteristics of arc, carbon arc, metal arc, hydrogen arc welding, Modern welding techniques like Ultrasonic & Laser welding.	**8Hrs.**
Unit 3: Electrical Traction System: Different systems of traction, Advantages & disadvantages, Systems of track electrification, Speed-time curve, Tract effort, Adhesive weight, Coefficient of adhesion, Specific energy consumption, Power supply arrangements, Brief about the Current collecting systems, Desirable characteristics of traction motors, Suitable motors for traction, Control of D.C. traction motors, Shunt transition, Bridge transition, Regenerative braking, Concept of Monorail & Advance Traction.	**8Hrs.**
Unit 4: Illumination: Requirement of good lighting, Classification of light fitting & luminaries, Factor to be considered for design of indoor & outdoor lighting scheme, Design procedure for factory lighting, flood lighting & street lighting, Discharge lamps, MV and SV lamps comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control.	**8Hrs.**

Texts and references:

1. Taylor E.O., Utilization of Electrical Engineering', Longman.
2. Partab H.P.,' Art & Science of Utilization of Electrical Engineering 'Dhanpat Rai Publications.
3. Gupta J.B. 'Utilization of Electric Power & Electric Traction' S.K. Kataria &Sons.
4. Uppal S. L., 'Electrical Power', Khanna Book Publication.

Title of the Course: Power System Analysis Course Code: UELPC0502	L	T	P	Credit
	3	-	-	3

Course Pre-Requisite: Basic knowledge of transmission and distribution, Circuit theory.

Course Description: This course discusses the concepts of power system analysis, load flow techniques and power system stability.

Course Objectives:

1. To introduce the per unit system and explain its advantages and computation.
2. To explain the necessity and conduction of short circuit analysis.
3. To explain analysis of three phase symmetrical faults on synchronous machines.
4. To explain symmetrical components, their advantages, and the calculation of symmetrical components.
5. To explain formulation of network models and bus admittance matrix for solving load flow problems.
6. To explain solution methods like GS, NR and fast decoupled in load flow studies.
7. To explain numerical solution of swing equation for stability analysis.

Course Outcomes:

CO	After the completion of the course the student should be able to	Blooms level	Descriptor
CO1	**Understand the** per unit system, its advantages and calculation and get the knowledge of the various power system components, structure.	2	Understanding
CO2	**Analyze the** faults on power system, compute fault currents for protection and other studies.	4	Analyzing
CO3	**Evaluate the** formulation of bus admittance matrix for solving load flow problems	5	Evaluate
CO4	**Evaluate the** dynamics of synchronous machine, the concept of steady state stability, its evaluation, and its importance.	5	Evaluate

CO-PO Mapping:

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2										2
CO2	2		3	2								2	2
CO3	2	3										2	2
CO4	1	2	1	2								2	2

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	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 afterMSE.

Course Contents	
Unit Title and Contents	**Hours**
Unit 1: Power System Overview Power scenario in India, Power system components representation, Single line diagram, per unit quantities, p.u impedance diagram, Network graph, Bus incidence matrix, Primitive parameters Bus admittance matrix from primitive parameters. Formation of bus admittance matrix of large power network.	**08**
Unit 2: Load Flow Studies Bus classification, Network Model Formulation, Formation of $Ybus$ by Singular Transformation, Load Flow Problem, Gauss-Seidel (GS) Method, Newton-Raphson (NR) Method, Decoupled Load Flow Methods, Comparison of Load Flow Methods.	**08**
Unit 3: Symmetrical Fault Analysis Introduction, Transient on a Transmission Line, Short Circuit of a Synchronous Machine (On No Load), Short Circuit of a Loaded Synchronous Machine, Selection of Circuit Breakers.	**07**
Unit 4: Symmetrical Components Introduction, Fortescue's theorem, Symmetrical Component Transformation, Phase Shift in Star-Delta Transformers, Sequence Impedances and Sequence Network of Power System-Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances and Networks of Transmission Lines, Sequence Impedances and Networks of Transformers.	**08**
Unit 5: Unsymmetrical Fault Analysis Introduction, Symmetrical Component Analysis of Unsymmetrical Faults, Single Line-To-Ground (LG) Fault, Line-To-Line (LL) Fault, Double Line-To-Ground (LLG) Fault, Open Conductor Faults- One conductor open and Two conductor open.	**07**
Unit 6: Power system stability Introduction to stability studies, Swing equation, Swing curve, Power-Angle Equation, Equal area criterion, Critical clearing angle and Time, Further applications of the equal-area criterion, Classical step-by-step solution of the swing curve.	**07**

Textbooks:

Sr. No.	Title	Edition	Author/s	Publisher	Year
1	Modern Power system Analysis – by I.J.Nagrath & D.P.Kothari: Tata McGraw-Hill Publishing company, 2nd edition.	4th	I.J.Nagrath & D.P.Kothari	Tata McGraw-Hill Publishing company	2011
2	Power system Analysis Operation and control, Abhijit Chakrabarthi , Sunita Haldar, 3ed , PHI,2010.	2nd	Abhijit Chakrabarthi , Sunita Haldar,	PHI,2010	2010

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1	Elements of Power System	4th	William D. StevensonJr	McGraw Hill.	1982
2	Power System Analysis and Design	4th	J.Duncan Glover et al	Cengage	2008
3	Power System Analysis	1st	Hadi Sadat	McGraw Hill.	2002
4	Electrical Power Systems	5th	Ashfaq Husain	CBS Publishers & Distributors Pvt. Ltd	2007
5	https://archive.nptel.ac.in/courses/117/105/117105140/	NPTEL			

Title of the Course: Microcontrollers & Microprocessors Course Code: UELPE0511	L	T	P	Credit
	03	-	-	03

Course Pre-Requisite: Knowledge of numbering systems and Boolean algebra. Knowledge of combinational and sequential logic circuits.

Course Description: This course discusses microprocessors & microcontrollers, its architecture, programming, interfacing and application.

Course Objectives:

1. To explain the microprocessor, microcontroller & advanced microcontroller architecture.
2. To use the 8051 addressing modes and instruction set and apply this knowledge to develop programs in assembly language and C language.
3. To define the protocol for serial communication and understand the microcontroller development systems.
4. To explain the interrupt structure of the microcontroller and to develop programs related to serial programming.
5. To provide students with interfacing concepts and develop interfacing circuits for simple devices.

Course Outcomes:

COs	After the completion of the course the students will be able to	Blooms level	Descriptor
CO1	Explain the architecture and features of 8086 processor.	2	Understanding
CO2	Explain the architecture and features of microcontrollers.	2	Understanding
CO3	Apply programming techniques to implement counters, timers, interrupts and other peripherals.	3	Applying
CO4	Interfacing of microcontroller with electrical and electronics systems.	3	Applying

POMAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1					1	1						
CO2	1			1		1							
CO3		1			2			1			1	1	1
CO4		1			2		1	1			1	1	1

Assessments:

Teachers' assessment-

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

Assessment	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

ISE1 and ISE2 are based on assignment / declared test / quiz / seminar / Group Discussions etc.

MSE: Assessment is based on 50% of course content. (Normally first three modules)

ESE: Assessment is based on100% course content with 60-70% weightage for course content. (Normally the last three modules covered after MSE.)

Course Contents:	
Unit Title and Contents	**Hours**
Unit1: Introduction to concept of microprocessor 8086 and microcontroller 8051 Introduction to 8086 Architecture, Features, Signals, Difference between processor and controller, Advantage of microcontrollers. Intel 8051 Functional block diagram, Functions of pins of 8051, Memory organization of 8051, PSW and Flag Bits, Stack and Stack pointer, Overview of special function registers, Overview of Texas Instrument 28379D Dual-Core Real Time Microcontrollers.	**8Hrs.**
Unit 2: Instruction Set 8051 Data transfer instructions and programs in assembly language. Arithmetic and logical instructions and programs in assembly language. Boolean and Program Branching instructions and programs in assembly language. Addressing modes of 8051.	**8Hrs.**
Unit 3: Programming of 8051 & Timers in 8051 8051Programming in C, Data types in C. Ports of 8051, their use, and programming in C (Byte Level and Bit-level). Timers and counters in 8051	**7Hrs.**
Unit 4: Interrupts & Serial Communication in 8051 Interrupt structure of 8051 and SFR associated with interrupts Programming of External hardware interrupts in C. Serial port Structure in8051. Programming of Serial port for transferring and receiving data in C in mode1.	**6Hrs.**
Unit 5: Interfacing with 8051 Interfacing of DC motor with 8051, Interfacing of Stepper motor with 8051and its programming. Interfacing and programming of LED and Relay with 8051.	**5Hrs.**
Unit 6: Introduction to advanced microcontroller Introduction to PIC Microcontroller, Introduction to Raspberry Pi, Comparison of various Rpi Models, Understanding SoC architecture and SoCs used in Raspberry Pi, Pin Description of Raspberry Pi, On-board components of Raspberry Pi.	**8Hrs.**

Textbooks:

1. J.L.Antonakos, "AnIntroductiontotheIntelFamilyofMicroprocessors",Pearson,1999.
2. M.A.Mazidi & J.C. Mazidi "Microcontroller and Embedded systems using Assembly & C (2/e)", Pearson Education, 2007.
3. Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux 1st Edition by Derek Molloy, wiley publications 2016

Reference Books:

1.1. JohnH.Davies,"MSP430MicrocontrollerBasics",ElsevierLtd.,2008
2. B.B.Brey, "The Intel Microprocessors,(7/e),EasternEconomyEdition",2006.
3. K.J.Ayala,"The8051Microcontroller ",(3/e),Thomson DelmarLearning,2004.
4. I.S.MacKenzie and R.C.W.Phan.,"The 8051Microcontroller (4/e)",Pearson education, 2008.

Programming the Raspberry Pi, Second Edition: Getting Started with Python 2nd Edition by Simon Monk McGraw Hill Professional, 04-Jun-2021 - Technology & Engineering - 208 pages

Title of the Course: Material Science Engineering Course Code: UELPE0512	L	T	P	Credit
	03	-	-	03

Course Pre-Requisite: Foundational understanding of physics, chemistry and Basics of electrical engineering

Course Description: This course introduces the fundamental principles of materials science and their applications in engineering. It covers the structure, properties, processing, and performance of materials, focusing on metals, ceramics, polymers, and composites. Students will explore the relationship between material structure and properties, as well as the mechanisms behind material behaviour under various conditions. The course emphasizes the role of materials in modern engineering solutions and provides a foundation for selecting and designing materials for specific applications. Topics include crystallography, phase diagrams, mechanical properties, thermal properties, electrical properties, and failure mechanisms.

Through this course, students will gain the knowledge necessary to understand material behaviour and apply material science principles to innovate, design, and improve engineering systems.

Course Objectives:

1. To understand the conducting, dielectric, insulating and magnetic materials and their applications.
2. To apply the knowledge of superconducting materials and their applications
3. To analyze the performance of materials and batteries.

Outcomes:

COs	After completion of the course the students will be to	Bloom's Level	Descriptor
CO1	Understand the properties of materials required for electrical engineering and their applications.	2	Understanding
CO2	Apply the knowledge of conducting and superconducting materials in modern technologies.	3	Applying
CO3	Apply the knowledge of conducting and superconducting materials in modern technologies.	3	Applying
CO4	Analyze the performance of various types of modern engineering materials & batteries.	4	Analyzing

PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3		1	1								1	
CO2	3		2	1	1							1	
CO3	3		2	1	1							1	
CO4	3	1	3	1	1						1	1	1

Assessments:

Teacher's assessment-

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

Assessment	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 etc.
MSE: Assessment is based on 50%of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content. (Normally last three modules) covered after MSE.

