D Y PATIL
DEEMED TO BE
UNIVERSITY

SCHOOL *of* ENGINEERING
& MANAGEMENT
KOLHAPUR

F.Y. B. Tech.
Electrical Engineering
Structure and Curriculum

Department of First Year Engineering

w. e. f. A.Y.: 2024-25

F.Y. B. Tech Electrical Engineering Structure 2024-25

SEMESTER – I											
			Teaching Scheme				Theory			Practical		
Course Category	Course Type	Course Name	Credits	Contact Hrs.			ISE	MSE	ESE	INT	OE/ PoE	Total Marks
				L	P	T						
Basic Sciences	BSC	Linear Algebra & Calculus	4	3	-	1	20	30	50	25	-	125
	BSC	Applied Chemistry	4	3	2	-	20	30	50	25	-	125
Engineering Science	ESC	Problem Solving through Programming	4	3	2	-	20	30	50	25	-	125
Ability Enhancement Course	AEC	Professional Communication	2	1	2	-	25	-	-	25	-	50
Vocational Skills Enhancement Course	VSEC	Python Programming	2	1	2	-	25	-	-	25	-	50
Indian Knowledge System	IKS	Historical Places in and Around Kolhapur District	2	2	-	-	20	30	-	-	-	50
Co-Curricular Activities	CCA	Liberal Learning - I	2	-	4	-	-	-	-	50	-	50
Mandatory Course	MC	Finishing School Training - I	-	3	-	-	50	-	-	-	-	Grade
		Rural/Social Internship	-	-	-	-	-		-	50	-	Grade
		Total	**20**	**13**	**12**	**1**	**180**	**120**	**150**	**225**	-	**575**
SEMESTER – II												
Basic Sciences	BSC	Differential Equations & Numerical Techniques	4	3	-	1	20	30	50	25	-	125
	BSC	Applied Physics	4	3	2	-	20	30	50	25	-	125
Engineering Science	ESC	Generative AI	4	3	2	-	20	30	50	25	-	125
	ESC	Digital Logic Design	4	3	2	-	20	30	50	25	-	125
Co-Curricular Activities	CCA	Liberal Learning - II	2	-	4	-	50	-	-	-	-	50
Program Core Courses	PCC	Basics of Analog Electronics	2	2	-	-	-	-	50	-	-	50
Vocational Skills Enhancement Cours	VSEC	Design Thinking Through Innovation	2	1	2	-	25	-	-	25	-	50
Mandatory Course	MC	Capstone Project	-	-	-	-	-	-	-	50	-	Grade
		Finishing School Training - II	-	3	-	-	50	-	-	-	-	Grade
		Total	**22**	**15**	**12**	**1**	**205**	**120**	**250**	**175**	-	**650**

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School of Engineering & Management

Department of First-Year Engineering

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

F. Y. B. Tech. Scheme of Teaching and Examination w. e. f. A. Y. 2024-2025

Semester -I

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme			
				L	P	T			Type	Max. Marks	Minimum Marks For Passing	
Students Induction Program as Per AICTE Guidelines												
1	241ELEBSCL101	BSC	Linear Algebra & Calculus	03	--	--	03	100	ISE MSE ESE	20 30 50	40	
2	241ELEBSCL107	BSC	Applied Chemistry	03	--	--	03	100	ISE MSE ESE	20 30 50	40	
3	241ELEESCL101	ESC	Problem Solving through Programming	03	--	--	03	100	ISE MSE ESE	20 30 50	40	
4	241ELEIKSL101	IKS	Historical Places in and Around Kolhapur District	02	--	--	02	50	ISE MSE	20 30	20	
5	241ELEVSECL103	VSEC	Python Programming	01	--	--	01	25	ISE	25	10	
6	241ELEAECL102	AEC	Professional Communication	01	--	--	01	25	ISE	25	10	
7	241ELEBSCP102	BSC	Linear Algebra & Calculus Tutorial	--	--	01	01	25	ISE	25	10	
8	241ELEBSCP108	BSC	Applied Chemistry Laboratory	--	02	--	01	25	ISE	25	10	
9	241ELEESCP102	ESC	Problem Solving through Programming Laboratory	--	02	--	01	25	ISE	25	10	
10	241ELEVSECP104	VSEC	Python Programming Laboratory	--	02	--	01	25	ISE	25	10	
11	241ELEAECP103	AEC	Professional Communication Laboratory	--	02	--	01	25	ISE	25	10	
12	241ELECCAP101	CCA	Liberal Learning - I	--	04	--	2	50	ISE	50	20	
Total				**14**	**14**	**01**	**20**	**575**	--	--	--	--
Mandatory Courses												
1	241ELEMC102	MC	Rural/Social Internship	--	--	--	--	50	ISE	Grade	--	--
2.	241ELEMC101	MC	Finishing School Training - I	03	--	--	--	50	ISE	Grade	--	--

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

F. Y. B. Tech. Scheme of Teaching and Examination w. e. f. A. Y. 2024-2025
Semester -II

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme			
				L	P	T			Type	Max. Marks	Minimum Marks for Passing	
1	241ELEBCSL103	BSC	Differential Equations & Numerical Techniques	03	--	--	03	100	ISE MSE ESE	20 30 50	40	
2	241ELEBSCL105	BSC	Applied Physics	03	--	--	03	100	ISE MSE ESE	20 30 50	40	
3	241ELEESCL105	ESC	Generative AI	03	--	--	03	100	ISE MSE ESE	20 30 50	40	
4	241ELEESCL103	ESC	Digital Logic Design	03	--	--	03	100	ISE MSE ESE	20 30 50	40	
5	241ELEPCCL101	PCC	Basics of Analog Electronics	02	--	--	02	50	ESE	50	20	
6	241ELEVSECL101	VSEC	Design Thinking Through Innovation	01	--	--	01	25	ISE	25	10	
7	241ELEBSCP104	BSC	Differential Equations & Numerical Techniques Tutorial	--	--	01	01	25	ISE	25	10	
8	241ELEBSCP106	BSC	Applied Physics Laboratory	--	02	--	01	25	ISE	25	10	
9	241ELEESCP106	ESC	Generative AI Laboratory	--	02	--	01	25	ISE	25	10	
10	241ELEESCP104	ESC	Digital Logic Design Laboratory	--	02	--	01	25	ISE	25	10	
11	241ELEVSECP102	VSEC	Design Thinking Through Innovation Laboratory	--	02	--	01	25	ISE	25	10	
12	241ELECCAP102	CCA	Liberal Learning - II	--	04	--	02	50	ISE	50	20	
			Total	**14**	**10**	**1**	**22**	**650**	--	--	--	--
Mandatory Courses												
1	241ELEMC104	MC	Capstone Project	--	--	--	--	50	ISE	Grade	--	--
2.	241ELEMC103	MC	Finishing School Training - II	03	--	--	--	50	ISE	Grade	--	--

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Linear Algebra & Calculus	
Course Code: 241ELEBSCL101	**Semester:** I
Teaching Scheme: L-T-P: 3-1-0	**Credits:** 3
Evaluation Scheme ISE-I/MSE/ISE-II: 10/30/10	**ESE Marks:** 50

Prior Knowledge of:	Matrices, Derivatives

Course Objectives:

1.	To teach mathematical methodology.
2.	To develop mathematical skills and enhance the logical thinking power of students.
3.	To provide students with skills in Linear Algebra and Calculus.
4.	To imbibe graduates with mathematical knowledge, computational skills, and the ability to deploy these skills effectively in solution of engineering problems.

Curriculum Details

Course Contents	Duration
Unit 1: Unit-I Linear Algebra –I • Introduction to matrices, types of matrices. • Rank of matrix by normal form and echelon form. • Solution of simultaneous linear non-homogenous equations. • Solution of simultaneous linear homogenous equations. • Numerical Solutions of Linear Equations by Gauss-Elimination method	**07 Hrs**
Unit 2: Linear Algebra –II • Definition of linear combination of vectors. • Dependence and independence of vectors. • Eigen values and its properties. • Eigen vectors and its properties. • Cayley-Hamilton Theorem	**07 Hrs**
Unit 3: Partial Differentiation • Introduction. • Partial derivatives. • Total derivatives. • Euler's theorem on homogeneous functions. • Jacobian and its properties	**07 Hrs**
Unit 4: Partial Differential Equations • Definition of partial differential equation. • Standard method to solve first order non-linear partial differential equations of the Form I f(p, q)=0 • Standard method to solve first order non-linear partial differential equations of the Form II f(z,p,q)=0 • Standard method to solve first order non-linear partial differential equations of the Form III f(x, p)=g(y, q) • Lagrange's method to solve first order linear partial differential equations	**07 Hrs**
Unit 5: Vector Calculus	**07 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

• Introduction. • Gradient of scalar point function. • Divergence of vector point function. • Curl of a vector point function. • Irrotational, Solenoidal vector field	
Unit 6: Integral Calculus • Introduction of improper integral. • Gamma function and its properties. • Beta function and its properties. • Error Function and its properties	**07 Hrs**

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
101.1	**Reduce** matrices to echelon form and **apply** the concept of rank of matrices to solve system of linear equations
101.2	**Identify** Eigen values & make use of it for finding Eigen vectors
101.3	**Apply** the knowledge of partial differentiation
101.4	**Solve** partial differential equations with different methods.
101.5	**Apply** knowledge of vector differentiation to find curl and divergence of vector fields.
101.6	Use special functions and their properties during their higher learning

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / COs	BTL	1	2	3	4	5	6	7	8	9	10	11	12
101.1	2,3	3	2	--	--	1	---	--	--	--	--	--	1
101.2	2,3	3	2	--	--	1	--	--	--	--	--	--	1
101.3	3	3	2	--	--	--	--	--	--	--	--	--	1
101.4	3	2	2	--	--	--	--	--	--	--	--	--	1
101.5	3	2	2	--	--	1	--	--	--	--	--	--	1
101.6	3	2	2	--	--	--	--	--	--	--	--	--	1

Text Books:

D. Y. Patil Education Society
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School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Higher engineering Mathematics	36th	B. S. Grewal	Khanna publishers	2001
2	A Text Book of Applied Mathematics	7th	P. N. Wartikar, J. N. Wartikar	Vidyarthi Griha Prakashan, Pune.	2006
3	Advanced Engineering Mathematics	1st	H. K. Dass	S. Chand Publications, New Delhi	2011
4	Advanced Engineering Mathematics	7th	Peter V.O'Neil	Cengage learning	2012
5	Linear Algebra		Jin Ho Kwak and Sungpyo Hong	Springer	2004
6	Numerical Methods in Engineering and Science		B.S. Grewal	Khanna Publishers	

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Advanced Engineering Mathematics	5th	Erwin Kreyszig	India Pvt, Ltd.	2014
2	Higher Engineering Mathematics	6th	B. V. Ramana	Tata M/c Graw Hill Publication	2010
3	Calculus	8th	James Stewart	Cengage Learning	2016
4	A Textbook of Engineering Mathematics	6th	N.P.Bali, Iyengar	Laxmi Publication	2004
5	Elementary Linear Algebra	5th	Stephen Andrilli and David Hecker	Academic Press	2016

Useful Link /Web Resources:

1. DELNET- http://www.delnet.in
2. NDL-http://ndl.iitkgp.ac.in
3. N-LIST- http://www.nlist.inflib.ac.in
4. https://www.youtube.com/results?search_query=Dr+Navneet+Sangle

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Linear Algebra & Calculus Tutorial	
Course Code: 241ELEBSCP102	**Semester:** I
Teaching Scheme: L-T-P: 0-1-0	**Credits:** 1
Evaluation Scheme ISE: 25	**ESE Marks:** --

Prior Knowledge of:	Matrices, Derivatives

Course Objectives:

1.	To teach mathematical methodology.
2.	To develop mathematical skills and enhance the logical thinking power of students.
3.	To provide students with skills in Linear Algebra and Calculus.
4.	To imbibe graduates with mathematical knowledge, computational skills, and the ability to deploy these skills effectively in solution of engineering problems.