Course Contents:	
Unit 1: --- Introduction to Material Science: Classification & Scope of electrical materials, Requirement of Engineering materials, Classification of solids based on energy gap, Types of engineering materials, Levels of material structure. Spintronics and Spintronic materials, Ferromagnetic semiconductors, **Conductors:** Conductor materials, Factors affecting conductivity, Thermal conductivity, Heating effect of current, Thermoelectric effect, Seeback effect, Thomson effect, Wiedemann – Franz lawand Lorentz relation.	**8 Hrs.**
Unit 2: --- Conductive Materials: Types of conducting materials, Low & High resistivity materials, Fusible materials, Filament materials, Carbon as filamentary and brush material, Material for conductors, cables, wires, solder, sheathing and sealing, Sizing of electrical conductors as per National Electrical Code.	**8Hrs.**
Unit 3: ---Superconductive Materials: Concept of superconductors, Meaning of phenomenon of superconductivity, Properties of superconductors, Types of superconductors, Critical magnetic field and critical temperature, Effects of Isotopic mass on critical temperature, Silsbee rule, Depth of penetration and coherence length. Ideal and Hard superconductors, Mechanism of super conduction, London's theory for Type I superconductors, GLAG theory for Type I superconductors, BCS theory, Applications and limitations. Applications of high temperature superconductors, Superconducting solenoids and magnets.	**8Hrs**
Unit 4: --- Insulating & Dielectric Materials: Mica, Porcelain, Glass, Micanite and Glass bonded mica. Polymeric materials – Bakelite, Polyethylene. Natural and synthetic rubber. Paper. Choice of solid insulating material for different applications, Liquid insulating materials – Requirements, Transformer oil, Bubble theory, Aging of mineral insulating oils. Gaseous insulating Materials – Air, Nitrogen, Vacuum& SF6. **Dielectrics:** Introduction to dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric strength and Dielectric loss. Polarization, Mechanisms of polarization, Comparison of different polarization process, Factors affecting polarization.	**8Hrs.**
Unit 5: ---Magnetic Materials Concept of magnetic dipole, Relation between relative permeability and magnetic susceptibility. Classification of magnetic materials, Diamagnetic, Para magnetism, Ferromagnetism, Antiferromagnetism. Ferrimagnetism and ferrites – properties and applications, Soft and hard ferrites. Curie temperature, Laws of magnetic materials. Magnetization curve, Initial and maximum permeability. Types of magnetic materials, Soft and hard magnetic materials, High energy magnetic materials, Commercial grade soft and hard magnetic materials. Transformer grade steel.	**8Hrs.**
Unit 6: ---Modern Engineering Materials and Batteries Metallic glasses, liquid crystals, Shape memory Alloys, Biomaterials, Aerogels, Nanomaterials. Material used for batteries – Lead-acid, Lithium ion, Sodium – Sulphur, Nickel – Cadmium, IS standards.	**5Hrs**

Textbooks:

1. S. P. Seth, "A Course in Electrical Engineering Materials", Dhanpat Rai and Sons
2. [T2] "Electrical Engineering Materials", T.T.T.I, Madras.

3. K. B. Raina& S. K. Bhattacharya, "Electrical Engineering Materials", S. K. Kataria& Sons.
4. P.K. Palanisamy, "Material Science for Electrical Engineering", SciTech Pub. (India) Pvt. Ltd., Chennai.
5. Ronald M. Dell and David A.J. Rand, "Understanding Batteries", Royal Society of Chemistry, 2001 Publication
6. S. P. Chalotra & B. K. Bhatt, "Electrical Engineering Materials", Khanna Publishers, Nath Market.
7. James F. Shackelford & M. K. Muralidhara, "Introduction to Material Science for Engineering", Sixth Edition by Pearson Education
8. "Insulation Technology Course Material of IEEMA Ratner", Pearson Education.
9. Traugott Fischer, "Materials Science for Engineering Students", Elsevier publications.
10. Linden and Reddy, "Handbook of Batteries", New York McGraw Hill, 2002, Publication

References:

1. A.J. Dekker, "Electrical Engineering Materials", Pearson.
2. R. Balasubramaniam, "Callister's Material Science and Engineering", Wiley
3. Dr.G.P.Chhalotra, Dr.B.K.Bhat, "Electrical Engineering Materials", Khanna Publications
4. Korthauer, "Lithium – Ion Batteries: Basics and Applications"
5. S.O.Kasap, "Principles of Electronic Materials and Devices", McGraw Hill
6. IS code for electrical engineering materials

Title of the Course: Renewable Energy Sources Course Code: UELPE0513	L	T	P	Credit
	03	--	--	03

Course Pre-Requisite: Basic Physics, Electrical Engineering Fundamentals, Introduction to Energy Systems, Conventional Energy Environmental Sciences, Hydro-Electric Generation.

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. The course delves into the technical aspects of solar energy, covering both thermal and photovoltaic power generation, along with the design, analysis, and operation of solar photovoltaic systems. 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.

Course Objectives:

1. Understand renewable energy sources.
2. Explain and analyze Solar Photovoltaic and thermal systems.
3. Explain and analyze wind energy conversion systems.
4. Understand the basics of Hydrogen energy and fuel cell technology.

Course Outcomes: Course Objectives: To make the students aware of

COs	After completion of the course the students will be to	Bloom's Level	Descriptor
CO1	Understanding Renewable Energy Sources	2	Understand
CO2	Understand the basics of Hydrogen energy and fuel cell	2	Understand
CO3	Explain and analyze Solar Photovoltaic and thermal systems.	4	Analyze
CO4	Explain and analyze wind energy conversion systems.	4	Analyze

PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	1	1	3					3	2
CO2	3	3	3	1	3	1	2					3	3
CO3	3	3	2	1	1	2	3					3	3
CO4	3	3	2	2	1	2	3					3	3

Assessments:
Teachers' assessment-
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	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 etc.
MSE: Assessment is based on 50% of course content. (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content. (Normally last three modules covered after MSE.)

Course Contents:	
Unit1:---Renewable Energy Sources Introduction & Importance of Renewable Energy Sources, Principles of renewable energy; energy and sustainable development, fundamentals and social implications. Carbon Credits from Renewable Energy Projects. Worldwide Renewable Energy availability, renewable energy availability in India, brief descriptions on tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. State & Central Government Incentive Scheme for RES.	**6 Hrs.**
Unit2:---Solar Photovoltaic Energy Conversion System: Fundamentals of Solar Radiation, Solar radiation Measurements using Pyrheliometers, Pyrometer, Sunshine Recorder. Basics of PV cell, materials used for PV cell, efficiency of PV cell, equivalent electrical circuit, open circuit voltage and short circuit current, I-V & P-Curves, effects of different electrical parameters on I-V&P-V curves. Configuration of PV power generation system-off-grid system & grid-connected PV system, Photovoltaic applications: --Battery chargers, domestic lighting, street lighting and water pumping.	**8 Hrs.**
Unit3: ---Solar Thermal Energy Conversion System: Principle of conversion of solar radiation into heat, Collectors used for solar thermal conversion: -Flat plate collectors and Concentrating collectors, Classification of concentrating collectors. Solar Thermal Power generation: - Solar central receiver system - Heliostats and receiver, Solar thermal applications- Solar heating/cooling techniques, Solar hot water systems - Solar distillation and drying, Solar greenhouses.	**8 Hrs.**
Unit4:---Wind Energy Conversion system: 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.	**8 Hrs.**

Unit5:-Wind Electric Generators Concept of fixed speed and variable speed Wind Electric Generators, Type of Wind Electric Generator: -Fixed Speed Induction Generators – Configuration – working - control strategies-Modeling of Induction generators. DFIG based Wind Turbines- Configuration – working - control strategies-Modeling of DFIG. Direct driven FRC Synchronous Generator -Configuration – working - control strategies-Modeling of DFIG. Direct driven Permanent Magnet Synchronous Generator- Configuration – working - control strategies-Modeling of DFIG.	**8 Hrs.**
Unit6:- Green Energy Hydrogen: --Basics in Production Techniques Hydrogen- Purity Index of water - Physical and chemical properties - Salient characteristics - Production of hydrogen technologies (electrolysis method only). Benefits of hydrogen. Economic and environmental analysis on usage of hydrogen. Fuel Cells:--Principle-Working- Thermodynamics and kinetics process performance evaluation of fuel cell- Comparison on battery Vs fuel cell. Application of Fuel Cell and Economics cell Fuel cell usage for domestic power systems	**7 Hrs.**

Textbooks:

1. Boyle, Godfrey, "Renewable Energy", (2ndedition), Oxford UniversityPress,2004.
2. G. S. Sawhney, "Non-Conventional Resources of Energy", PHI Publication2012.
3. Chetan Singh Solanki "Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers, and Engineers" PHI Learning Pvt. Ltd., Delhi, New Delhi, India.
4. John Twidell & Toney Weir, Renewable Energy Resources, E & F N Spon.

References:

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.
3. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma
4. Bent Sorensen (Sorensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier Academic Press, UK
5. NPTEL :: Chemical Engineering - Fuel Cell Technology,
6. NPTEL :: Chemical Engineering - NOC:Hydrogen Energy: Production, Storage, Transportation and Safety.

Title of the Course: Business Planning and Strategy **Course Code: UELHS0501**	**L**	**T**	**P**	**Credit**
	02	**-**	**-**	**02**

Course Pre-Requisite: Basic knowledge of business operations and management functions.

Course Description: This course focuses on strategy formulation and implementation, emphasizing the functions of general management. It aims to develop skills in strategic thinking, leadership, communication, teamwork, and cross-functional integration, preparing students to tackle complex organizational challenges and enhance their managerial competencies.

Course Objectives: To make the students aware of

1. Fundamental concepts and processes involved in strategic management.
2. Internal and external environments impacting strategic decisions.
3. The creation, formulation, and execution of effective strategies.
4. Real-world case studies and current business strategies.

Course Outcomes:

COs	After the completion of the course the students will be able to	Blooms level	Descriptor
CO1	Understand the role and key concepts of strategic management	2	Understanding
CO2	Analyze the strategic environment, resources, and capabilities.	4	Analyzing
CO3	Develop business level and corporate-level strategies.	3	Apply
CO4	Estimating effective mechanisms for implementing and controlling strategic plans.	4	Analyzing
CO5	Apply strategic leadership and entrepreneurial strategies	3	Apply

POMAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2					1	2				
CO2	3	3	2		1			1	2				
CO3	3	3	3		2	1		2	3	2			
CO4	2	3	3		3	2	1	2	3	2			
CO5	3	3	3		3	2	2	3	3	3	2		

Assessments:
Teacher's assessment-
ESE: Assessment is based on 100%.

Assessment	Marks
ESE	50

Course Contents:

Unit 1: Concept of strategy: Defining strategy, Levels at which strategy operates, Strategic Decision Making and Approaches to Strategic Decision making, essence of strategic thinking, replacing planning with strategic thinking, strategic management process. Mission and Purpose, Objectives and Goals, Strategic Business Units. Environment Analysis and Diagnosis - SWOT analysis, Concept of Environment and its components, Environment scanning and appraisal, organizational appraisal, Strategic advantage analysis and diagnosis	**8 Hrs.**
Unit2: Strategy Formulation and Choice of Alternatives Grand Strategies –Stability, growth, retrenchment & combination strategies- Modernization, Diversification, Integration, Merger, Take-over and Joint Venture strategies, Turnaround – divestment and Liquidation strategies. Strategies for competing in globalizing markets. Process of Strategic Choice – Process of strategic choice – Gap analysis. Industry analysis, competitor analysis - Porter's Five forces Model of competition. SWOT analysis- Synergy and Dysergy, Mckinsey's 7's framework; GE-9 Cell Model, Bostan's Consultancy Model. Distinctive competitiveness; Factors affecting Strategic Choice	**8 Hrs.**
Unit 3: Implementation of Strategy: Inter-relationship between formulation and implementation; Issues in strategy implementation, Resource Allocation, Budgets, Behavioral Issues – Leadership styles – Charismatic, transformational, visionary, team, cross-cultural & ethical leadership, corporate culture and values power Social Responsibilities – Ethics, Building capable organization;	**6 Hrs.**
Unit4: Functional Issues – Financial, Marketing, Operations and Personnel Plans and policies. Strategy and Structure: Organization structure, Structural Considerations, Structure for strategies, Organizational design and change, Matching structure and strategy.	**4 Hrs.**
Unit5: Strategy Evaluation: Importance, Overview of strategic evaluation, strategic control, techniques of strategic evaluation and control, Operational Control. B) Corporate Governance – Introduction & meaning, who are stakeholders?, ownership & management, governing board, governance issues, governance & strategic implementation.	**6 Hrs.**

Texts books:

1. Business Policy –AzharKazmi –S.Chand&Co. New Delhi
2. Strategic Management: Concepts & Cases – UpendraKachru, Excel Books.
3. Strategic Planning: Formulation of Corporate strategy – V.S. Ramaswamy, S. Namakumari- Macmillan Publishing House Ltd.
4. Management Policy & Strategic Management – R.M.Shivastava, Himalaya Publishing House, Mumbai.
5. Creating Excellence – Craig R. Hickman & Michael A. Silva – London Univeral Book Stall, New Delhi. 6. Organizational Behaviour- Stephen P. Robbinson – PHI, New Delhi.