List of Tutorials

Tut. No.	Title of Tutorials	Duration
01	**Linear Algebra –I:** Rank of Matrix, Solutions of Non-homogeneous simultaneous linear equations	01Hr
02	**Linear Algebra –I:** Solutions of simultaneous linear homogeneous equations	01Hr
03	**Linear Algebra –II:** Dependence and Independence of vectors	01Hr
04	**Linear Algebra –II:** Eigen values and Eigen vectors of Matrix, Cayley-Hamilton Theorem	01Hr
05	**Partial Differentiation – I:** Euler's theorem on homogeneous functions.	01Hr
06	**Partial Differentiation –II:** Partial derivatives, Jacobian and its properties	01Hr
07	**Partial Differential Equations-I:** Form I f(p, q)=0, Form II f(z,p,q)=0	01Hr
08	**Partial Differential Equations-II:** Form III f(x, p)=g(y, q), Lagrange's method to solve first order linear partial differential equations.	01Hr
09	**Integral Calculus-I:** Gamma function and its properties	01Hr
10	**Integral Calculus-II:** Beta function and its properties, Error function and its properties	01Hr
11	Linear Algebra-I using SCILAB/MATLAB	01Hr
12	Linear Algebra-II using SCILAB/MATLAB	01Hr

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Applied Physics	
Course Code: 241ELEBSCL105	**Semester: I & II**
Teaching Scheme: L-T-P:3-0-0	**Credits: 03**
Evaluation Scheme ISE-I/MSE/ISE-II: 10/30/10	**ESE Marks: 50**

Prior Knowledge of:	Fundamentals of optics, semiconductors, nature of radiation, quantum mechanics, electrochemistry.

Course Objectives:

1.	To provide basic concept of modern optics
2.	To make the students grasp the working principles of LASER and its applications
3.	To perceive the fundamentals of quantum mechanics and its applications
4.	To explain electronic properties of semiconductors materials from quantum mechanical point of view
5.	To elucidate the thermodynamic and kinetic properties of cell reactions in rechargeable batteries

Curriculum Details

Course Contents	Duration
Unit 1: Wave Optics • Introduction: interference, diffraction, review of geometric and optical path • Theory of plane diffraction grating and grating equation • Resolving power of plane diffraction grating • Newton's ring: Experimental arrangement • Diameter of bright and dark ring • Determination of wavelength of monochromatic light using Newton's ring	**07 Hrs**
Unit 2: LASER • Concept of LASER, • Principle and working of LASER: Absorption, Spontaneous emission, Stimulated emission, Population inversion • Einstein's coefficient • Properties of LASER • Types of LASERS - Ruby LASER, He-Ne LASER • Applications of LASER: Industrial, Medical	**07 Hrs**
Unit 3: Quantum Mechanics	**07 Hrs**

• Introduction to quantum physics • de Broglie wavelength of matter waves and its different forms • Heisenberg's uncertainty principle • Wave function and probability interpretation • Schrödinger's time independent & dependent wave equation (1-D) • Energy of particle in 1-D potential well using Schrödinger equation • Numerical	
Unit 4: Semiconductor Physics • Fermi Dirac distribution • Formation of bands in solids • Fermi energy and Fermi level in intrinsic and extrinsic semiconductors • Dependence of Fermi energy on temperature • Hall effect: equation for Hall voltage and Hall coefficient and relation between them • Numerical	**07 Hrs**
Unit 5: Semiconductor Devices and Digital Electronics • Properties of a P-N junction • Diode equation and I-V characteristic • Construction, working and I-V characteristics of BJT, JFET and MOSFET • Introductory digital concepts: Logic levels, Digital waveform and characteristic. Time clock and timing diagram • Logic functions and logic gates: AND, OR, NOT, NAND, NOR, X-OR, and X-NOR • Numerical	**07 Hrs**
Unit 6: Supercapacitor and Battery • Introduction: Electrolytic and galvanic cells, • Electrochemical energy storage: Supercapacitors and Batteries • Types of supercapacitors and batteries • Cell reactions in rechargeable batteries • Thermodynamic and Kinetic parameters of cell reactions • Courses of the cell reactions in different rechargeable batteries • Heat effects and Battery parameters	**07 Hrs**

Self-learning topics: Fire Temperature sensor (TIR-based), NDT of materials, Optical fiber as sensors, CO_2 LASER

Course Outcomes (COs): After completion of the course, students will be able to:

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

CO	Statements
105.1	**Apply** the principle of interference and **relate** concepts in various engineering applications
105.2	**Summarize** the working mechanism and applications of LASER
105.3	**Examine** 1-D potential well problems using principles of quantum mechanical phenomenon
105.4	**Interpret** the electronic properties of semiconductors
105.5	**Express** the output characteristics of P-N junction-based semiconductor devices
105.6	**Determine** the equilibrium cell voltage using thermodynamic parameters of rechargeable batteries

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / Cos	BTL	1	2	3	4	5	6	7	8	9	10	11	12
105.1	3	3	2	-	-	-	-	-	-	-	-	-	1
105.2	2	3	2	-	-	-	-	-	-	-	-	-	1
105.3	3	3	2	-	-	-	-	-	-	-	-	-	1
105.4	2	3	2	-	-	-	-	-	-	-	-	-	1
105.5	2	3	2	-	-	-	-	-	-	1	-	-	1
105.6	3	3	2	-	-	-	-	-	-	1	-	-	1

Text Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Engineering Physics	1st	H. K. Malik	Tata McGraw Hill Education	2019
2	A Text Book of Engineering Physics	Revised	M. N. Avadhanulu, P. G. Kshirasagar	S. Chand Publications	2018
3	Engineering Physics	Revised	L.N. Singh	Synergy Knowledge Ware	2016
4	Engineering Physics	Revised	V. Rajendran	Tata McGraw Hill Education	2010
5	Engineering Physics	1st	R.K. Gaur, S.L. Gupta	Dhanpat Rai Publications	1993

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Fundamentals of Physics	Revised	J. Walker, D. Halliday, R. Resnick	Wiley Publications	2018
2	Engineering Physics	1st	B.K. Pandey and Chaturvedi	Cengage learning Publications	2017
3	Battery Technology Handbook	2nd	H. A. Kiehne	Marcel Dekker, Inc., New York	2003
4	Introduction to Solid State Physics	8th	Charles Kittel	John Willey and Sons Inc.	2009
5	Solid State Physics	6th	S.O.Pillai	New edge Internationals	2009
6	Digital Fundamentals	8th	T. L. Floyd	Pearson Education Inc., New Delhi	2003

Useful Link /Web Resources:

1. http://hyperphysics.phy-astr.gsu.edu/hbase/index.html
2. https://en.wikipedia.org/wiki/Wave_interference
3. https://en.wikipedia.org/wiki/Introduction_to_quantum_mechanics

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(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Applied Physics Laboratory	
Course Code: 241ELEBSCP106	**Semester:** I/II
Teaching Scheme: L-T-P: 0-0-2	**Credits: 01**
Evaluation Scheme: ISE: 25	**ESE Marks:**

Prior Knowledge of:	Optics, magnetic materials, semiconductor basics, graph plotting, slope calculation

Course Objectives:

1	To make the students understand the concept of physics for the effective application in the field of engineering and technology.
2	To use the knowledge of electron transport in semiconductors.
3	To summarize the factors affecting the capacitance of the supercapacitors.

List of Experiments-

Exp. No	Title of Experiments	Duration
01	To compute diameter of cylindrical obstacle using mono chromatic Source	02 Hrs
02	To calculate radius of curvature of Plano convex lens using Newton's ring	02 Hrs
03	To determine the velocity of the ultrasonic wave in water using ultrasonic Interferometer	02 Hrs
04	To determine wavelength of LASER using diffraction grating	02 Hrs
05	To decide band gap energy of P-N junction diode	02 Hrs
06	To determine divergence of LASER beam	02 Hrs
07	To determine resolving power of diffraction grating	02 Hrs
08	To recognize carrier concentration of semiconductor using Hall effect	02 Hrs
09	To Determine wavelength of light using plane diffraction grating	02 Hrs
10	To study physical significance of wave function quantum mechanics	02 Hrs
11	To calculate the resolving power of telescope	02 Hrs
12	To prove De Morgan's theorem	
13	To calculate the performance parameters of a given supercapacitor device using the data recorded on an electrochemical work-station	02 Hrs

Minimum 10 Experiments should be conducted from above list.

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Outcomes (COs): After successful completion of the course, students will be able to

CO	Statements
106.1	**Implement** knowledge related to optics to use for suitable purposes in applied physics
106.2	**Examine** the properties of LASER for suitable applications in applied physics
106.3	**Apply** the theory of semiconductors to estimate band gap energy and carrier concentration
106.4	**Determine** the performance parameters of a supercapacitor device using a modern electrochemical workstation

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / COs	BTL	1	2	3	4	5	6	7	8	9	10	11	12
106.1	3	3	-	-	-	-	-	-	-	-	-	-	1
106.2	3	3	-	-	-	-	-	-	-	-	-	-	1
106.3	3	3	-	-	-	-	-	-	-	-	-	-	1
106.4	3	3	-	-	-	1	-	-	-	-	-	-	1

Suggested Learning Resources: Text Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Engineering Physics	1st	H.K. Malik	Tata McGraw Hill Education	2019
2	A Text Book of EngineeringPhysics	Revised	M. N. Avadhanulu, P. G. Kshirasagar	S. Chand Publications	2018
3	Engineering Physics	Revised	L. N. Singh	Synergy Knowledge Ware	2016
4	Engineering Physics	Revised	V. Rajendran	Tata McGraw Hill Education	2010
5	Engineering Physics	1st	R.K. Gaur, S.L. Gupta	Dhanpat Rai Publications	1993

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Fundamentals of Physics	Revised	J.Walker, D.Halliday, R.Resnick	Wiley Publication	2018
2	Engineering Physics	1st	B.K. Pandey and Chaturvedi	Cengage Learning Publications	2017
3	Battery Technology Handbook	2nd	H. A. Kiehne	Marcel Dekker, Inc., New York	2003
4	Introduction to Solid State Physics	8th	C.Kittel	John Willey and Sons Inc.	2009
5	Solid State Physics	6th	S.O.Pillai	New edge Internationals,	2009
6	Digital Fundamentals	8th	T. L. Floyd	Pearson Education Inc., New Delhi	2003

Useful Link /Web Resources:

1. https://vlab.amrita.edu/?sub=1
2. http://vlabs.iitb.ac.in/vlab/labsps.html

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Problem-Solving Through Programming	
Course Code: 241ELEESCL101	**Semester:** I
Teaching Scheme: L-T-P: 3 – 0 – 0	**Credits:** 03
Evaluation Scheme ISE-I, MSE, ISE-II:10/30/10	**ESE Marks:** 50

Prior Knowledge of:	Basic knowledge of computers.

Course Objectives:

1.	Acquire basic principles of problem-solving using computers.
2.	Learn and use the syntax of C programming language to solve basic science and engineeringproblems.
3.	Select appropriate programming constructs, data structures, and functions to build solutionsto a variety of problems.

Curriculum Details:

Course Contents	Duration
Unit 1: Introduction to C programming: Fundamentals of algorithms, flowcharts. **Getting started with C**- Basic structure of C program, features of C language,Character set, C tokens, Keywords and Identifiers, Data types and Format Specifier. Managing Input and Output operations. **Variable**s-Local and Global variables, rules for defining a variable name, variable initialization-Run time and compile time, variable declaration. **Constants**-Defining Constant by using preprocessor directive and keyword const. **Operators:** Arithmetic operators, Relational operators, Logical Operators, Assignment operators, Increment and Decrement operators, Conditional operators, Bit-wiseoperators, Special operators. Operator precedence and Associativity.	**07Hrs**
Unit 2: Programming Constructs: **Need of Decision-making statements**- 'if' statement, Simple 'if' statement, the 'if…else' statement, nesting of 'if…else' statements, The 'else if' ladder, The 'switch' statement, break statement, The 'go to' statement. **Need of looping statements**: The 'for',' while', and' do-while statements with examples.	**08 Hrs**
Unit 3: Arrays& Strings: **Arrays**-Types of arrays, Declaration arrays, initializing dimensional arrays (One-Dimensional and Two-Dimensional Array)-Run time Initialization and Compile time Initialization with examples. **Character Arrays and Strings**: Declaration and Initialization- Run time Initialization and Compile time Initialization with examples, reading string from the terminal and writing strings to screen, String handling Functions - strcpy(), strcmp(), strlen(), strcat().	**07Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Unit 4: Structures and Unions: **Structures**-Elements of Structure –Structure definition, declaring structure variables, Structure initialization. Accessing structure members by using '.' Operator, Arrays of structure, Arrays within structures. **Unions**: Elements of Union–Union definition, declaring union variables, Union initialization, Comparison of Structure and Unions.	**07Hrs**
Unit 5: Functions: Need for Functions, Types of functions (User Defined and Built–In). **User-defined Function**-Elements of UDF-Function Definition, Function declaration, Function call. Actual Parameters, Formal Parameters. **Categories of functions**- With Argument and with the return value, No Argument and with a return value, With Argument and No return value, No Argument, and No return value. Storage classes (Automatic, Static, Extern, and Register). Passing arrays to function, Structures, and Functions. **Recursion.**	**07Hrs**
Unit 6: Pointers: Introduction to Pointers, accessing a value of variable by using Pointers-Declaration of Pointer variable, Initialization of pointer variables, Dereference operator. Pointers as function arguments-Call by value and call by reference. Pointers Expression, Pointers and Arrays, Pointers and Strings, Pointers to Functions, Pointers and Structures.	**06Hrs**

Self-learning topics: Recent trends in IT.

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
101.1	Describe the basic structure of C program and use of different data type.
101.2	Develop conditional and Loop statements to write C programs.
101.3	Explain the concept of arrays and strings to store homogeneous data.
101.4	Use functions to break programs into small module.
101.5	Explain the concept of structures and unions.
101.6	Use pointers to access memory location.

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes(POs)

POs / Cos	BTL	1	2	3	4	5	6	7	8	9	10	11	12
101.1	2	3	3	2	-	-	-	-	-	-	-	-	1
101.2	2	3	3	2	-	-	-	-	-	-	-	-	1
101.3	2	3	3	2	-	-	-	-	-	-	-	-	1
101.4	2	3	3	2	-	-	-	-	-	-	-	-	1
101.5	2	3	3	2	-	-	-	-	-	-	-	-	1
101.6	2	2	2	2	-	-	-	-	-	-	-	-	1

Text Books:

Sr.No	Title	Edition	Author(s)	Publisher	Year
1	Programming in ANSI C	8th	E. Balagurusamy	McGraw Hill Education	2019
2	Let Us C	16th	Yashwant Kanetkar	BPB Publication	2017

Reference Books:

Sr.No	Title	Edition	Author(s)	Publisher	Year
1	Programming with ANSI And Turbo C	-	Ashok Kamthane	Pearson Education	2002
2	Programming in C	2nd	J.B Dixit	Firewal Media	2011
3	The Complete Reference Edition	4th	Herbert Schildt	McGraw-Hill Education	2017

Useful Link /Web Resources:

https://nptel.ac.in/courses/1061041282.

https://www.udemy.com/courses

https://www.coursera.org

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Problem-Solving Through Programming Laboratory	
Course Code: 241ELEESCP102	**Semester:** I
Teaching Scheme: L-T-P: 0 – 0 – 2	**Credits:** 01
Evaluation Scheme ISE:25	**ESE Marks:** 25

Prior Knowledge of:	Basic understanding of computer operations and familiarity with mathematical concepts

Course Objectives:

1.	Acquire basic principles of problem-solving using computers.
2.	Learn and use the syntax of C programming language to solve basic science and engineeringproblems.
3.	Select appropriate programming constructs, data structures and functions to build solutions to variety of problems.

Details:

Exp. No	Title of Experiments	Duration
01	To Study basic Linux commands and different IDEs used for programming.	02 Hrs
02	Basic C Programming	02 Hrs
03	C Programs based on Data Types and Operators	02 Hrs
04	C Programs based on Control Structures-conditional statements	02 Hrs
05	C Programs based on Control Structures-loops	02 Hrs
06	C Programs based on Functions	02 Hrs
07	C Programs based on array and string manipulation.	02 Hrs
08	C Programs based on Structures	02 Hrs
09	C Programs based on Pointers	02 Hrs
10	C Programs based on File Handling	02 Hrs

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
102.1	Develop problem-solving strategies and computational thinking.
102.2	Design and implement algorithms using the C programming language.
102.3	Write, test, and debug C programs effectively.
102.4	Apply problem-solving techniques to a variety of programming challenges.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes(POs)

POs / Cos	BTL	1	2	3	4	5	6	7	8	9	10	11	12
102.1	2	1				1							2
102.2	2		2					1		1			2
102.3	2	1	2		3			1		1			2
102.4	2	2	2		3	1		1		1	1	1	2

Text Books:

Sr.No	Title	Edition	Author(s)	Publisher	Year
1.	Let Us C	16th Edition	Yashavant Kanetkar	BPB Publication.	2017
2.	Computer Fundamentals	4th Edition	P. K. Sinha,	BPB Publications.	2011
3.	How to Solve it by Computer		R.G. Dromey	Pearson Education India	
4.	The Complete	4th Edition	Herbert Schildt	McGraw-Hill Education	

Reference Books:

Sr.No	Title	Edition	Author(s)	Publisher	Year
1.	The C Programming Language	2nd Edition	Brian W. Kernighan, Dennis Ritchie	Pearson Education India	2019
2.	C How to Program	7th Edition	Deitel	Pearson Education India	2017

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Digital Logic Design	
Course Code:241ELEESCL103	**Semester:** I
Teaching Scheme: L-T-P:3-0-0	**Credits:**3
Evaluation Scheme ISE-I, MSE, ISE-II:10/30/10	**ESE Marks:**50

Course Prerequisites:	Basic algebra and understanding of logic

Course Objectives:

1.	To understand the basic concepts of digital systems, including binary number systems, Boolean algebra, and logic gates.
2.	To apply and simplify Boolean expressions and logic circuits using Karnaugh maps and Boolean algebra.
3.	To construct digital circuits using basic components like multiplexers, decoders, encoders, and flip-flops.
4.	To artculate the concepts of Processing unit and memory subsystem.

Course Description:

Digital Logic Design focuses on essential concepts in digital systems, including Boolean algebra, logic gates, and both combinational and sequential circuits. The course emphasizes hands-on learning of Sequential and Combinational Circuit designs through hands-on practical's using simulators. By the end, students are equipped to apply digital logic design concepts in computer engineering and related fields.

Curriculum Details:

Course Contents	Duration
Unit 1: Introduction to Digital System and Number System Digital Systems, Number System, Number system conversions, Logic Gates, minimization: Representation of truth-table, SOP form, POS form, Simplification of logical functions, Minimization of SOP and POS forms, don't care conditions Reduction techniques: K-Maps up to 4 variables.	**05Hrs**
Unit 2: Combinational Logic Design BCD, Excess-3, Gray code, Binary Code. Half- Adder, Full Adder, Half Subtractor, Full Subtractor, Multiplexers (MUX), Demultiplexers (DEMUX)	**07 Hrs**
Unit 3: Sequential Logic Design & Synchronous and Asynchronous Circuits Latches and Flip-Flops, Flip-Flop: SR, J-K, D, T; Preset & Clear, Truth Tables, and Excitation tables, Conversion of Flop- Flop, Registers: SISO, SIPO, PISO, PIPO, Asynchronous Counter, Synchronous Counter, BCD Counter	**08Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Unit 4: Introduction to Computer Organization Function and structure of a computer Functional components, interconnection of components, Bus Structures. Processing Unit: Organization of a processor - Registers, ALU and Control unit, Instruction cycle	**07Hrs**
Unit 5: Input/output Subsystem Access of I/O devices, I/O ports, I/O interfaces - Serial port, Parallel port, PCI bus, I/O peripherals - Input devices, Output devices, Secondary storage devices.	**07Hrs**
Unit 6: Memory Subsystem Memory Hierarchy, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory.	**08 Hrs**

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
103.1	Describe the working of basic digital components.
103.2	Solve Boolean expressions for designing digital circuits using K-Maps.
103.3	Design Combinational digital circuits & Sequential circuits.
103.4	Demonstrate basics of Computer organization and Memory

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes(POs)

POs / Cos	BTL	1	2	3	4	5	6	7	8	9	10	11	12
103.1	2	1	-	-	-	-	-	-	-	-	-	-	-
103.2	2	1	1	-	-	2	-	-	-	-	-	-	-
103.3	2	2	2	2	2	3	-	-	-	1	2	-	-
103.4	2	1	-	-	1		-	-	-	-	-	-	-

Text Books:

1. R.P.Jain, "Modern Digital Electronics", Tata McGraw-Hill, 4th Edition,2010 ISBN 978-0-07-06691-16
2. Moris Mano, "Digital Logic and Computer Design", 2017, Pearson, ISBN 978-93-325-4252-5
3. W. Stallings, "Computer Organization & Architecture: Designing for performance", 10th Edition, 2016, Pearson Education/ Prentice Hall of India, ISBN-10: 0-13-410161-8 | ISBN-13: 978-0-13-410161-3

Reference Books:

1. John Yarbrough, "Digital Logic applications and Design", Cengage Learning, 2006, ISBN 13:978-81-315-0058-3
2. Norman B & Bradley, "Digital Logic and Design Principles", Wiley India Ltd, 2000, ISBN 978-81-265-1258-4.