Title of the Course: Control System Laboratory **Course Code: UELPC0531**	**L**	**T**	**P**	**Credit**
	-	**-**	**2**	**01**

Course Pre-Requisite: Control system, MATLAB basics.

Course Description: This course deals with the fundamentals of classical control system and analysis which includes both the practical and theoretical aspects. This course provides an overview of classical control systems for undergraduate levels and covers mathematical modeling of physical control systems in the form of differential equations and transfer functions, system performance indices of feedback control systems via classical techniques such as root-locus and frequency-domain methods, state space analysis.

Course Objectives:

1. This course intends to model a physical system that issue full control point of view.
2. This course intends to introduce various analysis techniques determining performance features of the systems MATLAB.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Blooms level**	**Descriptor**
CO1	Understand the principles of classical and modern control systems.	4	Analyzing
CO2	Develop programming and computation skills in control systems.	4	Analyzing
CO3	Design and simulate control systems using software tools.	3	Applying

POMAPPING

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

Teacher's assessment-

One component of In Semester Evaluation (ISE) and One End Semester Examination (ESE) having50% and 50% weights respectively

Assessment	Marks
ISE	25
ESE (POE)	25

ISE1 Assessment is based on performing the experiments and submitting the journal. This will be done every week and when the experiment is performed.

ESE(POE): Assessment is based on Practical performance and oral examination.

List of Experiments:	
1. To study input output characteristics of various control system components.	**2 hours**
2. Step Response Analysis of Electrical, Fluid, and Thermal Systems	**2 hours**
3. To obtain transfer function and poles zeros of DC motor experimentally.	**2hours**
4. To obtain root locus experimentally.	**2hours**
5. Study effect of feedback gain on system response by using software tools (LT spice, PSpice).	**2hours**
6. Study effect of damping factor zeta on time control performance specifications by using software tools.	**2hours**
7. Obtain root locus for a given system and find performance specifications there from Study effect of addition of zero and pole on root locus by using software tools.	**2hours**
8. To Study bode plot and obtain gain margin and phase margin for various systems by using software tools.	**2hours**
9. To obtain state space representation from transfer function, find Eigen values, analyze controllability, Observability and stability by using software tools.	**2Hours**
10. Case study: Design and analysis of a control system for a practical application.	**2hours**

Textbooks:

1. Control System Engineering, Norman S. Nise,6th Edition, John Wiley and Sons,2012
2. Control Systems, M. Gopal, 4th Edition, Anshan Publishers,2012.
3.ControlSystems,2nd Edition, N.C. Jagan, BS Publications
4.Advanced Control Engineering, R.S. Burns, Butterworth Heinemann,2001.

Reference Books:

1.Basic Control Systems Engineering, Paul H. Lewis & Chang Yang, Pentice Hall
2.ModernControlEngineering, Eastern Economy, K. Ogata,5thEdition, 2010.

Title of the Course: Power System Analysis lab Course Code: UELC0632	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: Basic Knowledge of Transmission and distribution, Electrical power system.

Course Description: This course discusses the about different electrical software used for solving different power system problems.

Course Objectives:

1. To do symmetrical fault analysis in power system
2. To do unsymmetrical fault analysis in power system.
3. To develop primitive matrix required for power system analysis.
4. To do analysis for the power system network using load flow solutions methods.

Course Outcomes:

CO	After the completion of the course the student should be able to	Blooms level	Descriptor
CO1	**Evaluate** Symmetrical components of unbalanced voltage and currents.	2	Understanding
CO2	**Analyze** power system under Symmetrical fault and Unsymmetrical fault conditions.	4	Analyze
CO3	**Develop** impedance and admittances bus matrices.	3	Apply
CO4	**Use** Gauss Seidal, Newton Raphson, and Fast decoupled method for load flow studies.	3	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												2
CO2	3		2										2
CO3	3												
CO4	2		2										2

Assessments:

Teachers' assessment-

In Semester Evaluation (ISE), and End Semester Examination (ESE) having 50% weightage each

Assessment	Marks
ISE	25
ESE(OE)	25

ISE is based on at least two of the assessment tools like performance of student in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). ESE Assessment is based on performance in a practical examination and oral test thereafter at the end of the semester.

Course Content	Hours
Experiment No.1: Write a MATLAB programme to transform unsymmetrical components into symmetrical components and vice-versa.	2 Hrs
Experiment No.2: To Determine Fault Currents and Voltages in a power system with Star-Delta Transformers at a Specified Location for LG and LL by simulation.	2 Hrs
Experiment No.3: To Determine Fault Currents and Voltages in a power system with Star-Delta Transformers at a Specified Location for LLG and LLLG by simulation.	2 Hrs
Experiment No.4: Y Bus Formation for Power Systems with and without Mutual Coupling by Singular Transformation and Inspection Method.	2 Hrs
Experiment No.5: Formation of Z Bus (without mutual coupling) using Z-Bus Building Algorithm.	2 Hrs

Course Content	Hours
Experiment No.6: Load Flow Analysis using Gauss Siedel Method for Both PQ and PV Buses.	2 Hrs
Experiment No.7: Load Flow Analysis using NR for Both PQ and PV Buses.	2 Hrs
Experiment No.8: Load Flow Analysis using Fast Decoupled Method for Both PQ and PV Buses.	2 Hrs
Experiment No.9: To determine Fault Currents and Voltages in a power system for a symmetrical three phase fault by simulation.	2 Hrs
Experiment No.10: Industrial Visits. Power station.	2 Hrs

Note: Software used for the practical's: MATLAB, ETAP, POWER WORLD SIMULATOR.

Textbooks:

Sr. No.	Title	Edition	Author/s	Publisher	Year
1	Modern Power system Analysis – by I.J.Nagrath & D.P.Kothari: Tata McGraw-Hill Publishing company, 2nd edition.	4th	I.J.Nagrath & D.P.Kothari	Tata McGraw-Hill Publishing company	2011
2	Power system Analysis Operation and control, Abhijit Chakrabarthi , Sunita Haldar, 3ed , PHI,2010.	2nd	Abhijit Chakrabarthi , Sunita Haldar,	PHI,2010	2010

References:

SN	Title	Edition	Author/s	Publisher	Year
1	Elements of Power System	4th	William D. StevensonJr	McGraw Hill.	1982
2	Power System Analysis and Design	4th	J.Duncan Glover et al	Cengage	2008
3	Power System Analysis	1st	Hadi Sadat	McGraw Hill.	2002

Title of the Course: Python for Electrical Engineering Course Code: UELVS0531	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: Basic understanding of any programming language, basic understanding of circuits, signals and systems, power systems.

Course Description: This course is designed to combine concepts from computer engineering and electrical engineering. Students are introduced to Python programming and its applications in solving electrical engineering problems. The curriculum focuses on leveraging Python as a versatile tool for tasks such as circuit analysis, power system simulations, signal processing, and automation.

Course Objectives

1. **Understanding** of Python fundamentals, including data structures, control statements, libraries, script files, function files.
2. **Apply** Python to circuit simulation, signal processing and power system analysis.
3. **Analyze** electrical systems by interpreting data and identifying patterns through simulations.

Course Outcomes

COs	After completion of the course the students will be to	Bloom's Level	Descriptor
CO1	**Understand** the fundamentals of python programming.	2	Understand
CO2	**Apply** python programming to solve basic electrical engineering problems.	3	Apply
CO3	**Analyze** electrical systems and electrical measurement data using different Python libraries.	4	Analyze

PO Mapping

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

Assessments:

Teachers' assessment

Assessment	Marks
ISE	25

ISE marks will be based on the practical performance, journal writing and oral examinations held throughout the semester.

List of Experiments	Hours
Exp1: Fundamentals of programming in Python. Basic commands and codes.	**2**
Exp 2: Write a script file and a function file.	**2**
Exp 3: Write a function file calculating the different parameters of a DC circuit.	**2**
Exp 4: Generate and plot sinusoidal voltage and current waveforms using Matplotlib.	**2**
Exp 5: Analyze RLC parallel circuit.	**2**
Exp 6: Analyze RLC series circuit.	**2**
Exp 7: Perform Phasor analysis for a RL circuit and compute the real and the reactive powers.	**2**
Exp 8: Perform nodal analysis by solving simultaneous equations using Python NumPy.	**2**
Exp 9: Write a function file to generate different waveforms and compute the amplitude spectrum using the Discrete Fourier Transform (DFT).	**2**
Exp 10: Simulate voltage and current waveforms with harmonics. Calculate the Total Harmonic Distortion (THD).	**2**
Exp 11: Write a function file creating three-phase voltage signals and calculating sequence components for balanced and unbalanced systems.	**2**
Exp 12: Import and process electrical measurement data (voltage, current, frequency) from CSV files.	**2**
Note: Students are required to perform a minimum of ten experiments from the above given list.	

Reference books

1. Python for science and engineering by Hans-Petter Halvorsen, https://www.halvorsen.blog/
2. Introduction to Python and Spice for Electrical and Computer Engineers by James Squire and Anthony English, Elsevier publication.
3. Python: The Complete Reference by Martin C. Brown, Mc Graw Hill Publication.

Title of the Course: Community Engagement Project	L	T	P	Credit
Course Code: UELIL0531	-	-	02	01

Course Pre-Requisite: Basics of Electrical and Electronics Engineering.

Course Description:
This lab aims to cultivate critical thinking skills in students for solving social problems by applying science and engineering in an innovative way. Student groups, with a maximum of three members, will identify relevant social issues and conduct a thorough requirement analysis. After consulting with the course coordinator and conducting a comprehensive literature review or needs assessment, students will define the project title, aim, and objectives for their project. Based on the identified needs, the group will develop detailed specifications for the final project outcome.

Course Objectives:
1. **Define and analyse** the problem statement clearly and effectively.
2. **Investigate and apply** troubleshooting methodologies to diagnose and resolve issues.
3. **Transform** innovative ideas into functional prototypes or products, applying engineering principles.
4. **Collaborate** effectively in a team environment to implement and refine project ideas.
5. **Develop** effective communication skills to present and articulate the theme, progress, and outcomes of the project.

Course Outcomes:

COs	After completion of the course the students will be	Bloom's Level	Descriptor
CO1	Apply the knowledge of advanced Electric and Electronic fundamental for problem definition.	4	Analyzing
CO2	Develop methodology to troubleshoot circuit.	4	Analyzing
CO3	Test the developed hardware/software of the project	5	Evaluating
CO4	Demonstrate the hardware of the projects.	5	Evaluating

CO-POMAPPING

CO	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO1	3	3	2	3	2	2	1					3	3
CO2	3	3	2	3	2	2	1					3	3
CO3	3	3	3	2	2	3	2	3	2	3	2	3	2
CO4	3	3	3	2	2	3	2	3	2	3	2	3	2

Assessments:
Teachers 'assessment-

In Semester Evaluation (ISE), and End Semester Examination (ESE) having 50% weightage each

Assessment	Marks
ISE	25

ISE is based on the performance of students in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz).