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School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Digital Logic Design Lab	
Course Code: 241ELEESCP104	**Semester:** I / II
Teaching Scheme: L-T-P: 0-0-2	**Credit:** 01
Evaluation Scheme: ISE: 25	**ESE Marks:**

Course Description:
Digital Logic Design This subject covers practical details of the subject Digital Logic Design and Memory organization in computers.

Course Objectives	
1	To provide hands on experience on construction of basic digital logic circuits
2	To get practical experience on Demorgan's theorem, SOP and POS forms.
3	To demonstrate verification of Full Adders, Subtractors, Gray to binary converters and vice versa
4	To verify working of Flip-flops, Counters and Shift registers

Sr. No	**Experiment**
1	Realization of functions using basic and universal gates (SOP and POS forms).
2	Study of Boolean algebra & De Morgan's theorem.(Verification of Theorem with truth table)
3	Realization of 4/5 variable K-maps.
4	Design and Realization of half /full adder and subtractor using basic gates and universal gates.
5	Design and Realization of Multiplexers and Demultiplexers.
6	Study of Flip-Flops: J-K, D, T, S-R.
7	Study of Registers and Counters.
8	Study of Bus Structure and Instruction Cycle.
9	Interfacing counter circuit with seven segment display.
10	Hand- on -constructin of various combinational circuits using CircuitVerse Simulator.

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
104.1	Construct the truth table of various Logic Gates and combination circuits using logic gates.
104.2	Design, test, and evaluate various combinational circuits such as adders, subtractors, multiplexers, demultiplexers, decoders, etc.
104.3	construct flip-flops, counters, and shift registers
104.4	Simulate various combinational circuits using Circuit Verse Simulator.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes(POs)

POs / Cos	BTL	1	2	3	4	5	6	7	8	9	10	11	12
104.1	2	1								2			
104.2	2	1	1			2				2			
104.3	2	2	2			3				2	2		1
104.4	2	1			1					2			

Text Books:

1. R.P.Jain, "Modern Digital Electronics", Tata McGraw-Hill, 4th Edition,2010 ISBN 978-0-07-06691-16
2. Moris Mano, "Digital Logic and Computer Design", 2017, Pearson, ISBN 978-93-325-4252-5
3. W. Stallings, "Computer Organization & Architecture: Designing for performance", 10th Edition, 2016, Pearson Education/ Prentice Hall of India, ISBN-10: 0-13-410161-8 | ISBN-13: 978-0-13-410161-3

Reference Books:

1. John Yarbrough, "Digital Logic applications and Design", Cengage Learning, 2006, ISBN 13:978-81-315-0058-3
2. Norman B & Bradley, "Digital Logic and Design Principles", Wiley India Ltd, 2000, ISBN 978-81-265-1258-4.

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Design Thinking Through Innovation	
Course Code: 241ELEVSECL101	**Semester:** I/II
Teaching Scheme: L-T-P: 1-0-0	**Credits:** 01
Evaluation Scheme: ISE: 25	**ESE Marks:**

Prerequisites: Understanding, User-Centric Mindset, Collaboration and Teamwork, Curiosity and Open-Mindedness, Effective Communication Skills, Learning Orientation, and Risk Tolerance.

Course Description:

The Design Thinking & Innovations subject aims to provide students with the tools and exposure to address problems using the design thinking process. The curriculum for "Design Thinking through Innovations" structured in such a way students learn to acquire both knowledge of design and practice of skills required to develop an attitude towards design. Being of the exemplary kinds, it focuses more on hands-on knowledge, learned by doing and acting upon challenges discovered within the community and surroundings.

Course Objectives:

1.	To Familiarize with Engineering Design Process and The basics of Design Thinking
2.	To Bring Awareness on Idea Generation to Solve the Problems
3.	To Familiarize with the various types of prototype and the techniques used for prototyping.

Course Outcomes (COs): At the end of the course, the students should be able to:

CO	Statements	BTL
101.1	**Learn the** Structured Approach of Engineering Design and the Relevance of Design and Design Thinking in Engineering & **Understand** Idea Generation Techniques to find solutions to Problems.	**1**
101.2	**Understand** the various types of prototypes and **Inculcate** the techniques used for prototyping.	**2**

Course Content:

Content	Duration
Unit I: Engineering Design, Design Thinking and Idea Generation • Introduction, Key Concepts of Design, A Simplified Process of Engineering Design • What is Design Thinking? - Its Importance, Socio-Economical Relevance, Principles, Origin, Process of Design Thinking, Relevance of Design and Design Thinking in Engineering • Introduction to Idea Generation, Idea Generation Techniques, Processes, Define the Problem, Needs v/s Wants, Identify Philosophy, Problem Solving Tools, Case Studies • Critical thinking: Fundamentals, Characteristics, Critical v/s Ordinary Thinking. • Critical thinking skills- linking ideas, structuring arguments, five pillars of critical thinking.	**07 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Unit II: Prototyping and Tools for Design - Innovation • Prototyping: Introduction, Need, Process, Types, Fidelity for prototypes, Minimum Usable Prototype [MUP] – Concept, challenges, etc. • Prototyping for Digital & Physical products: Concept, What is unique in Digital and Physical Prototypes? • Digital & Physical prototypes: Preparation; testing prototypes with users. • Introduction to Different tools used for design and Innovation, such as Hand Saw (Wood, PVC, CPVC and Steel), Component cutter, Spanners, Allen key & Wrench (Flat, Ring, Adjustable), Solder Gun, Component cutter, Tweezer, Multi meter, Glue Gun, Hex saw, Cutter, Wire Stripper.	**07 Hrs**

Text Books:

Sr. No	Title	Author(s)	Publisher	Year
1.	Introduction to Design Thinking	S.Salivahanan, S.Suresh Kumar, D.Praveen Sam	Tata Mc Graw Hill, First Edition	2019
2.	The Design Thinking Playbook	Michael Lewrick	Wiley	2019
3.	Prototyping for Designers: Developing the best Digital and Physical Products	Kathryn McElroy	O'Reilly	2017

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1.	Design Thinking – New Product Essentials from PDMA	1st	Michael G. Luchs, Scott Swan , Abbie Griffin	Wiley	2015
2.	101 Design Methods: A Structured Approach for Driving Innovation in Your Organization	1st	Vijay Kumar	Wiley	2012

Online Resources:

Sr. No.	Online Resource Link	Source
1	Introduction to Design Thinking - Course (swayam2.ac.in) Design Thinking Full Course | Design Thinking Process | Design Thinking For Beginners | Simplilearn - YouTube	Swayam (NPTEL) &YouTube
2	Thinking at IDEO - Insight, innovation, & a healthy dose of play	IDEO
3	INTRO (youtube.com)	YouTube
4	The Power of an Entrepreneurial Mindset | Bill Roche | TEDxLangleyED (youtube.com)	YouTube
5	https://www.ideou.com/pages/design-thinking	IDEO U
6	https://dschool.stanford.edu/	Stanford D school
7	https://www.designthinkersacademy.com/usa/	Design Thinking Institute
8	https://www.ibm.com/design/thinking/page/toolkit	Design thinking ToolKit
9	https://hbr.org/2018/09/design-thinking-is-fundamentally-conservative-and-preserves-the-status-quo	

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Design Thinking Through Innovation Lab	
Course Code: 241ELEVSECP102	**Semester:** I / II
Teaching Scheme: L-T-P: 0-0-1	**Credit:** 01
Evaluation Scheme: ISE: 25	**ESE Marks:**

Prerequisites: Understanding, User-Centric Mindset, Collaboration and Teamwork, Curiosity and Open-Mindedness, Effective Communication Skills, Learning Orientation, and Risk Tolerance.

Course Description:

The Design Thinking & Innovations subject aim at providing students with the tools and exposure to be able to address problems using the design thinking process. Design Thinking & Innovations is designed in such a way students learn to acquire both knowledge of design and practice of skills required to develop an attitude towards design. Being of the exemplary kinds, it focuses more on hands-on knowledge, learned by doing and acting upon challenges discovered within the community and surroundings.

Course Objectives:

1.	To Discuss Various Techniques of Idea Generation.
2.	To Explain the Various Tools Used for Innovation.
3.	To Discuss the Methods of Implementing Design Thinking in The Real World.
4.	To Discuss the Implementation of Creativity and Innovation.

Course Outcomes (COs):

At the end of the course, the student should be able to:

CO	Statements	BTL
105.1	**Learn the** Structured Approach of Engineering Design and the Relevance of Design and Design Thinking in Engineering & **Understand** Idea Generation Techniques to find out solutions to Problems.	**1**
105.2	**Understand** the various types of prototypes and **Incorporate** the techniques used for prototyping.	**2**

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Content

Sr. No.	Title of Experiments/Assignment List	Duration
01	Overview of Design Thinking: Ethical Design and Critiques, Generation of "IDEA", Problem Identification and Exercises.	02 Hrs
02	Brainstorming Sessions to Find out Solution for Identified Problems	02 Hrs
03	Prototyping and Modelling Challenge, Various Tools and Methodology Used for the Prototyping.	02 Hrs
04	Hands-On Demonstration of Different Tools used for Design & Innovation.	02 Hrs
05	Hands-On Demonstration of Soldering Machine, Function and Purpose of Soldering Machine.	02 Hrs
06	Explanation and Usage of Joining & Insulation Tools and Technics.	04 Hrs
07	Assembly and Disassembly of Two Wheel Drive Robot Based Vehicle.	02 Hrs
08	Micro Project: Group Formation and Idea Generation.	02 Hrs
09	Creation of Prototype and Innovative Solution.	02 Hrs
10	Test and Evaluation of Prototype.	02 Hrs
11	Report Drafting - Instructions & Practices.	02 Hrs
12	Presentation & Exhibition.	02 Hrs

Suggested Learning Resources: --

Reference Books:

Sr. no.	Name of Book	Author	Year
1.	Design Thinking: Understand-Improve-Apply	S. G. Blank	2007
2.	Design Thinking for Innovation Research and Practice	Walter Brenner, Falk Uebernickel, Springer	2016
3.	Business Design Thinking and Doing: Frameworks, Strategies and Techniques for Sustainable Innovation	Angele M. Beausoleil	2022

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(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Historical Places in and Around Kolhapur District	
Course Code:241ELEIKSL101	**Semester:** I/II
Teaching Scheme L-T-P :2-0-0	**Credits:**02
Evaluation Scheme ISE-I, MSE, ISE-II:10/30/10	**ESE Marks:**