Course Contents:

- Environment protection, global warming, safe drinking water, waste management, renewable energy utilities, biomedical engineering, accident prevention, enabling weaker section of society, efficiency/cost/ time improvements, human hardship reduction, prosthesis, smart city, smart transportation, energy audit and saving.
- Studentsshouldformgroupsofmaximumfourinrespectivepracticalbatch.
- Project should be a working model based upon their knowledge, understanding and practices.
- Evaluation of mini project will be through presentation, demonstration and report writing.

1. Smar grids & Renewable Energy

Unlike in the past, whereby consumers solely depended on a local electrical power company, today, they have many options. With the ability to even generate their own power through renewable energy sources like solar panels, wind turbines, and geothermal systems, some consumers also now want to sell their surplus electricity back to the grid. This shift not only promotes energy independence but also supports a sustainable future by reducing reliance on fossil fuels. As a result, the electricity delivery infrastructure has to change. In response to these demands, most Energy Departments around the world are placing smart devices throughout their networks, right up to customers' homes, offices, and factories. The smart grid collects valuable data to allow both consumers and suppliers a higher degree of control over multiple power sources, including renewable energy. It also enables them to predict surges in usage, integrate intermittent energy from renewables, and instantly detect outages. By allowing end-to-end communication between distribution sites, power plants, renewable energy installations, and the end user's electrical point-of-presence, smart grids significantly raise efficiency and reduce costs. Soon, it's inevitable that electrical engineers will frequently come across smart grids and be asked to help develop one.

2. Electric Vehicle

Tesla's achievement of a $100 billion market valuation marked a historic milestone, establishing it as the first publicly listed US carmaker to reach this benchmark. This milestone signals the growing permanence of electric vehicles (EVs) in the automotive industry. Experts project that by 2030, over 125 million EVs will be on the road, building on the millions already in operation today. EV manufacturers are heavily investing in advanced technologies, paving the way for innovations such as longer-lasting batteries, faster charging solutions, highly accurate autonomous driving systems, solar-powered EVs, and even electric-powered aircraft. These advancements are shaping the future of transportation, emphasizing sustainability and technological progress.

3. Wireless Power Transmission

Wireless power transfer is still in its early stages, but its potential is immense. In the near future, advancements in wireless charging technology are expected to enhance the convenience of powering laptops, smartphones, earphones, and other smart devices. Beyond this, wireless charging is anticipated to revolutionize the electric vehicle (EV) industry. Drivers may soon park their vehicles on charging spots without the need for physical connections, eliminating the reliance on large charging docks. Experts predict that within a few years, dynamic wireless charging—charging electric vehicles while they are in motion—will also become a reality, paving the way for more efficient and seamless energy transfer systems.

4. Artificial Intelligence

As artificial intelligence (AI) continues to revolutionize industries such as armaments and medicine, its influence on the field of Electrical Engineering is inevitable. Electrical engineers are uniquely positioned to leverage AI and machine learning, blending their technical expertise with advanced computational tools to achieve remarkable results. Key contributions of AI in Electrical Engineering include:
Designing complex algorithms for data analysis and interpretation

Creating new codes or optimizing existing ones for enhanced functionality

Developing large-scale AI and machine learning platforms
Formulating innovative strategies in electronics and automation
One of the most significant applications of AI in this field is image processing. By utilizing AI, electrical engineers can create sophisticated algorithms that enable machines to identify electrical or structural abnormalities in systems and frameworks. These systems can promptly provide feedback or recommend corrective actions, thereby enhancing efficiency and safety. This advancement is especially critical in hazardous environments, such as large-scale electronic production lines, where workplace safety is a top priority.

5. **Energy Saving Lighting Technologies:**

LED lamps, once considered a luxury due to their high cost, have now become the standard for lighting solutions. With prices dropping to as low as Rs. 150 or less, LED bulbs are now affordable for the average consumer. Their energy-saving capabilities make them a cost-effective choice, paying for themselves within a few months. On average, households can save between Rs. 3000 and Rs. 5000 annually on utility bills by switching to LEDs. With ongoing advancements in smart technology, LED lighting is expected to become even more energy-efficient, user-friendly, and seamlessly integrated into modern homes in the near future.

6. **Internet of Things (IOT)**

The Internet of Things (IoT) is transforming various facets of the electrical engineering landscape. From smart grids and smart lighting to Visible Light Communication (VLC) systems, IoT has become deeply interwoven with the industry. Consequently, it is essential for every electrical engineer to develop proficiency in IoT technologies.

Key applications of IoT in electrical engineering include:

- **Smart Grids**: Enabling real-time monitoring, automated distribution, and efficient energy management.
- **Smart Inverters**: Enhancing the efficiency and adaptability of renewable energy systems.
- **Advanced Metering Infrastructure (AMI)**: Providing precise energy usage data to optimize consumption and billing.
- **Remote Control Operations**: Allowing remote management of energy-consuming devices for improved convenience and efficiency.
- **SCADA Systems**: Strengthening the supervisory control and data acquisition capabilities in complex electrical networks.

The integration of IoT into electrical engineering not only enhances system efficiency but also opens new opportunities for innovation and smarter energy solutions.

7. **Sustainable Energy**

With scientists advocating strongly for decisive action against climate change, the energy sector can no longer afford to rely on fossil fuels and other environmentally harmful energy sources. The global push for sustainable energy solutions has reached unprecedented levels. Utility-scale renewable energy sources, such as solar, wind, and hydropower, are being implemented at an accelerated pace worldwide. This transition is not only crucial for mitigating climate change but also for ensuring a cleaner and more sustainable future for generations to come.

8. Energy Storage and Battery Management

While wind and solar power are excellent sources of sustainable energy, their intermittent nature presents challenges. Consumers can only harness these resources when they are available, underscoring the need for efficient energy storage solutions to save energy for later use. To address this, electrical engineers worldwide are focusing on developing advanced batteries and energy storage systems.

Key areas driving innovation in the field include:

- **Distributed Energy Resources (DER)**: Enhancing decentralized energy production and storage systems.
- **Grid Parity**: Striving to make renewable energy cost-competitive with traditional energy sources.
- **Artificial Intelligence and Sustainable Energy**: Leveraging AI to optimize energy usage, forecasting, and system performance.
- **Blockchain**: Enabling secure, transparent, and decentralized energy transactions.
- **Cybersecurity**: Safeguarding energy infrastructure against potential threats.

The rapid advancements in these areas signify a transformative period for the electrical engineering landscape, making sustainable energy solutions more accessible and reliable than ever before.

9. Robotics & Automation

While robotics-based technologies are often criticized for displacing jobs in many industries, their role in electrical engineering tells a different story. Robotics, combined with automation, plays a crucial role in enhancing workplace safety and operational efficiency. By reducing human exposure to hazardous environments, these technologies help mitigate risks and streamline processes.

For example, remotely controlled, wireless underground cable cutters can be deployed to perform high-risk tasks, eliminating the need for humans to work in potentially life-threatening conditions. Automation further enhances these systems by enabling tasks such as real-time monitoring, fault detection, and precision control in high-voltage environments. Automated robotic systems can also be programmed for repetitive tasks, ensuring consistency, reducing human error, and freeing engineers to focus on complex problem-solving and innovation.

This integration of robotics and automation not only advances safety standards but also transforms the way electrical engineering tasks are executed, paving the way for smarter, more efficient, and safer work environments.

Title of the Course: Microprocessor& Real Time Embedded Systems Course Code: UELMM0541	L	T	P	Credit
	03	-	-	03

Pre-Requisite Course: Knowledge of numbering systems, Boolean algebra, combinational and sequential logic circuits and operating system.

Course Description: This course discusses embedded system concept and its characteristics along with real time operating embedded system.

Course Objectives:

1. To understand the concept of embedded system design and analysis.
2. To understand the attributes related to quality of embedded system and its peripherals.
3. To familiarize structure of programming an embedded system.
4. To learn real time operating systems.

Course Outcomes:

COs	After the completion of the course the students will be able to	Blooms level	Descriptor
CO1	Interpret concept of embedded system design and analysis.	2	Understanding
CO2	Explain the characteristics and attributes of embedded system.	2	Understanding
CO3	Summarize real time operating systems & its process.	2	Understanding
CO4	Articulate embedded system programming.	3	Apply

POMAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1					1							
CO2	1	1				1							
CO3	1			1		1							
CO4		1			2			1			1	1	1

Assessments:
Teachers' assessment-

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content.

Course Contents:	
Unit 1: Introduction to Embedded Systems and General-purpose computer systems: history, classifications, applications and purpose of embedded systems. Core of Embedded Systems: Microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little-endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components, PCB and passive components	**7Hrs.**
Unit 2: Characteristics and quality attributes of embedded systems: Characteristics, Operational and Nonoperational quality attributes, application specific embedded system- washing machine, domain specific - automotive.	**7Hrs.**
Unit 3: Programming Embedded Systems: Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging.	**8Hrs.**
Unit 4: Peripherals: Control and Status Registers, Device Driver, Timer Driver-Watchdog Timers, Embedded Operating System, Real-Time Characteristics, Selection Process.	**6Hrs.**
Unit 5: Real Time Embedded Systems: Structure of a Real Time Embedded System — Estimating program run times – Task Assignment and Scheduling – Fault Tolerance Techniques – Reliability, Evaluation – Clock Synchronization.	**6Hrs.**
Unit 6: Processes and Operating Systems: Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real time operating systems- Priority based scheduling- Interposes communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE. - Distributed embedded systems – MPSoCs and shared memory multiprocessors. – Design Example - Audio player, Engine control unit – Video accelerator.	**8Hrs.**

Textbooks:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT I, II, III, V)
2. Jane W.S.Liu,‖ Real Time Systems‖, Pearson Education, Third Indian Reprint, 2003.(UNIT IV)

Reference Books:

1. Lyla B.Das, ―Embedded Systems : An Integrated Approach‖ Pearson Education, 2013.
2. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
3. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, AddisonWesley Professional, 2007.
4. Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall, 1999.
5. C.M. Krishna, Kang G. Shin, "Real-Time Systems", International Editions, Mc Graw Hill
6. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream Tech Press, 2018.
7. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc Graw Hill, 2022.

Semester VI												
Sr. No.	**Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**	**Evaluation Scheme**			
									Component			
1	PC	UELPC0601	Electrical Drives & Control	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
2	PC	UELPC0602	IOT for Electrical Engg.	2	-	-	2	2	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
3	PC	UELPC0603	Power System Protection	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
4	PEC	UELPE061X	Program Elective- II	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
5	OE	UELOE062X	Open Elective -II	3	-	-	3	3	ISE1	10		40
									MSE	30		
									ISE2	10		
									ESE	50	20	
6	AEC	UELAE0631	Business Communication and Value Science	-	-	2	2	1	ISE	50	20	20
7	PC	UELPC0631	Electrical Drives & Control Laboratory	-	-	2	2	1	ISE	25	10	
									ESE (POE)	25	10	
8	PC	UELPC0632	IOT for Electrical Engg. Laboratory	-	-	2	2	1	ISE	25	10	
									ESE (OE)	25	10	
9	PC	UELPC0633	Power System Protection Laboratory	-	-	2	2	1	ISE	25	10	
10	FP	UELIL0631	Mini Project-II	-	-	2	2	1	ISE	25	10	
11	CC	UELCC0631	Co -Curricular Activities-III	-	-	2	2	1	ISE	50	20	
12	MM	U**MM0***	Multi-Disciplinary Minor-IV	3	-	-	3	3	ESE	100	40	40
			Total:				**29**	**23**	**Total Marks: 850** **Total Credit: 23**			

PROGRAM ELECTIVE - II							
Sr. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Hrs. / Week**	**Credits**
1	UELPE0611	Electrical Machine Design	3	-	-	3	3
2	UELPE0612	Power System Operation and Control	3	-	-	3	3
3	UELPE0613	Advanced Control System	3	-	-	3	3
		Total:				**3**	**3**

Dr. M.K. Aalam
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Kolhapur Institute of Technology's College of Engineering Kolhapur (Empowered Autonomous)

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Title of the Course: Electrical Drives and Control Course Code: UELPC0601	L	T	P	Credit
	03	-	-	03

Course Pre-Requisite: Basic Electrical Engineering Electronics. Electromagnetic Fields and Machines, Control Systems, Power Electronics and Mathematics.

Course Description:
This course provides an in-depth understanding of electrical drives and their control systems. The course explores the dynamics of electrical drives, delving into torque equations, speed-torque conventions, load characteristics, and system stability. Special focus is given to the operation and control of DC motor drives, including multi-quadrant and dual converter-fed systems, chopper-controlled drives. The course also covers induction motor drive control, particularly voltage and current-fed inverter techniques, as well as advanced methods like vector or field-oriented control. Additionally, the course introduces special-purpose motor drives, including Permanent Magnet AC (PMAC) motors, Brushless DC motors, and stepper motors, with an emphasis on their features and control characteristics.

Course Objectives: To make the students aware of
1. Understand and analyze the fundamentals of electrical drives
2. Examine the dynamics and operational characteristics of electrical drives
3. Implement control strategies for different motor drives
4. Design and simulate advanced motor drive systems

Course Outcomes:

COs	After the completion of the course the students will be able to	Blooms level	Descriptor
CO1	Understand the fundamentals of electrical drives and their applications	2	Understand
CO2	Demonstrate a comprehensive understanding of the dynamics of electrical drives	3	Apply
CO3	Analyze and implement control techniques for electrical drives	4	Analyzing
CO4	Design and control DC motor and induction motor drives for various applications	5	Evaluate

PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	2							2	2
CO2	3	3	2	2	2							2	3
CO3	3	3	3	2	3							2	3
CO4	3	3	3	2	2							2	3

Assessments:
Teachers' assessment-
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

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

ISE 1 and ISE 2 are based on examples like assignment/declared test/quiz/seminar/Group Discussions.
MSE: Assessment is based on 50% of course content. (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content. (Normally last three modules covered after MSE.)

Course Contents:	
Unit 1: Basics of Electrical Drives and Control: Electrical drives, Types, Advantages and disadvantages of electrical drives, Parts of Electrical drives, Choice of electrical drives for typical applications, classes of motor duty, determination of Motor Rating.	**6 Hrs.**
Unit 2: Dynamics of Electrical Drives: Fundamental Torque Equations, Speed Torque Conventions and Multi-quadrant Operation. Equivalent Values of Drive Parameters, Components of Load Torques, Nature and Classification of Load Torques, Steady State Stability, Load Equalization.	**7 Hrs.**
Unit 3: Control of Electrical Drives: Concept of Constant Torque control, constant power control, role of a gear in conventional drive and the concept of elimination of gear in electrical drive. Modes of the operation, speed control and drive classification, close loop control of drives. Closed loop torque control, Closed loop speed Control, Closed loop speed Control of multi motor drives, speed sensing, current sensing, Phase-locked-loop (PLL) control.	**8 Hrs.**
Unit 4: DC Motor Drives: Multi-quadrant operation of separately excited DC Shunt and DC Series motor using single phase and three phase full controlled and half controlled converter. Dual converter fed DC Drives. Chopper controlled DC motor drives, Performance and stability of variable speed DC drives, Regenerative breaking the DC Motor.	**8 Hrs.**
Unit 5: Control of Induction Motor Drives: Voltage Fed inverter (VSI) control, Open loop V/F Control, Speed control with torque and flux control. Current Fed inverter control (CSI), Independent Current and Frequency control. Speed and flux control in Current fed inverter drive, V/F Control in Current fed inverter drive. Introduction to Vector or field-oriented control.	**8 Hrs.**
Unit 6: Special Purpose Motor Drives: Synchronous motor and brushless dc motor drives, Synchronous motor variable speed drives, Variable frequency control, Permanent Magnet AC (PMAC) Motor Drives, Brushless DC Motor Drives. Traction motors, Conventional dc and ac traction drives, 25 kV ac traction using semiconductor converter controlled dc motors drives.	**8 Hrs.**

Texts and references:
1) Fundamentals of the electrical drives: Gopal K Dubey, Narosa publication
2) Advanced power Electronics and A.C. Drives: B.K. Bose
3) Electrical Drives Concept and application: Vedam Subrahnyam
4) Analysis of thyristor power conditioned motors: S. K. Pillai
5) T.J.E. Miller, Switched Reluctance & P.M. B.L. DC motor, Pergamon Press.
6) Special electrical Machines, K. Venkataratnam, University press, 2009, New Delhi.

Title of the Course: IOT for Electrical Engineering Course Code: UELPC0602	L	T	P	Credit
	02	-	-	02

Course Pre-Requisite: Knowledge of microcontrollers, Programming concept.

Course Description: This course discusses internet of things its architecture, connectivity, interfacing and application.

Course Objectives:

1. To understand fundamentals, architecture and various technologies of Internet of Things.
2. To impart knowledge on the infrastructure, sensor technologies and networking technologies of IoT.
3. To know the connectivity of devices using web and internet in the IoT environment.
4. To know various data acquisition methods, data handling using cloud for IoT applications.
5. To understand the implementation of IoT by studying case studies like Smart Home, Smart city.

Course Outcomes:

COs	After the completion of the course the students will be able to:	Blooms level	Descriptor
CO1	Familiarize students with the architecture and protocols associated with IoT	2	Understanding
CO2	Explain a fundamental understanding of the Internet of Things and its significance.	2	Understanding
CO3	Develop skills in selecting appropriate technologies to implement IoT solutions effectively.	3	Apply
CO4	Implement the IoT solution for smart home and smart security etc.	4	Design

PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1												
CO2		1											
CO3	1	1	1	2	2	2	1	1				1	1
CO4	1	1	1	2	2	2	1	1				1	1

Assessments:

Teachers' assessment-

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

Assessment	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

ISE1 and ISE2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content. (Normally first three modules)
ESE: Assessment isbasedon100%coursecontentwith60-70%weightage for course content. (Normally last three modules covered after MSE.)

Course Contents:	
Unit1:1. Introduction to IoT Definition and significance of IoT, Characteristics and architecture of IoT systems, Physical and logical design of IoT Functional blocks, Communication models, Communication Application Programming Interfaces (API).	**6Hrs.**
Unit2: IoT Communication Networks and Protocols Overview of communication networks: Home Area Network (HAN), Neighborhood Area Network (NAN), Field Area Network(FAN),Wide Area Network(WAN),Controller Area Network(CAN) Wireless Sensor Networks (WSNs), Access technologies and communication protocols, Overview of IEEE standards: 802.15.4, 802.11ah, LoRa WAN, Application layer protocols: CoAP, MQTT	**9Hrs.**
Unit3: IoT Sensors and Actuators Types of sensors used in IoT: environmental, medical, RFID, Actuator technologies and their applications, Challenges in IoT implementation: security, privacy, data management	**7Hrs.**
Unit4: Applications of IoT Smart homes: appliances, security systems, Smart energy solutions: smart meters, smart grids, Other applications: smart cities, automotive sector, healthcare, agriculture. .	**8Hrs.**

Textbooks:

1. Internet of Things by Rajkamal, Tata Mc Graw Hill Publication.
2. Internet of Things: A Hands-on Approach by Vijay Madisetti and Arshdeep Bahga, Universities Press.

Reference Books:

1. The Internet of Things: Connecting Objects by Hakima Chaouchi, Wiley Publication.
2. The Internet of Things –Key Applications and Protocols by Olivier Hersentetal., Wiley.

Title of the Course: Power System Protection
Course Code: UELPC0603

Course Pre-Requisite: Basic understanding of Power System, Fault Analysis, Per Unit System, Circuit analysis.

Course Description: This course provides an in-depth understanding of the principles, techniques, and technologies used in the protection of power systems. It covers the design and application of protection schemes to safeguard electrical equipment and ensure system reliability during faults and abnormal operating conditions. Students will explore the operation of protective relays, circuit breakers, and other components.

Course Objectives: To make the students

1. **Understand** faults and protection principles, including protection devices.
2. **Apply** different techniques to protect Transmission lines & various power system equipment.
3. **Analyze** computer/numerical protection schemes for power system protection.

Course Outcomes

COs	After completion of the course the students will be to	Bloom's Level	Descriptor
CO1	**Understand** power system faults, basics of power system protection and different components used for power system protection.	2	Understand
CO2	**Apply** different techniques to protect Transmission lines & various power system equipment.	3	Apply
CO3	**Analyze** the construction and working of Circuit Breakers.	4	Apply
CO4	**Analyze** the mathematical foundations of digital relaying techniques for power system protection.	4	Analyze

CO PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1		3							
CO2	3	3	3	3	2	2						1	1
CO3	2	2	2	1	1	1						1	1
CO4	3	3	3	3	3	1						1	1

Assessments:

Teachers' assessment

Assessment	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 etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content. (Normally the last three modules) covered after MSE.

Course Content
Unit 1: Introduction to Power System Protection Overview of Power System faults, types causes and effects of faults, need for power system protection, essential qualities of a protection system, components of a protection system, zones of protection, primary and back-up protection, current transformers (CT) and potential transformers (PT), Relays, classification of relays, operating principles and construction of different types of relays
Unit 2: Transmission Line Protection Basics of transmission line protection, overcurrent protection schemes, feeder protection, distance protection, conditions affecting the performance of distance relays.
Unit 3: Power System Equipment Protection Introduction to differential relaying, zone of protection of a differential relay, through fault stability, percentage differential protection, differential protection for various power system equipment's, generator protection schemes, transformer protection schemes.
Unit 4: Circuit Breakers Introduction to circuit breakers, arcing phenomenon, types of circuit breakers, methods used for arc extinction, recovery voltage, RRRV, resistance switching, current chopping
Unit 5: Computer Relaying Introduction to computer relaying, benefits, computer relay architecture, analog to digital converters, anti-aliasing filters, substation computer hierarchy.
Unit 6: Mathematical basis for protective relaying algorithms Fourier Series, estimation of phasors using full-cycle Discrete Fourier Transform (DFT), estimation of frequency in digital relays, practical considerations for selection of various algorithms.
Reference Books: 1. Badri Ram and D. N. Vishwakarma, Power System Protection and Switchgear, Tata McGraw Hill Education Private Limited 2. Paithankar Y.G, Fundamentals of Power System Protection, PHI Learning Pvt, 2010 Edition 3. Arun G. Phadke, J.S. Thorpe, Computer Relaying for Power Systems, Research Studies Press. 4. Practical Power System Protection, L.G. Hewiston, Mark Brown, Ramesh Balakrishnan, Elsevier.

Title of the Course Electrical Machine Design Course Code: UELPE0611	L	T	P	Credit
	03	-	-	03

Course Prerequisites: Electrical Machines, Electrical Engineering materials.

Course Description:
This course deals with the design of electrical machines using an analytical approach. The course covers the detailed part by part design of various machines derived using fundamental electromechanical equations. Various conventional electromechanical devices/machines including transformers, induction, synchronous and dc machine design is covered.

Course Objectives:
- To Understand the Principles of Electrical Machine Design.
- To select Electrical Engineering Materials required in machine design.
- To understand the design of transformer, Induction Motor & Synchronous Machine.
- To understand design of special purpose machines.