Curriculum Contents	Duration
Unit 01: Chhatrapati Shahu Maharaj: A King for Society • Introduction • Life History • Contribution of Rajarshi Shahu Maharaj in various fields as a modern Social Reformer as Women Empowerment in the 19th Century • Development in Education • Social Reservation and equality • Agriculture • Industry • Initiation for Radhanagari Village and Dam	07 Hrs
Unit 02: A Study of Khidrapur- Kopeshwar • Life History of Khidrapur Kopeshwar Temple • The Wonder of Khidrapur Kopeshwar Temple • Swarga Mandap in Kopeshwar Temple • Sabha Mandap, Antaral Kaksha of Kopeshwar Temple • Beauty of Exterior Architecture of Kopeshwar Temple • Mystery of Black stone • Measures Suggested to Development of Khidrapur	07 Hrs
Unit 03: A Study of Panhala Fort and Pawankhind • History of Panhala Fort • Major Features: Andhar Bawadi • Major Features: Kalavanticha Mahal, Ambarkhana • Major Features: Dharma Koti, Sajja Koti • Teen Darwaja, Raj Darwaja • Rajdindi Bastion • Journey from Panhalgad to Pawankhind by Chhatrapati Shivaji Raje	07 Hrs
Unit 04: A Study of Mahalaxmi Temple • History and construction of Temple • The Main Shrines Doorway • Darshan and Kurma Mandap • Ganapati Chowk, Garud Mandap • Boundary wall, Entrances and complex • Mahalaxmi Temple Timings • Kiranostav Celebrations	07 Hrs

References:

1. Social Movements in India: A Review of Literature – Ghanshy am ShahISBN 0761995145 New Delhi ; Thousand Oaks : Sage Publications, 2004
2. Rajarshi Shahu Maharaj – Jeevan Vakarya, editor – Ramesh Patnage.
3. Shahu Chhatrapati - Royal Revolutionary – DhananjayKeer
4. Samajik SanshodhanPadnativaTantre – Dr. Pradeep Aaglave.
5. Kalasekar. T. L : Khidrapur: Khojurao of Maharashtra.
6. Chothe R.G : Temples of Khidrapur, A heritage of India.
7. Kulkarni A. B : Kopeshwar temple of Khidrapur.
8. Gazetteer of Kolhapur District.
9. Eaton, Richard Maxwell (2005). The New Cambridge History of India
10. "Translations of Panhala inscriptions". Government of Maharashtra. Retrieved 19 March 2009.
11. "Mahalakshmi Temple - Jewel Among Kolhapur Temples
12. "Inside Temples". mahalaxmikolhapur.com.

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Differential Equations Numerical Technique	
Course Code: 241ELEBSCL103	**Semester: II**
Teaching Scheme: L-T-P: 3-0-0	**Credits:** 3
Evaluation Scheme ISE-I/MSE/ISE-II:10/30/10	**ESE Marks:** 50

Prior Knowledge of:	Formulae of Derivatives and Integration, Differential Equation, Statistics.

Course Objectives:

1.	To teach mathematical methodology.
2.	To develop mathematical skills and enhance logical thinking power of students.
3.	To provide students with skills in differential equations and numerical techniques.
4.	To imbibe graduates with mathematical knowledge, computational skills and the ability to deploy these skills effectively in solution of engineering problems.

Curriculum Details

Course Contents	Duration
Unit 1: Ordinary Differential Equations of First Order and First Degree • Definition of differential equation, order and degree of differential equation • Exact differential equations • Non - exact differential equations • Linear differential equations • Bernoulli's differential equations	**07 Hrs**
Unit 2: Applications of Ordinary Differential Equations • Introduction of variable separable form. • Orthogonal trajectories. (Cartesian form) • Applications to simple electrical circuits • Newton's law of cooling • Rate of decay and growth	**07 Hrs**
Unit 3 Numerical methods to solve Ordinary Differential Equations • Introduction • Picard's method • Taylor's series method • Euler's method • Runge - Kutta's method (Fourth order)	**07 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Unit 4: Laplace Transform • Laplace transforms of elementary functions • Properties of Laplace transforms (First Shifting ,Change of scale property , Multiplication & Division by t) • Inverse Laplace transforms by partial fraction	**07 Hrs**
Unit 5: Fourier Series and Fourier Transforms • Definition: Fourier Series, Euler's formulae, and examples • Introduction: Fourier transforms • Fourier Sine transform • Fourier Cosine transforms	**07 Hrs**
Unit 6: Z Transform • Definition: Z transform • Properties of Z transform • Z transform of basic sequences • Z transform of some standard discrete function • Inverse Z transform	**07 Hrs**

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
1	**Solve** ordinary differential equations of first order and first degree
2	**Apply** the knowledge of ordinary differential equation of first order and first degree
3	**Use** the numerical methods to solve ordinary differential equations
4	**Understand** definition of Laplace transforms and its properties
5	**Calculate** Fourier transforms of given functions
6	**Calculate** Z transforms of given functions

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / COs	BTL	1	2	3	4	5	6	7	8	9	10	11	12
1	2,3	3	2	--	--	1	---	--	--	--	--	--	1
2	3	3	2	--	--	--	--	--	--	--	--	--	1
3	2,3	3	2	--	--	1	--	--	--	--	--	--	1
4	2	2	2	--	--	1	--	--	--	--	--	--	1
5	3	2	2	--	--	--	--	--	--	--	--	--	1
6	3	2	2	--	--	--	--	--	--	--	--	--	1

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Text Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Advanced Engineering Mathematics	7th	Peter V.O'Neil	Cengage Learning	2012
2	Advanced Engineering Mathematics	1st	H.K. Dass	S. Chand Publications, New Delhi	2011
3	A Text Book of Applied Mathematics	7th	P.N.Wartikar, J.N.Wartikar	Vidyarthi Griha Prakashan, Pune.	2006
4	Higher Engineering Mathematics	36th	B.S. Grewal	Khanna Publishers	2001

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Advanced Engineering Mathematics	5th	Erwin Kreyszig	India Pvt, Ltd.	2014
2	Higher Engineering Mathematics	6th	B.V.Ramana	Tata M/c Graw-Hill Publication	2010
3	Numerical Methods for Scientific and Engineering Computation	5th	M.K.Jain	New Age International Pvt. Ltd New Delhi	2007
4	A Textbook of Engineering Mathematics	6th	N.P.Bali, Iyengar	Laxmi Publication	2004

Useful Link /Web Resources:

1. DELNET- http://www.delnet.in
2. NDL-http://ndl.iitkgp.ac.in
3. N-LIST- http://www.nlist.inflib.ac.in
4. https://www.youtube.com/results?search_query=Dr+Navneet+Sangle

D. Y. Patil Education Society
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School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Differential Equations Numerical Technique Tutorial	
Course Code: 241ELEBSCP104	**Semester: II**
Teaching Scheme: L-T-P: 0-0-1	**Credits:** 1
Evaluation Scheme ISE: 25	**ESE Marks:** 50

Prior Knowledge of:	Formulae of Derivatives and Integration, Differential Equation, Statistics.

Course Objectives:

1.	To teach mathematical methodology.
2.	To develop mathematical skills and enhance logical thinking power of students.
3.	To provide students with skills in differential equations and numerical techniques.
4.	To imbibe graduates with mathematical knowledge, computational skills and the ability to deploy these skills effectively in solution of engineering problems.

List of Tutorials

Tut. No	Title of Tutorial	Duration
01	**Ordinary Differential Equations:** Exact and non-exact differential equations.	01Hr
02	**Ordinary Differential Equations:** Linear and non-linear differential equations.	01Hr
03	**Applications of Ordinary Differential Equations:** Orthogonal Trajectories. (Cartesian curves), Applications to Simple Electrical Circuits.	01Hr
04	**Applications of Ordinary Differential Equations:** Newton's law of cooling, Rate of Decay and growth.	01Hr
05	**Numerical Solution of Ordinary Differential Equations of First Order and First Degree:** Picard's method, Taylor's series method.	01Hr
06	**Numerical Solution of Ordinary Differential Equations of First Order and First Degree:** Euler's method, Runge-Kutta's method.	01Hr
07	**Laplace Transform:** First Shifting, change of scale property, Multiplication & Division by t	01Hr
08	**Laplace Transform:** Inverse Laplace transforms by partial fraction	
09	**Fourier Transform:** Fourier Sine Transform, Fourier Cosine Transforms	01Hr
10	**Z Transform:** Z transforms of basic sequence, Z transform of some standard discrete function, Inverse Z transform	01Hr
11	Numerical Techniques-I using SCILAB/MATLAB	01Hr
12	Numerical Techniques-II using SCILAB/MATLAB	01Hr

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Text Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Advanced Engineering Mathematics	7th	Peter V.O'Neil	Cengage Learning	2012
2	Advanced Engineering Mathematics	1st	H.K. Dass	S. Chand Publications, New Delhi	2011
3	A Text Book of Applied Mathematics	7th	P.N.Wartikar, J.N.Wartikar	Vidyarthi Griha Prakashan, Pune.	2006
4	Higher Engineering Mathematics	36th	B.S. Grewal	Khanna Publishers	2001

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Advanced Engineering Mathematics	5th	Erwin Kreyszig	India Pvt, Ltd.	2014
2	Higher Engineering Mathematics	6th	B.V.Ramana	Tata M/c Graw-Hill Publication	2010
3	Numerical Methods for Scientific and Engineering Computation	5th	M.K.Jain	New Age International Pvt. Ltd New Delhi	2007
4	A Textbook of Engineering Mathematics	6th	N.P.Bali, Iyengar	Laxmi Publication	2004

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Applied Chemistry	
Course Code: 241ELEBSCL107	**Semesters:** I and II
Teaching Scheme: L-T-P: 3 – 0 - 0	**Credits: 3**
Evaluation Scheme ISE-I/MSE/ISE-II: 50	**ESE Marks: 50**

Prior Knowledge of:	Periodic properties of elements, Basics of organic, inorganic, physical, and analytical chemistry

Course Objectives:

1.	**Understand** the principles and applications of sensors.
2.	**Discuss** the Basic concepts of electronic memory and display Systems
3.	**Illustrate** general synthesis and mechanisms of some advanced polymeric Materials and nanomaterials
4.	**Evaluate** the electrochemical energy storage systems such as lithium batteries and design for usage in electrical and electronic applications
5.	**Interpret** of extraction of metal from e-waste.
6.	**Apply** the theoretical aspects for understanding the water chemistry