Course Outcomes:

COs	After completion of the course the students will be able to	Bloom's Level	Descriptor
CO1	Apply electrical machine design fundamentals and material selection for electrical machines.	3	Apply
CO2	Construct DC Machines & Transformers.	6	Create
CO3	Estimate design parameters of induction machines and synchronous machines.	6	Create
CO4	Design special purpose machines.	6	Create

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	2									2	
CO2	3	2	3	1	1							2	
CO3	3	2	3	1	1							3	
CO4	3	2	3	1	1							2	

Assessments:
Teachers' assessment-
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	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 etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weight-age for course content.(Normally last three modules) covered after MSE.

Course Contents:	
Unit 1: Fundamental Aspects of Electrical Machine Design: Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques. **Electrical Engineering Materials**: Desirability's of Conducting Materials, Comparison of Aluminium and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel. Insulating Materials: Desirable Properties, Temperature Rise and Insulating Materials, Classification of Insulating materials based on Thermal Consideration.	**08Hrs**
Unit 2: Design of DC Machines: Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings, (use of software tools for design is expected).	**08Hrs**
Unit 3: Design of Transformers: Output Equations of Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformers with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes, (use of software tools for design is expected).	**08Hrs**
Unit 4: Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.	**08Hrs**
Unit 5: Design of Three Phase Synchronous Machines: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.	**08Hrs**
Unit 6: Design of Special Machines: Design of Synchronous Reluctance Machines, Design of Brushless Permanent Magnet Machines, stepper motors.	**04Hrs**

Text Books:

1. A course in Electrical Machine design - A.K.Sawhney, Dhanpat Rai 6th Edition, 2013.
2. T. A. Lipo, "Introduction to AC Machine Design", IEEE Press – Wiley Publications, 2017.

References:

1. Performance and Design of Alternating Current Machines M.G. Say CBS Publisher 3 rd Edition, 2002
2. Design Data Handbook A. Sanmugasundaram Et al New Age International 1 st Edition, 2011
3. J. Pyrhonen, T. Jokinen, and V. Hrabovcova, "Design of Rotating Electrical Machines", John Wiley and Sons Inc., 2nd edition, 2013.
4. R. Krishnan, "Switched Reluctance Motor Drives", CRC Press LLC, USA, 2001.
5. J. R. Hendershot and T. J. E. Miller, "Design of Brushless Permanent – Magnet Motors", Motor Design Books LLC, 2nd edition, 2010.

Title of the Course Power System operation and control Course Code: UELPE0612	L	T	P	Credit
	03	**-**	**-**	**03**

Course Prerequisites: Basics of Electrical power systems, Power system analysis

Course Description:
This course offers an in-depth exploration of the fundamental principles and advanced techniques in the operation and control of power systems. Designed for students pursuing a career in electrical engineering or energy management, the course covers a range of topics essential for understanding the complexities of modern power grids.

Course Objectives:

- To Understand Power System Operations and Control
- To Analyze Economic Operation of Power Systems
- To Optimize Unit Commitment in Power Systems
- To Implement Hydrothermal Scheduling Techniques
- To Understand Automatic Generation Control (AGC)
- To Analyze Voltage and Reactive Power Control

Course Outcomes:

COs	After completion of the course the students will be to	Bloom's Level	Descriptor
CO1	To understand power systems operation, control and the economic operation of power system.	2	Understand
CO2	To explain unit commitment.	2	Understand
CO3	To explain hydrothermal scheduling.	2	Understand
CO4	To analyze power system operation with AGC and to implement different voltage control methods.	4	Analyze

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3			2		2					2	
CO2			3	3		2		2				2	
CO3	2	2		2					2		2	1	
CO4			3	3		2		2				2	

Assessments:
Teachers' assessment-
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50%weights respectively

Assessment	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 etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content. (Normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Power System Operation and Control - Operating States of a Power System, Objectives of Power System Control, Key Concepts for Reliable Operation, Major Threats to System Security, Preventive and Emergency Controls, Control Problems, Energy Management Centers, Major Components of Energy Centers, Modern scenario of power system.	**06Hrs**
Unit 2: **Economic Operation of Power Systems -** Generator Operating Cost, Performance Curves, Input-Output Curve for Thermal Plants, Heat Rate Curve, Incremental Fuel Rate Curve, Incremental Cost Curve, Input-Output Curve for Hydroelectric Unit, Economic Dispatch, Constrained Parameter Optimization using different methods, Deviations from Economic Dispatch, Economic Dispatch Including Generator Limits. (Numerical treatment)	**08Hrs**
Unit 3:Unit Commitment : Constraints in Unit Commitment, Spinning Reserve, Thermal Unit Constraints, Start-Up Costs of Thermal Units, Network Constraints, Emission Constraints, Capacity Limits of Generations, Fuel Constraints, Security Constraints, Hydel Plant Constraints, Priority List Method, Dynamic Programming, Dynamic Programming Methods for Unit Commitment, Alternative Approaches to Unit Commitment, Security Constraints in Unit Commitment, Expert System for Unit Commitment(Numerical treatment).	**08Hrs**
Unit 4: Hydrothermal Scheduling – Scheduling Hydro Systems, Discrete Time Interval Method, Short Term Hydrothermal Scheduling Using γ-λ Iterations, Short Term Hydrothermal Scheduling Using Penalty Factors, (Numerical treatment).	**07Hrs**
Unit 5: Automatic Generation Control: Basic Generator Control Loops, commonly used Terms in AGC, Functions of AGC, Speed Governors, Mathematical Model of Automatic Load Frequency Control, AGC Controller, Proportional Integral Controller, introduction to power system stabilizer (PSS), steady state and transient response including PSS.	**08 Hrs**
Unit 6: Voltage Control and power system security: Production and Absorption of Reactive Power, Methods of Voltage Control, Dependence of Voltage on Reactive Power, Sensitivity of Voltage to Changes in P And Q, Cost Saving, Methods of Voltage Control by Reactive Power Injection, Voltage Control Using Transformers, Voltage Stability. Definition and Importance of Power System Security, Types of Power System Security-Operational Security, Threats to Power System Security, Key Objectives of Power System Security.	**08 Hrs**

TextBooks:

1) Power System Operation and Control K. Uma Rao Wiley 1st Edition, 2012
2) Power system operation and control, by Sivanagaraju, Pearson publication

References:

1) Power Generation Operation and Control Allen J Wood etal Wiley 2nd Edition,2003
2) Power System Stability and Control Prabha Kundur McGraw Hill 8th Reprint, 2009

Title of the Course: Advanced Control Systems **Course Code: UELPE0613**	**L**	**T**	**P**	**Credit**
	03	**-**	**-**	**03**

Course Prerequisites: Basics of Control Systems, Laplace Transform.

Course Description:
Advanced Control Systems is an intensive course designed to provide students with an in-depth understanding of the advanced control techniques and methodologies. Building upon fundamental principles of control engineering, this course delves into sophisticated strategies for the analysis, design, and implementation of control systems in various engineering applications. Through a combination of theoretical lectures, practical examples, students will develop the skills necessary to tackle complex control challenges encountered in modern engineering systems.

Course Objectives:

1. To provide a strong insight on the state space representation and on advanced control system.
2. To provide the analysis and design techniques to analyze the behavior of nonlinear control systems.

Course Outcomes:

COs	**After completion of the course the students will be to**	**Bloom's**	**Descriptor**
CO1	Describe the Function of Nonlinear Systems.	**2**	Understand
CO2	Analyze the different Control Systems with State variable methods	**4**	Analyzing
CO3	Design of control system via pole placement and state observers	**5**	Evaluating
CO4	Determine the stability of systems by Lyapunov Stability Analysis and Parameter Optimization	**5**	Evaluating

CO-POMAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3	2	2	2	1							1	3
CO2	2	2	2	2	1							3	2
CO3	2	2	2	2	1							2	2
CO4	2	2	2	2	1							2	2

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

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

ISE1 and ISE2 are based on assignment/ declared test/quiz/seminar/Group Discussions etc. MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weight-age for course content.(Normally last Three modules) covered after MSE.

Course Contents:

Unit-I: Control System Analysis Using State Variable Methods Introduction, Vectors and Matrices, State variable Representation, Conversion of State variable Models to Transfer functions, Conversion of Transfer functions to Canonical State variable Models, Eigen Values and Eigen Vectors, Solution of State Equations, Concept of Controllability and Observability, Review Examples.	**08 Hrs**

Unit II: State Variable Analysis of Digital Control Systems Introduction, State Description of Digital Processors, State Description of Sampled Continuous- Time Plants, State Description of Systems with Dead-Time, Solution of State Difference equations, Review Examples.	**07 Hrs**
Unit III: Pole Placement Design Introduction, Stability Improvement by state feedback, Necessary and sufficient conditions for Arbitrary Pole-Placement, State regular design, Design of State Observer, Compensator Design by the separation Principle, State feedback with integral control.	**07 Hrs**
Unit IV: Lyapunov Stability Analysis Introduction, Basic Concept, Stability Definitions, Stability theorems, Lyapunov Functions for Non-Linear Systems, Lyapunov Functions for Linear Systems, A Model reference Adaptive System, Discrete– Time Systems, Review Examples.	**07 Hrs**
Unit V: Linear Quadratic Optimal Control Parameter Optimization and Optimal Control Problems, Quadratic Performance Index, Control Configurations, State Regulator Design through the Lyapunov Equations, Optimal State Regulator through the Riccati Equation, Optimal Digital Control Systems, Central monitoring & Control systems Review Examples.	**08 Hrs**
Unit VI: Non Linear Control Systems Introduction, A Class of Nonlinear System: Separable Nonlinearities, Filtered Nonlinear System: The Describing Function analysis, Describing Function of Common Nonlinearities, Stability Analysis by the Describing Function method, Non Linear Sampled – data System, Second order Non Linear System on the Phase Plane, Review Examples.	**08 Hrs**

Text Books:

1. Control System Engineering, Norman S. Nise,4th Edition, John WileyandSons,2004.
2. Control Systems,2nd Edition, N.C.Jagan,B S Publications.
3. Advanced Control Engineering, R.S.Burns, Butterworth Heinemann, 2001.

References:

1. K.Ogata, "Modern Control Engineering",Fourth Edition, PrenticeHallofIndia,2002.
2. J.NagrathandM.Gopal,"ControlSystemEngineering",SecondEdition,WileyEastern Limited.
3. M.Gopal,"ControlSystems,PrinciplesandDesign",SecondEdition,TMH,NewDelhi,2002.
4. B.C.Kuo,"AutomaticControlSystems",SeventhEdition,PrenticeHallofIndia,NewDelhi, 2002.
5. A.Nagoor Kani, Control System, RBA Publications.
6. M.Gopal, Digital Control & State Variable Methods, TMH.

Title of the Course: Business Communication and Value Science (Practical) **Course Code: UELAE0631**	**L**	**T**	**P**	**Credits**
	-	-	2	1

Course Pre-Requisite: Basics of Communication Skills, LSRW Skills, Grammar etc.

Course Description:

This practical course is designed to build essential communication, emotional, and professional skills among undergraduate engineering students. Through engaging and hands-on activities, role plays, reflections, and presentations, students will enhance their self-awareness, emotional intelligence, intercultural sensitivity, teamwork, and workplace readiness.

Course Learning Objectives:

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

1. Conduct self-assessments to identify personal strengths and areas for growth.
2. Develop life skills like empathy, resilience, and interpersonal communication.
3. Understand and apply soft skills and ethics in real-life contexts.
4. Demonstrate professional communication in interviews, group tasks, and presentations.
5. Enhance employability quotient through resume writing, group discussion, and mock interviews.
6. Apply emotional intelligence and cross-cultural communication in workplace scenarios.
7. Practice leadership, motivation, and storytelling techniques for professional success.