Curriculum Details

Course Contents	Duration
Unit 1: Water Chemistry • Introduction, Types of impurities in natural water. • Water quality parameters total solids, acidity, alkalinity, chlorides, COD and BOD. (definition, causes, significance) • Hardness of water, types of hardness, units of hardness, numerical on hardness. • Ill effects of hard water in steam generation in boilers (scale & sludge formation, caustic embrittlement and boiler corrosion) • Treatment of hard water (Ion exchange and reverse osmosis process) • Biosensors for glucose detection.	**07 Hrs**
Unit 2: Sensors • Introduction, working, principle and applications of conductometric sensors, electrochemical sensors, thermometric sensors (Flame photometry) and optical sensors (colorimetry). • Hydrated gel sensor (P^H meter). • Sensors for the measurement of dissolved oxygen (DO). • Electrochemical gas sensors for SOx and NOx. • Disposable sensors (DS): Introduction, principle, characteristics of disposable sensors, Advantages of DS over Classical sensors.	**07 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Unit 3: Materials for Memory and Display Systems **Memory Devices**: • Introduction, basic concepts of electronic memory, Classification of electronic memory devices (organic, polymeric and hybrid material). • Manufacturing of semiconducting chips. • Green computing: Bio-composite based memory devices **Display Systems**: • Nanomaterials and organic materials for display technology (Light absorbing and emitting materials) used in optoelectronic devices. • Liquid crystals display (LC's) –Introduction, classification, properties and application in Liquid Crystal Displays (LCD's). • Properties and application of Organic Light Emitting Diodes (OLED's) and light-emitting electrochemical cells	**07 Hrs**
Unit 4: Energy System and Battery Technology • Introduction, Classification of batteries (primary and secondary batteries). • Construction, working, advantages, and applications of the carbon-zinc cell, Ni-Cd, and Li-ion battery as an electrochemical cell. • Principle, Properties, and applications of Quantum dots sensitized solar cells (QDSSC's). • Fuel cells: Concept, types of fuel cells and merits. • Construction, working and applications of phosphoric acid fuel cells and Hydrogen-oxygen fuel cell	**07 Hrs**
Unit 5: Sustainable Chemistry and E-waste management: • Introduction, sources of e-waste, Composition, Characteristics, and Need of e-waste management. • Toxic materials used in manufacturing electronic and electrical products, health hazards due to exposure to e-waste. • Recycling and Recovery: Different approaches of recycling (separation, thermal treatments, hydrometallurgical extraction, direct recycling). • Extraction of Metal from E-waste. Role of stakeholders in environmental management of e-waste (producers, consumers, recyclers, and statutory bodies).	**07 Hrs**
Unit 6: Engineering Advanced materials and Green Chemistry • Introduction, and classifications of polymer. • Introduction, synthesis, properties & applications of Bakelite and Urea-formaldehyde resin. • Conducting Polymers: Introduction, Synthesis & Mechanism of conduction in polyaniline. • Biodegradable polymers: Introduction and their requirements. Synthesis, properties and applications of Polylactic acid. **Green Chemistry:** • Introduction, Aims, goals and applications. • Twelve principle of green chemistry. • Green Fuels: Introduction, construction and working of solar photovoltaic cell, advantages, and disadvantages.	**07 Hrs**

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(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
107.1	**Understand** the principles and applications of sensors.
107.2	**Discuss and assess** the Basic concepts of electronic memory and display Systems
107.3	**Illustrate** general synthesis and mechanisms of some advanced polymeric Materials and nanomaterials
107.4	**Evaluate** the electrochemical energy storage systems such as lithium batteries and design for usage in electrical and electronic applications
107.5	**Interpret** the extraction of metal from e-waste and the role of stakeholders in the environmental management of e-waste.
107.6	**Apply** the theoretical aspects for understanding water chemistry

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / Cos	BTL	1	2	3	4	5	6	7	8	9	10	11	12
107.1	3	3	-	-	-	-	-	-	-	-	-	-	1
107.2	2	3	-	-	-	-	-	-	-	-	-	-	1
107.3	2	3	-	-	-	-	-	-	-	-	-	-	1
107.4	2	3	-	-	-	-	-	-	-	-	-	-	1
107.5	3	3	-	-	-	-	-	-	-	-	-	-	1
107.6	3	3	-	-	-	-	-	-	-	-	-	-	1

Text Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Functional and smart materials,	--	Chander Prakash, Sunpreet Singh, J. Paulo Davim	CRC Press, ISBN: 978-036-727-510	2020,
2	A Textbook of Engineering Chemistry	12th	S. S. Dara, S. S. Umare	S. Chand & Company Ltd., New Delhi.	2011
3	A Text Book of Engineering Chemistry	--	Shashi Chawla	Dhanpat Rai & Co.	2017
4	A textbook of Engineering Chemistry	--	Jain and Jain,	Dhanpatrai Publication.	2015

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Energy storage and conversion devices: Supercapacitors, batteries, and hydroelectric cells,	1st edition, I	Anurag Gaur, A. L. Sharma, Anil Arya.	CRC Press, SBN: 978-1-003-14176-1	2021
2	E-waste recycling and management: present scenarios and environmental issues	Vol. 33.	Khan, Anish, and Abdullah M. Asiri.	Springer, ISBN: 978-3-030-14186-8.	2019
3	Functional and smart materials,	--	Chander Prakash, Sunpreet Singh, J. Paulo Davim	CRC Press, ISBN: 978-036-727-510	2020,
4	A Textbook of Engineering Chemistry	12th	S. S. Dara, S. S. Umare	S. Chand & Company Ltd., New Delhi.	2011

Useful Link /Web Resources:

1. https://ndl.iitkgp.ac.in/
2. https://www.youtube.com/watch?v=faESCxAWR9k

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(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Applied Chemistry Laboratory	
Course Code:241ELEBSCP108	**Semesters:** I & II
Teaching Scheme: L-T-P: 0-0-2	**Credit:** 1
Evaluation Scheme: ISE: 25	**ESE Marks:**

Prior Knowledge of:	Experiments based on titration, Handling of Glassware & Chemicals, and Preparation of Solutions.

Course Objectives:

1.	To test water quality parameters using various titration analysis methods
2.	To synthesize simple advanced materials and estimate concentration of elements in material's
3.	To know handling of glassware's and simple equipment's for chemical analysis.

List of Experiments-

Exp. No	Title of Experiments	Duration
01	Determination of total hardness of water sample by EDTA method (Complex metric Titration).	02Hrs
02	To determine the normality of given strong acid by titrating against strong alkali solution by conduct meter	02Hrs
03	To determine the normality of given weak acid by titrating against strong alkali solution by conductometer.	02Hrs
04	Determination pH of given solutions by pH meter.	02Hrs
05	Estimation of Iron from a solution by calorimetry.	02Hrs
06	Estimation of Nickel from a solution by calorimetry	02Hrs
07	To determine the approximate analysis of coal.	02Hrs
08	To study the Construction and working of Galvanic cell	02Hrs
09	To estimate amount of calcium from waste chalk.	02Hrs
10	Estimation of zinc metal from brass solution.	02Hrs
11	Preparation of urea-formaldehyde resin.	02Hrs
12	Preparation of phenol formaldehyde resin.	02Hrs

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
108.1	**Analyse** hardness, acidity, alkalinity, and chloride content of water and percentage of elements in some alloys.
108.2	**Produce** various advanced materials and analyse aqueous solutions using instruments.
108.3	**Perform** various experiments by following written instructions.
108.4	**Express** involvement by understanding concepts in applied chemistry.

Course Articulation Matrix: Mapping of Course Outcomes (Cos) with Program Outcomes (PO's)

PO's / Cos	BTL	1	2	3	4	5	6	7	8	9	10	11	12
108.1	3	3	-	-	-	-	-	-	-	-	-	-	1
108.2	3	3	-	-	-	-	-	-	-	-	-	-	1
108.3	3	3	-	-	-	-	-	-	-	-	-	-	1
108.4	3	3	-	-	-	-	-	-	-	-	-	-	1

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Laboratory manual on engineering chemistry	1st	S. K. Bashin, Dr.Sudha Rani	Dhanpat Rai Publishingcompany Ltd.,New Delhi	2012
2	Engineering Chemistry	15th	P. C. Jain,	Dhanpat Rai Publishing Company Ltd., New Delhi	2014

Useful Link /Web Resources:

1. https://www.vlab.co.in/broad-area-chemical-science

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School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Generative AI	
Course Code: 241ELEESCL105	**Semester:** II
Teaching Scheme: L-T-P: 3 – 0 - 0	**Credits:** 3
Evaluation Scheme: ISE-MSE Marks: 50	**ESE Marks:** 50

Course Description: Students will explore the basic principles of machine learning and neural networks, gaining insights into how AI systems learn from data to generate novel outputs. The course covers key areas of AI application, including natural language processing and computer vision, providing students with a broad perspective on the field's capabilities and potential.

Course Objectives:

1. To Explain the basic principles of Machine Learning.
2. To Describe the core concepts of neural networks and deep learning
3. To Distinguish between different generative models (e.g., GANs, VAEs)

Course Outcomes (COs):

Upon successful completion of this course, the students will be able to:

C105.1	Understand and explain the fundamentals of AI and generative AI
C105.2	Develop proficiency in prompt engineering and apply effective techniques for text generation
C105.3	Analyze and compare different types of generative models, including their capabilities.
C105.4	Evaluate the ethical implications, societal impact, and future potential of generative AI

Content	Hours
Unit 1: Introduction to AI and Generative AI Definitions of AI and generative AI. Brief history and types of AI.	5
Unit 2: Fundamentals of Generative AI "Neural networks, machine learning, deep learning. How generative AI ""learns""?"	7
Unit 3: Prompt Engineering and Text Generation "What is prompt engineering? Importance of prompts in generative AI. Techniques for effective prompt writing. How do text generation models work? Applications in writing, chatbots, and education."	7
Unit 4: Introduction to Generative Models What are generative models? Overview of different types (GANs, VAEs, etc.) Simple examples of content generation Generating simple images or melodies	7

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Unit 5: Image and Art Generation Image generation techniques. Role of prompts in image generation	6
Unit 6: Ethical Considerations and Future of Generative AI Potential applications and impact on society Ethical considerations (bias, misinformation, etc.) Privacy and security concerns Discussing the future of AI	8

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	Pos											
	1	2	3	4	5	6	7	8	9	10	11	12
C205.1	1				1							1
C205.2	1		2		1							
C205.3	1	2		1	1							
C205.4						3	2	3				1

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Generative AI Laboratory	
Course Code: 241ELEESCP106	**Semester:** II
Teaching Scheme: L-T-P: 0 – 0 - 2	**Credits:** 1
Evaluation Scheme: ISE Marks: 25	**ESE-**

Course Description: This course provides an introduction to generative artificial intelligence (AI), covering fundamental concepts, Models, AI tools and applications. Students will learn about various generative models and tools used in creating content such as images, text, music, prompt engineering concepts and ethics.

Course Objectives:

1. To study basic principles of generative AI.
2. To study different types of generative models and their applications.
3. To give hands-on experiences with existing generative models and tools.
4. To explore ethical considerations and societal implifications of generative AI technologies.

Course Outcomes (COs):

Upon successful completion of this course, the students will be able to:

C205.1	Understand and explain the fundamentals of AI and generative AI
C205.2	Develop proficiency in prompt engineering and apply effective techniques for text generation
C205.3	Analyze and compare different types of generative models, including their capabilities.
C205.4	Evaluate the ethical implications, societal impact, and future potential of generative AI

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	Pos											
	1	2	3	4	5	6	7	8	9	10	11	12
C205.1	1				1							1
C205.2	1		2		1							
C205.3	1	2		1	1							
C205.4						3	2	3				1

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(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

List of Assignments		
Ass. No.	**Name of Assignment**	**Hours**
1	Use AIweirdness.com to explore simple text generation. (https://www.aiweirdness.com/)	2
2	Use Teachable Machine by Google to create a simple image classifier. (https://teachablemachine.withgoogle.com)	2
3	Use Neural Network playground to visualize how neural networks make decisions. (https://playground.tensorflow.org/)	2
4	Use GPT-3 playground or a similar tool to generate text. (https://studio.ai21.com/)	2
5	Create a simple chatbot using Dialogflow or Botpress.	2
6	Use DALL-E mini or Midjourney to create AI-generated art	2
7	Experiment with DeepArt.io to apply artistic styles to photos	2
8	Use Mubert to generate AI music .	2
9	Experiment with Google's Magenta studio for music creation	2
10	Use the What-If Tool by Google to explore machine learning models and dataset bias	2

Online Resources:

1. https://www.deeplearning.ai/courses/generative-ai-for-everyone/
2. https://www.coursera.org/learn/introduction-to-generative-ai
3. https://www.w3schools.com/gen_ai/gen_ai_prompt_intro.php
4. https://www.tutorialspoint.com/prompt_engineering/prompt_engineering_introduction.htm
5. https://www.youtube.com/@AI.Overpowered

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Professional Communication	
Course Code: 241ELEACEL102	**Semester:** I/II
Teaching Scheme L-T-P: 1-0-0	**Credits:** 01
Evaluation Scheme: - ISE: 25	**ESE:** --

Prior knowledge of:	Basic English grammar, Basics of communication

Course Objectives:

1.	To **make** students learn important communicative situations, the basics of communication, and its significance in the corporate sector
2.	To **sharpen** listening, speaking, reading, and writing skills
3.	To **facilitate** them to draft office documents effectively
4.	To **enhance** career skills to make students industry-ready

Curriculum Details

Course Contents	Duration
Unit 1 Language and Communication • Need for effective communication • The process and levels of communication • Professional communication • Communication networks/ flows • Forms and methods (verbal and non-verbal) of communication • Barriers to communication and solutions	**04 Hrs**
Unit 2 Introduction to LSRW • **Listening Skills:** Hearing and listening, Listening as an active skill; Types of Listening; Barriers to effective listening skills • **Speaking Skills**: Importance, Various oral business contexts/situations, Group communication, Preparing effective public speeches (Impromptu and Prepared) • **Reading Skills**: Benefits of effective reading, Types of reading (Skimming; Scanning, Intensive reading, Extensive reading) Overcoming common obstacles, Reading comprehension • **Writing Skills:** Importance, Paragraph writing techniques	**03Hrs**
Unit 3 Professional Correspondence • **Official correspondence** Principles, structure (elements) Layout (complete block, modified block, semi-block), Types (enquiry and reply, claim and adjustment) • **Office drafting** Writing notice, agenda, and minutes of the meeting • **Email writing** Advantages and limitations Style, structure, and content Email etiquette	**04 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Unit 4 Career Skills and Ethics	**03 Hrs**
• **Resume and cover letter writing** Types of resume Important features of selling resume Cover letter writing • **Job Interviews** Interview preparation FAQs (Frequently Asked Questions) • **Guidance for IELTS, TOFEL and GRE** • **Corporate etiquette and ethics**	

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
102.1	**Implement** verbal and non-verbal codes for effective communication
102.2	**Demonstrate** language learning skills- LSRW (Listening, Speaking, Reading, and Writing)
102.3	**Compose** business documents competently
102.4	**Enhance** employability and readiness for industry demand and career advancement

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / COs	BTL	1	2	3	4	5	6	7	8	9	10	11	12
102.1	3	-	-	-	-	-	-	-	2	3	3	-	1
102.2	3	-	-	-	-	-	-	-	2	3	3	-	1
102.3	3	-	-	-	-	-	-	-	2	3	3	-	1
102.4	3	-	-	-	-	-	-	-	2	3	3	-	1

Suggested Learning Resources:

Text Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Technical Communication: Principles and Practice	4th	Meenakshi Raman & Sangita Sharma	Oxford University Press	2022
2	Personality Development and Soft- Skills	2nd	Barun K. Mitra	Oxford University Press	2016
3	Communication Skills	2nd	Sanjay Kumar & Pushp Lata	Oxford University Press	2015
4	Communication Skills	3rd	Meenakshi Raman & Sangeeta Sharma	Oxford University Press	2013

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Business Communication	2nd	Urmila Rai and S.M. Rai	Himalaya Publishing House Pvt. Ltd.	2014
2	A University Grammar of English	1st	Randolph Quirk and S Greenbaum	Pearson	2007
3	Effective Technical Communication	2nd	B. K.Mitra	Oxford University Press	2006
4	Effective Technical Communication	2nd	M.Ashraf Rizvi	McGraw Hill Education	2005

Useful Links/Web Resources:

1. https://www.skillsyouneed.com
2. https://www.psychologytoday.com
3. https://www.britishcouncil.in
4. https://www.udemy.com
5. https://www.englishclub.com

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Professional Communication Laboratory	
Course Code: 241ELEVSECP103	**Semester:** I/II
Teaching Scheme L-T-P: 0-0-2	**Credit:**01
Evaluation Scheme: ISE Marks: 25	**ESE Marks:** --

Prior knowledge of:	Basic language learning and people skills

Course Objectives:

1.	To **familiarize** students with English phonology and improve their pronunciation
2.	To **improve** language learning skills (LSRW) by providing ample practice
3.	To **develop** students' verbal and non-verbal communication
4.	To **cultivate** creative thinking and workplace skills

List of Lab Sessions

Session No	Title of Activities	Duration
01	**Icebreaking: Introducing self and others** Different ways of introducing self and others: demonstration	02Hrs
02	**Phonetics** Introduction to phonetics - consonants, vowels and diphthongs, stress, intonation in English with video samples	02Hrs
03	**Remedial English** Vocabulary-building games and identifying errors revising rules of English grammar	02Hrs
04	**Listening Practice** Listening comprehension, strategies for effective listening with audio/video samples	02Hrs
05	**Reading Practice** Improving Comprehension Skills, Techniques for good comprehension	02Hrs
06	**Technical Writing Practice** Paragraph writing, writing notices, agenda minutes of the meeting, email writing	02Hrs
07	**Public Speaking** Practicing extempore and prepared speeches	02Hrs
08	**Group discussion** Group discussions on current topics	02Hrs
09	**Mock Meetings** Purposes, preparation, and procedure for conducting effective meetings	02Hrs
10	**Mock Interviews** Preparing for FAQs and facing mock interviews	02Hrs
11	**Creative Writing** Blog Writing	02Hrs
12	**Film/Book Appreciation** Showing short films and appreciation of them. Reading novels or short stories and critical analysis of them.	02Hrs

D. Y. Patil Education Society
(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
103.1	**Demonstrate** effective LSRW skills
103.2	**Articulate** words accurately and create grammatically correct sentences
103.3	**Deliver** speeches and participate in GDs, business meetings, and mock interviews effectively
103.4	**Draft** business documents and blogs by following writing ethics

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / COs	BTL	1	`2	3	4	5	6	7	8	9	10	11	12
103.1	**3**	-	-	-	-	-	-	-	**2**	**3**	**3**	-	**1**
103.2	**3**	-	-	-	-	-	-	-	**2**	**3**	**3**	-	**1**
103.3	**3**	-	-	-	-	-	-	-	**2**	**3**	**3**	-	**1**
103.4	**3**	-	-	-	-	-	-	-	**2**	**3**	**3**	-	**1**

Suggested Learning Resources:

Text Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	A Practical Course in Spoken English	1st	J.K. Gangaj	PHI Learning Pvt. Ltd	2014
2	English Language Laboratories	2nd	Nira Konar	PHI Learning Pvt. Ltd	2014
3	Better English Pronunciation	2nd	J.D.O Connor	Cambridge University Press,	1980

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Communication Skills	2nd	Sanjay Kumar & Pushp Lata	Oxford University Press	2015
2	Technical Communication: Principles and Practice	2nd	Meenakshi Raman & Sangita Sharma	Oxford University Press	2011

Useful Links /Web Resources:

1. https://www.indiabix.com
2. https://www.skillsyouneed.com
3. https://interviewbuddy.in
4. https://learnenglish.britishcouncil.org
5. https://www.fluentu.com

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(Deemed To Be University)
School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Basics of Analog Electronics	
Course Code: 241ELEPCCL101	**Semester:** II
Teaching Scheme L-T-P: 2 – 0 - 0	**Credits:** 02
Evaluation Scheme: - ISE:	**ESE: - 50**

Prior Knowledge of:	Ohm's law, Semiconductor theory

Course Objectives:

1.	To make the students learn basic knowledge of electronic component and electronic devices
2.	To introduce fundamental concepts of Semiconductor devices.
3.	To study the fundamental principles of operational amplifiers and its Applications.
4.	To expose the students to the working principles of different types of Sensors

Curriculum Details

Course Contents	Duration
Unit-I: Basics of Electronic component • Definition and types of Resistor, capacitor, inductor • Classification of electronic component • Simplification of networks using series and parallel combinations(R,L,C) • Block diagram of Cathode ray oscilloscope, Digital storage Oscilloscope, Digital multi-meter, Function generator, Power supply	**06 Hrs**
Unit II: Semiconductor Devices • Introduction to semiconductor. • Construction, symbol, working, characteristics, applications of • P-N Junction, Light Emitting diode • Rectifiers:(HWR, FWR, Bridge) • Transistor: construction, types, operation; transistor configuration.	**06 Hrs**
Unit III: OP-AMP • Introduction to Operational amplifier • Block diagram of op-amp, • Dual input balanced output differential amplifier • Dual input unbalanced output differential amplifier • Open loop and Closed loop configuration of opamp • Applications of Op-amp - Summing Amplifiers, Differential amplifier, Integrator, differentiator	**06 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Unit IV: Sensors and Transducers • Classification of transducers • Difference between sensors and transducers • Temperature Sensor • Speed Sensor • Displacement Sensor • Pressure Sensor • Photo sensor • Piezoelectric sensor	**06Hrs**

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
101.1	Explain the basic concept of electric Components & Instruments
101.2	Identify type of diodes, transistor configurations
101.3	Explain the operational amplifier with its Application
101.4	Classify different types of Sensors

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / Cos	BTL	1	2	3	4	5	6	7	8	9	10	11	12
101.1	2	2	2	-	-	-	-	-	-	-	-	-	1
101.2	2	2	2	-	-	-	-	-	-	-	-	-	1
101.3	2	2	2	-	-	-	-	-	-	-	-	-	1
101.4	2	2	2	-	-	-	-	-	-	-	-	-	1

Text Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	Theory and problems of Basic Electrical Engineering	Eastern Economy Edition	I. J. Nagrath and Kothari	PHI learning 2. Pvt .Ltd	2009
2	Basic Electrical Engineering	2nd Edition.	V. N. Mittal and Arvind Mittal	Tata Mc Graw Hill	2007
3	Basic Electrical Engineering	1st Revised Edition	V.K. Mehta,	S. Chand & Co. Pvt . Ltd. New Delhi)	2008
4	Op Amps and Linear Integrated Circuits	IInd and latest edition	Ramakant A. Gaikwad	Pearson Education	

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Reference Books:

Sr. No	Title	Edition	Author(s)	Publisher	Year
1	A textbook of Electrical Technology Vol I	1st Edition.	B. L. Theraja and A. K. Theraja	Chand & Co. Pvt. Ltd. New Delhi	2008
2	operational Amplifiers and Linear Integrated Circuits	VI th edition	Robert Coughlin, Fredric Driscoll	Pearson Education	2006

Useful Link /Web Resources:

NPTL: https://www.youtube.com/watch?v=0SnfR13p6Mc&t=12s

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School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Python Programming	
Course Code: 241ELEVSECL103	**Semester:** I/II
Teaching Scheme L-T-P: 1 – 2 - 0	**Credits:** 02
Evaluation Scheme: - ISE: -25	**POE:** - 25

Prior knowledge of:	Basic Knowledge of computers

Course Description:
This subject covers basic principles of programming and programming ethics through the python programming language.