Course Outcomes:

CO	After Completion of the course, the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the importance of life skills for holistic personality development	2	Understand
CO2	Apply verbal and non-verbal communication skills in presentations and group activities	3	Apply
CO3	Analyze individual personality traits, values, and competencies for self-growth	4	Analyze
CO4	Evaluate cross-cultural cues and use emotional intelligence in workplace situations	5	Evaluate
CO5	Create job-oriented content such as resumes, cover letters, and participate in interviews	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO01	PSO02
CO1							2	1	1		2		
CO2							3	3	1		2		
CO3							3	1	3		2		
CO4							2	2	2		2		
CO5							2	2	1		2		

Assessments:

Teacher's Assessment: -

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

Assessment	Marks
ISE	50

Assessment will be based on:

Practical performance, Presentations, Group Discussions, Interviews, Assignments, Quizzes, Demonstrations, etc.

Course Contents:

Practical 1: Self-Awareness and SWOT	**2 Hours**
Understanding personal traits. SWOT and TOWS analysis. Presentation on self-strengths and surviving in the VUCA world. Reflection journal submission.	
Practical 2: Soft Skills and Workplace Ethics	**2 Hours**
Introduction and importance of Soft Skills. Checklist on Soft Skills and action plan for improvement. Peer discussion on ethical challenges- Participants will read case studies, discuss, and list down the soft skills.	
Practical 3: Assertive Communication and Positive Attitude	**2 Hours**
Positive self-talk, attitude, and goal setting. Checklist on Positive self-talk, Positive Attitude and Self-Esteem, Goal setting, right attitude Assertiveness Self-assessment Test: https://www.psychologytoday.com/intl/tests/personality/assertiveness-test	
Practical 4: Employability Quotient 1: Employment Correspondence	**2 Hours**
Drafting resume, cover letter, and professional email. Formatting, tone, and clarity practice.	
Practical 5: Employability Quotient 2: Workplace Expectations	**2 Hours**
Open discussion on the topic, "Employers' expectations and the need for new skillset for the changing workforce trends." The focus is on raising learning and adaptability through employment perspective. A detailed checklist is provided to the participants to match their skills and employer's expectations.	
Practical 6: Employability Quotient 3: Group Dynamics	**2 Hours**
Participants will be engaged in Group Discussion activity to harness effective communication skills, self-confidence, assertive self-expression, team work and constructive exchange of ideas and thoughts.	
Practical 7: Employability Quotient 4: Interview Techniques	**2 Hours**
Mock interviews with peer and faculty feedback. Tips on etiquette, articulation, and handling stress.	
Practical 8: Professional Presentation Skills	**2 Hours**

Participants will prepare and deliver a presentation on their technical projects/mini-projects. The focus will be on body language, voice modulation, team coordination, engagement with audience, time management, slide design/visuals, technical depth.	
Practical 9: Emotional Intelligence	**2 Hours**
Strategies to hone EI. Video screening and discussion. Extempore based on EI topics. Peer feedback. EQ test and reflection.	
Practical 10: Motivation and Leadership	**2 Hours**
Participants are given few case studies/ video samples to understand motivation. Participants will talk about their favourite leader and motivation through their life.	
Practical 11: Cross- cultural Communication	**2 Hours**
Techniques to facilitate cross-cultural communication. Participants will be provided a set of case scenarios to analyse cross-cultural communication. Participants will attempt a quiz based on different cultures.	
Practical 12: Storytelling for Business	**2 Hours**
Create and present a technical story. Emphasis on narrative, engagement, and audience connection.	
Reference Books:	
1. Dryden, W. & Constantinou, D. (2004). *Assertiveness Step by Step*. Sheldon Press. 2. Goleman, D. (2006). *Emotional Intelligence*. Bloomsbury Publishing. 3. Northouse, P. G. (2021). *Leadership: Theory and Practice*. Sage Publications. 4. Maslow, A. H. (1943). *A Theory of Human Motivation*. 5. Raman, M. & Sharma, S. (2013). *Communication Skills*. Oxford University Press.	
Online Resources:	
1. Ted Talk: How to Speak So That Others Want to Listen- https://www.youtube.com/watch?v=eIho2S0ZahI1 2. TEDx talk by Adam Galinsky: How to speak up for yourself- https://www.ted.com/talks/adam_galinsky_how_to_speak_up_for_yourself?language=en 3. https://www.youtube.com/watch?v=FFjGGZecO04 4. Steve Jobs: Connecting the dots- https://news.stanford.edu/2005/06/14/jobs-061505/	

Title of the Course: Electrical Drives and Control Laboratory Course Code: UELPC0631	L	T	P	Credit
	-	-	2	01

Course Pre-Requisite: Basic Knowledge of Power Electronics & Electrical Machines is desirable.

Course Description:

This course focuses on the practical aspects of motor drive systems, with an emphasis on different types of converter-fed and inverter-fed motor drives. It covers the operation, control, and performance analysis of DC motor drives (including single-phase and three-phase fully controlled, half-controlled, and dual converter systems) as well as chopper-fed DC motor drives. The course also delves into the control of three-phase induction motors, specifically using variable frequency drives (VFDs) and the slip power recovery scheme for speed control. Additionally, students will explore the speed control and operation of special-purpose motors, such as Brushless DC (BLDC), Permanent Magnet Synchronous Motors (PMSM), Switched Reluctance Motors (SRM), and Stepper motors.

Hands-on simulations of key motor drive systems, including the single-phase fully controlled converter, dual converter, and chopper-fed DC motor drives, will provide students with valuable practical experience in understanding the behavior and control of these systems. The course also includes simulation of advanced inverter operations such as 180-degree mode, helping students grasp the complexities of real-world motor control applications.

Course Objectives:

1. Understand and analyze the operation of controlled converter-fed DC motor drives.
2. Design and implement control strategies for DC and induction motor drives.
3. Simulate motor drive systems and analyze their behavior in different operating modes.
4. Explore and implement control methods for special purpose motors.

Course Outcomes:

CO	After the completion of the course the student should be able to	Blooms level	Descriptor
CO1	Understand and analyze the operation of controlled converter-fed DC motor drives.	3	Understand
CO2	Design and implement control strategies for DC and induction motor drives.	4	Apply
CO3	Explore and implement control methods for special purpose motors.	4	Apply
CO4	Simulate motor drive systems and analyze their behavior in different operating modes.	5	Analyze

PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	3							2	3
CO2	3	3	3	2	3							3	3
CO3	3	3	3	2	3							3	3
CO4	3	2	2	3	2							2	3

Assessments:

Teacher's Assessment: -

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

Assessment	Marks
ISE	25
ESE (POE)	25

ISE is based on at least two of the assessment tools like performance of student in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). ESE Assessment is based on performance in practical conduction & oral at the end of the semester.

List of Experiments: Perform any 10 Experiments. (Six hardware expt. and four based on Simulation)	
1. Single phase fully controlled converter fed separately excited DC motor drive.	**2 hours**
2. Three phase half-controlled converter fed separately excited DC motor drive.	**2 hours**
3. Three phase fully controlled converter fed separately excited DC motor drive.	**2 hours**
4. Dual converter fed separately excited DC motor drive.	**2 hours**
5. Chopper fed DC motor drive	**2 hours**
6. Inverter fed Three phase induction motor drive control using VFD.	**2 hours**
7. Speed control of three phase induction motor using slip power recovery scheme.	**2 hours**
8. Speed Control of special purpose Motors (BLDC/PMSM/SRM/Stepper motor)	**2 hours**
9. Simulation of single phase fully controlled converter fed separately excited DC motor drive.	**2 hours**
10. Simulation of Dual converter fed separately excited DC motor drive.	**2 hours**
11. Simulation of chopper fed DC motor drive.	**2 hours**
12. Simulation of 180-degree mode operation of inverter. Design of motor control unit.	**2 hours**

Title of the Course: IoT in Electrical Engineering Laboratory Course Code: UELPC0632	L	T	P	Credit
	-	-	02	01

Course Pre-Requisite: Basics of IoT, Microcontrollers.

Course Description: This course discusses the basics of IoT and enables the student to get acquainted with the required software and hardware necessary for implementing IoT solutions in real-world scenarios.

Course Objectives: To make the students aware of

1. To impart knowledge on the infrastructure, sensor technologies and networking technologies of IoT.
2. To analyze the challenges and develop IoT solutions.
3. To understand the working of basic microcontrollers such as Arduino Uno and the programming associated with it.
4. To seamlessly integrate microcontrollers with smart devices for different applications.
5. To apply the concept of IoT in real world scenarios.

Course Outcomes:

CO	After the completion of the course the student should be able to	Blooms level	Descriptor
CO1	Demonstrate the concepts of IoT to understand the working and implementation of IoT.	2	Understand
CO2	illustrate SQL Database creation along with Raspberry-Pi.	2	Understand
CO3	Apply programming techniques to Arduino Uno and sensors as part of IoT.	3	Apply

POMAPPING:

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

Assessments:

Teacher's assessment:

Assessment	Marks
ISE	25
ESE(OE)	25

In Semester Evaluation (**ISE**), and End Semester Examination (**ESE**) having 50% weightage each.

ISE is based on the performance of students in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). The course teacher shall set at least two assessment tools as mentioned above for ISE.

ESE: Assessment is based on performance and oral examination

Course Contents: Perform the following 10experiments.

Experiment1: --- Introduction to Arduino microcontroller and its programming.	
Experiment2: --- Interfacing LED and RGB with Arduino microcontroller.	
Experiment3: --- Using condition and looping with LED.	
Experiment4: --- Controlling SERVO motor with Arduino microcontroller.	
Experiment5: --- Interfacing Arduino with smart phone for enabling home automation	
Experiment6: --- Temperature and Humidity measurement using ESP 32 and Things Speak.	
Experiment7: --- WebSocket's programming for client server model.	
Experiment8: --- Introduction to Raspberry-pi programming.	
Experiment 9: --- Functional Testing Of Devices:Flashing the Operating System on the device into a stable functional state by porting desktop environment with necessary packages.	
Experiment10:--- Exporting display on to other systems:Making use of available desktop/laptop displays as a display for the device using SSH client and X11 display server.	
Experiment 11: --- My SQL Database installation in Raspberry-Pi.	
Experiment 12: -- SQL Queries by fetching data from database in Raspberry-Pi.	

References:

1. Designing the Internet of Things, Adrian Mc Ewen and Hakim Cassimally, Wiley, Firstedition,2013.
2. Getting Started with the Internet of Things, Cuno P fister, O'reilly,2011.
3. Internet of Things: A Hands-on Approach, Arshdeep Bahga ,and Vijay Madisetti, 2014.
4. ArduinoProgramming-TheUltimateBeginner'sandIntermediateGuidetolearnArduino Programming Step by Step.

The official Raspberry PI Handbook,2025, The Mag Pi, Raspberry Pi Pr

Title of the Course: Power System Protection Laboratory Course Code: UELPC0633	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: Basic understanding of Power System, Fault Analysis, Circuit analysis, Relay functioning.

Course Description: This laboratory course provides hands-on experience in the principles and practices of power system protection. Students will explore the operation, testing, and analysis of protective relays. Students will also be able to simulate different power system faults and observe the effects of such faults on system conditions.

Course Objectives

4. **Understand** the effect of different faults of electrical waveforms.
5. **Apply** coding and simulation skills for visualization of different faults and design of protection schemes.
6. **Analyze** the working of electromechanical type overcurrent relays and observe IDMT characteristics.
7. **Analyze** the working of static and microprocessor-based relays and observe definite-time characteristics.

Course Outcomes

COs	After completion of the course the students will be to	Bloom's Level	Descriptor
CO1	**Understand** the effect of different power system faults on voltage and current waveforms.	2	Understand
CO2	**Apply** coding and simulation skills for visualization of different faults and design of protection schemes.	3	Apply
CO3	**Analyze** the working of electromechanical, static and microprocessor-based relays.	4	Analyze

PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	2	2	1	1		1			1	1	1
CO2	1	1	1	1	2				1				1	1
CO3	1	1	2	2	1		1					1	1	1

Assessments:

Teachers' assessment

Assessment	Marks
ISE	25

List of Experiments	Hours
Exp 1: Construct voltage signals in MATLAB using script and function files.	**2**
Exp 2: Create SIMULINK model generating voltage signals with different features.	**2**
Exp 3: Create a function file computing the sequence components of a balanced and unbalanced three-phase system**.**	**2**

Exp 4: Create a function file computing the Root Mean Square (RMS) of a waveform.	**2**
Exp 5: Characteristics of an electromagnetic-type over-current relay using a relay trainer kit (non-directional).	**2**
Exp 6: Characteristics of an electromagnetic-type over-current relay using a relay trainer kit (Directional).	**2**
Exp 7: Characteristics of a solid-state-type over-voltage and under-voltage relay using a relay trainer kit.	**2**
Exp 8: Characteristics of a microprocessor-based over-voltage and under-voltage relay using a relay trainer kit.	**2**
Exp 9: Characteristics of a microprocessor-based over-current and under-current relay using a relay trainer kit.	**2**
Exp 10: Create a SIMULINK model for the protection of a single-phase transformer using the differential protection scheme.	**2**
Exp 11: Study of impact of DC offset on the performance of Distance relays through SIMULINK/ETAP.	**2**
Exp 12: Study of impact of source impedance and line impedance on the performance of Distance relays through SIMULINK/ETAP.	**2**
Exp 13: Visit and Audit of any power system protection setup.	**2**

Reference Books:

1. Warrington, Protective Relays – Their theory and practice, Volumes I, II and III, Chapman and Hall.
2. Arun G. Phadke, J.S. Thorpe, Computer Relaying for Power Systems, Research Studies Press.
3. Badri Ram and D. N. Vishwakarma, Power System Protection and Switchgear, Tata McGraw Hill Education Private Limited.

Practical Power System Protection, L.G. Hewiston, Mark Brown, Ramesh Balakrishnan, Elsevier.

Title of the Course: Mini Project-II Course Code: UELIL0631	L	T	P	Credit
	-	-	02	01

Course Pre-Requisite: Basics of Electrical and Electronics Engineering.

Course Description:

This lab prepares students to develop thinking processes to solve social problems by application of science and engineering in an innovative manner. The group of students not more than 3 should identify social problems, perform requirement analysis. After interactions with the course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and objectives of micro-project. As per requirements the group should develop specifications regarding the outcome of the project. The students should think critically and undertake design of the project with skills available with them to meet the requirements and specifications. The group is expected to detail specifications, methodology, resources required, and critical issues involved in design and implementation and submit the proposal within the first week of the semester. The student is expected to exert on design, development and testing of the proposed work as per the schedule. The working model of the project will be demonstrated for internal submission. Completed micro project and documentation in the form of micro project report is to be submitted at the end of semester. The project should be completed in 12 weeks including field trials if any. At the end of the project, the guide should advise students to protect Intellectual Property either in the form of Patent or registration of design or publish paper on work completed or participate in project competition.

Course Objectives:

1. **Identify** the problem statement.
2. **Understand** the methodology to troubleshoot the small circuit
3. **Convert** ideas into a product.
4. **Work** in a group to implement the idea.
5. **Communicate** effectively to present the mini project.

Course Outcomes:

COs	After completion of the course the students will be to	Bloom's Level	Descriptor
CO1	Apply the knowledge of advanced Electric and Electronic fundamental for problem identification.	4	Analyzing
CO2	Develop methodology to troubleshoot circuit.	4	Analyzing
CO3	Demonstrate the hardware/software of the project	5	Evaluating
CO4	Implement the hardware of the projects.	5	Evaluating

CO-POMAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PSO1	PSO 2
CO1	3	3	2	3	2	2	1					3	3
CO2	3	3	2	3	2	2	1					3	3
CO3	3	3	3	2	2	3	2	3	2	3	2	3	2
CO4	3	3	3	2	2	3	2	3	2	3	2	3	2

Assessments:
Teachers 'assessment-

In Semester Evaluation (ISE), and End Semester Examination(ESE) having 50%weightageeach

Assessment	Marks
ISE	25

ISE is based on the performance of students in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz).

Course Contents:

- Environment protection, global warming, safe drinking water, waste management, renewable energy utilities, biomedical engineering, accident prevention, enabling weaker section of society, efficiency/cost/ time improvements, human hardship reduction, prosthesis, smart city, smart transportation, energy audit and saving.
- Studentsshouldformgroupsofmaximumfourinrespectivepracticalbatch.
- Mini projects should be a working model based upon their knowledge, understanding and practices.
- Evaluation of mini project will be through presentation, demonstration and report writing.

5. **Smart Grids**

Unlike in the past, whereby consumers solely depended on a local electrical power company, today, they have many options. With the ability to even generate their own power, some consumers also now want to sell their surplus. As a result, the electricity delivery infrastructure has to change. In response to these demands, most Energy Departments around the world are placing smart devices throughout their networks, right up to customers' homes, offices, and factories. The smart grid collects valuable data to allow both consumers and suppliers a higher degree of control over multiple power sources. It also enables them to predict surges in usage and instantly detect outages. By allowing end-to-end communication between distribution sites, power plants, and the end user's electrical point-of-presence, smart grids significantly raise efficiency and reduce costs. Soon, it's inevitable that electrical engineers will frequently come across smart grids and or be asked to help develop one.

6. **Electric Vehicle**

Tesla recently hit the $100 billion milestone, making itself the first publicly listed US carmaker in history to do so. This is a good sign that electric vehicles have come to stay. Experts predict that by 2030, there would be over 125 million electric vehicles on the road. Considering the millions of EVs that are already roaming the streets, this is not so much of a long-short. Many EV manufacturers are investing hard into the tech, and consumers can expect better batteries, improved charging tech, more accurate autonomous driving, solar-powered EVs, and even electric planes.

7. **Wireless Power Transmission**

Wireless power transfer is in its primitive stages, but the future is bright. In future, we expect better wireless charging for laptops, smart phones, earphones, and other smart devices. Shortly, however, we expect much more. Soon, wireless charging will also become the standard for electric cars. Instead of the large charging docks, drivers will be able to park on a charging spot without needing to plug in. Expects predict that a few years from now, it will also be possible to charge your electric vehicle while it's moving.

8. **Artificial Intelligence**

If artificial intelligence has penetrated large industries like armaments and medicine, surely the Electrical Engineering landscape cannot be an exception. Electrical Engineers are expected to do much better with AI. By blending their prowess and skill with the know-how of AI and machine learning, electrical engineers are contributing the following:

- Create complex algorithms for data interpretation
- Generate new codes or revamping existing codes
- Build massive Ai and machine learning platforms
- Develop comprehensive strategies in the field of electronics

Most notably, artificial intelligence is going to help electrical engineers with image processing. Leveraging AI, engineerscaninventcompleximageprocessingalgorithmstohelpmachinesdetectelectricalorstructural

Title of the Course: Co-Curricular Activities-III Course Code: UELCC0631	L	T	P	Credits
			02	01

Course Pre-Requisite:

None: 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 helps 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 aimed at 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 Learning Objectives (CLOs):

1. To encourage students to showcase 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):
At the end of the course students will be able to:

CO1:	**Demonstrate** the ability to critically analyze information and apply independent judgment in decision-making within the context of the activity.
CO2:	**Apply** principles of management and organizational skills to plan, coordinate, and execute tasks related to the co-curricular activity.
CO3:	**Collaborate**effectivelywithpeerstoachievecommongoalsandobjectiveswithintheco-curricular activity.
CO4:	**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/Events Conducted by Professional Societies (ISTE, IEI, CSI, IEEE, IETE, SAE, ISRO-IIRS, SWE, ISHRAE, ASM, ISNT etc.) 4. Attending Full time Conference/ Seminars/ Exhibitions/ Workshop/ STTP Conducted at IITs/ NITs/ Reputed Institutes/ Universities 5. Attending Full time Conference/ Seminars/ Exhibitions/ Workshop/ STTP Conducted at KITCoEK 6. Paper Presentation in National/ International Conference of High Repute 7. Poster Presentation in National/ International Conference of High Repute 8. Paper Publication in National/ International Journal of High Repute 9. Industrial Training/ Internship (at least for 04Weeks) 10. 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 Secretary, Ladies Representative, Academic Toppers, Invitee Members) 2. Office Bearer of Professional Society Chapter (ISTE, IEI,CSI, IEEE, IETE, SAE, ISRO-IIRS, SWE, ISHRAE, ASM, ISNT etc.) 3. Office Bearer of Institute Level Student Club (Developer Student Club, Gaganvedhi, Walk with World, Team Mavericks, Cultural Club, Aura, Amateur Write Club, Rotaract Club of KIT Sunshine, Women Development and Gender Equality Cell, Shourya, Lead India etc.) 4. Office Bearer of Departmental Student Association 5. Office Bearer of E Cell, Digital Content Lab etc. 6. Student Ambassador for Mayura AICTE IDEA Lab/ NIDHI iTBI etc. 7. Editorial Board Member of Annual Magazine 8. Editorial Board Member of E-Newsletter 9. 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

Title of the Course: Artificial Intelligence for Robots Course Code: UELMM0641	L	T	P	Credit
	03	-	-	03

Course Pre-Requisite: Knowledge of linear algebra, calculus, probability, and statistics, understanding algorithms and data structures is essential for building efficient AI models along with programming skills.

Course Description: This course discusses fundamentals of robotics with artificial intelligence perception.

Course Objectives:

1. To understand fundamentals of artificial intelligence in robotics.
2. To familiarize the integration of Artificial Intelligence techniques in robotic systems.
3. To develop understanding of motion control and decision making in robots with Artificial Intelligence.
4. To understand the implementation of Artificial Intelligence in robots for different applications.

Course Outcomes:

COs	After the completion of the course the students will be able to	Blooms level	Descriptor
CO1	Explain fundamental principles of robotics and AI	2	Understanding
CO2	Understand integration of AI techniques in robotic systems.	2	Understanding
CO3	Develop skills in implementing AI algorithms for robotic applications.	3	Apply
CO4	Relate real-world applications of AI in various domains of robotics.	4	Analyzing

POMAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1			1		1							
CO2	1					1							
CO3		1			2			1			1	1	1
CO4		1			2	1	1	1			1	1	1

Assessments:
Teachers' assessment-

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content.

Course Contents: **Unit1: Fundamentals of Artificial Intelligence** Key concepts in artificial intelligence and machine learning, Machine learning basics: supervised, unsupervised, and Reinforcement learning, Introduction to neural networks and deep learning concept.	**7Hrs.**
Unit 2: Introduction to Artificial Intelligence in Robotics Overview of robotics and artificial intelligence, Types and classifications of robots, The role of AI in enhancing robotic capabilities.	**8Hrs.**
Unit 3: Robotic Perception Sensor technologies for robots: cameras, LIDAR, ultrasonic sensors, Image processing techniques for perception, Computer vision algorithms: object detection, recognition, and tracking	**8Hrs.**
Unit 4: Motion Planning and Control Kinematics and dynamics of robotic systems, Path planning algorithms: Dijkstra's algorithm, RRT (Rapidly exploring Random Tree), Control strategies for robotic movements: PID control, adaptive control	**8Hrs.**
Unit5: Decision Making in Robotics Decision-making frameworks: Markov Decision Processes (MDPs), Partially Observable MDPs (POMDPs), Reinforcement learning applications in robotics, multi-agent systems and coordination strategies	**8Hrs.**
Applications of Artificial Intelligence in Robotics Autonomous vehicles: navigation and obstacle avoidance, Industrial robots: automation and efficiency improvements, Service robots: applications in healthcare, agriculture, and domestic environments.	**7Hrs.**

Textbooks:

1. Artificial Intelligence for Robotics by Robin R. Murphy, Bradford Books;2nd edition.
2. Robotics: Modelling, Planning and Control by Bruno Sicilianoetal, Springer Nature; 2018th edition

Reference Books:

1. Introduction to Autonomous Robots by Nikolaus Correll.
2. Deep Learning for Robotics by Abhinav Gupta et al.

Dr. M.K. Aalam
BOS Chairman

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

Dr. Akshay Thorvat
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