Course Objectives:

1.	
2.	
3.	

Curriculum Details

Course Contents	Duration
Unit 1 Introduction to Python and Decision Structures Input, Processing, and Output: Introduction to programming and Python, Basic syntax, Displaying Output with the print Function, Comments, Variables, Operators, Reading Input from the Keyboard, Performing Calculations Decision Structures: The if Statement, The if-else Statement, Comparing Strings, Nested Decision Structures and the if-elif-else Statement	**04 Hrs**
Unit 2 Repetition Structures and Functions Repetition Structures: Introduction to Repetition Structures, The while Loop: A Condition Controlled Loop, The for Loop: A Count-Controlled Loop, Calculating a Running Total, Sentinels, Input Validation Loops, Nested Loops Functions: Introduction to Functions, Defining and Calling a Void Function, Designing a Program to Use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants, Introduction to Value-Returning Functions.	**03Hrs**
Unit 3 Python Data structures and String **Lists and Tuples:** Sequences, Introduction to Lists, List Slicing, Finding Items in Lists with the in Operator, List Methods and Useful Built-in Functions, Copying Lists, Processing Lists, Two Dimensional Lists, Tuples, **Dictionaries and Sets**: Operations and use. **Strings:** Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings.	**04 Hrs**
Unit 4 Modules and File Handling **Modules:** Writing Your Own Value-Returning Functions, The math Module, Storing Functions in Modules **Files:** Introduction to File Input and Output Using Loops to Process Files, Processing Records, Exceptions.	**03 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
103.1	Demonstrate use of decision and repetition structure in order to solve specific problem
103.2	Model a given big problem statement in to smaller parts to provide modular approach.
103.3	Choose proper data structure like list, touples, dictionaries etc. for solving given problem

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / COs	BTL	1	2	3	4	5	6	7	8	9	10	11	12
103.1	1	-	-	-	2	-	-	1	-	-	-	-	1
103.2	1	-	-	-	2			1	-	-	-	-	1
103.3	1	-	-	-	2			1	-	-	-	-	1

Text Books:

1. Ethics for the Information Age 6th edition Michael J. Quinn
2. Starting Out with Python 5th Tony Gaddis Pearson March 17th 2021
Core Python Programming 3rd R. Nageswara Rao Dreamtech Press 1 Jan 2018

Reference Books:

1. Python: The Complete Reference Indian Edition Martin C. Brown MGH March 2018

D. Y. Patil Education Society
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School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Python Programming Laboratory	
Course Code: 241ELEVSECP104	**Semester:** I/II
Teaching Scheme L-T-P: 0 – 0 - 2	**Credits:** 01
Evaluation Scheme: - ISE: -25	

Prior knowledge of:	Basic Knowledge of computers

Course Description:
This subject covers basic principles of programming and programming ethics through the python programming language.

Course Objectives:

1.	
2.	
3.	

List of Experiment

Session No	Title of Activities	Duration
01	Program based on the decision structures (if, If else, nested if else, if elif else)	02Hrs
02	Program to demonstrate use of different types of looping statements.	02Hrs
03	1. Program to write and use different types of user defined function	02Hrs
04	Programs to demonstrate the use of various built-in functions in Python,	02Hrs
05	Program demonstrating operations and use of List and Touple	02Hrs
06	Program demonstrating operations and use of Dictionary and set.	02Hrs
07	Program to demonstrate modules	02Hrs
08	Program to perform CURD operations in a file using file handling.	02Hrs
09	Implement stack operations	02Hrs
10	Implement Queue operations	02Hrs

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School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
104.1	Demonstrate use of decision and repetition structure in order to solve specific problem
104.2	Model a given big problem statement in to smaller parts to provide modular approach.
104.3	Choose proper data structure like list, touples, dictionaries etc. for solving given problem

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / COs	BTL	1	2	3	4	5	6	7	8	9	10	11	12
104.1	1				2			1					1
104.2	1				2			1					1
104.3	1				2			1					1

Text Books:

1. Ethics for the Information Age 6th edition Michael J. Quinn
2. Starting Out with Python 5th Tony Gaddis Pearson March 17th 2021
Core Python Programming 3rd R. Nageswara Rao Dreamtech Press 1 Jan 2018

Reference Books:

2. Python: The Complete Reference Indian Edition Martin C. Brown MGH March 2018

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Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Liberal Learning Course (LLC)	
Course Code: 241ELECCA101	**Semester:** I/II
Teaching Scheme: L-T-P :0 – 0 – 4	**Credits:** 02
Evaluation Scheme ISE-50	**ISE Marks:** 50

Syllabus Contents (All Clubs)	Duration
1. PAINTING • Memory Drawing - Human sketching, Object Drawing Perspective Memory • 2D Drawing - Basic Drawing Elements Principles, Compositions, Colour Scheme/Texture • 3D Drawing - 3D Basic Forms,3D Sketching, Light effect (shade/shadow)	**30 Hrs**
2. DANCE • Hip-Hop. • Information about elements. • Old School- New School steps. • Variations in old school new school steps. • How to use old-school steps in dance. • Choreography on 2 songs	**30 Hrs**
3. YOGA & MEDITATION • Breathing practices and pranayama • Sectional Breathing • Yoga deep Breathing • Concept of bandha and mudra • Rictation of pranava mantra • Anter Maun • Breath Mediation • Om dhayna	**30 Hrs**
4. Music • Introduction of Music • Taal • Practical Raag (Harmonium Swar) • Group Song • Presentation	**30 Hrs**
5. GUITAR • Introduction of Guitar • Guitar Tuning • Open strings Exercise • Finger Exercise • Scales and Intervals • Major Scale • Minor Scale • Strumming Pattern • Lead	**30 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

6. INTERIOR DESIGN **6.1 Primary elements in Architecture** • Elements of design such as point, line, shape, form, mass, space, color and texture patterns, light and shade; understanding the relations between them. **6.2 Principles in Architectural Design** • Principles of design such as harmony (unity), proportions, contrast, scale, balance (symmetric & asymmetric), rhythm (pattern), emphasis, scale proportion Finger Exercise **6.3 Color Theory** • Properties of color, color schemes, color value, intensity, Color texture, psychological effect of color. • Apply the knowledge of color theory and rendering techniques for Interior design assignments and portfolio Scales and Intervals • Introduction to Architectural lettering, size, and notation of drawing, symbolic representation of building elements and material, and other features as per standard practice. • Assignments included for Sketch plan measure drawing lettering and architectural symbols.	**30 Hrs**
7. ADVENTURE **7.1 Introduction to Adventure Activities** • Introduction • Benefits of adventure activities. • how to plan an adventure activity and prepare for safety.	
7.2 Safety Protocols, Risk Management and Basic First Aid for Adventure Activities • Equipment safety check • Emergency response procedure • Risk assessment and mitigation strategies. • Common injuries and ailments in adventure settings • Wound care and basic treatments • Heat and cold-related illnesses	
7.3 Adventure Cycling and Trekking Equipment Safety Check • Basic cycle/bike maintenance and repair • Cycling activity • Long-distance trekking and camping (One Day in Nature) • Route planning and logistics	**08 Hrs**
7.4 Environmental Stewardship and study of Wildlife • Leave No Trace principles • Environmental impact of adventure activities • Sustainability practices and conservation efforts • Habitat requirements and preferences of different species. • Interactions between wildlife and their environment. • Conservation strategies for maintaining viable populations. • Visit to Sanctuary -Dajipur, Radhanagari, Kolhapur,Jungle safari.	**08 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

7.5 Adventure Sports: Self-defense and Personal Development, Leadership. • Benefits of Self-Defense Sports • Physical fitness and conditioning • Improved self-confidence and self-esteem • Enhanced coordination, agility, and reflexes • Stress relief and mental discipline • Practical self-defense skills and situational awareness • Example:- Wrestling, boxing, Karate, Martial arts, taekwondo, lathikati • Building resilience and mental toughness • Teamwork and collaboration in challenging environments • Leadership skills and decision-making under pressure	**4Hrs**
7.6 Study of Historical Monuments • Historical background and evolution of Indian Culture. • History of Maratha Empire. • Visit Forts, temples, Palace, etc • **VISIT TO VERTICAL ADVENTURE PARK, MASAI PATHAR-JEUR** • Zipline • Zorbing ball • Bungee Ejection • High rope course • Rappelling • Parasailing • Sports Climbing • Slack Line • Rock climbing	**4Hrs**
8. Foreign Language-German • Introducing self and others • Grammar: WH questions, personal pronouns, simple sentences, verb conjugation • Themes: hobbies, the week, numbers, the alphabet, months, seasons • Grammar: articles, plural, the verbs to have and to be basic directions / • Grammar: definite and indefinite articles; negation - kein and nicht; • Form Filling Can understand and use familiar, everyday expressions and very simple sentences, which relate to the satisfying of concrete needs. Can introduce him/herself and others as well as ask others about themselves – e.g. where they live, who they know and what they own – and can respond to questions of this nature. Can communicate in a simple manner if the person they are speaking to speaks slowly and clearly and is willing to help.	**28 Hrs**
9. Photography. **9.1 Introduction to Digital Photography** • Understanding film and paper photography. • Learning about the digital revolution. • How photos are used today.	**30 Hrs**

Electrical Engineering Curriculum

(As Per National Education Policy 2020)

9.2 Digital Basics • Digital image method of storing and processing digital image: Raster and Vector method Doodling. • Representation of digital image: Resolution – Pixel Depth **9.3 Digital Basics** • Windows Operating System • Concept of Internet • Image transportation through floppy, CD, zip and Internet. **9.4 Image Editing** • Image editing through image editing • Software like Adobe Photoshop – Adjustment of Brightness, Contrast, Tonal and Colour Values – • Experimenting with Level and Curve.	
10. Art & Craft **10.1 Craft Skills** • Cutting and Pasting Techniques - collage. • Paper folding Techniques -Origami.	**4 Hrs**
10.2 D.I.Y Project • Craft project using recycled material • Doodling.	**4 Hrs**
10.3 Field Trip • Cultural visit • Outdoor sketching • Visit to the exhibition and museum	**8 Hrs**
10.4 Workshop • Pottery Making • Lantern Making	**6 Hrs**
10.5 Cultural Activities • Drama, • skit, • Open Mic, • Singing, Dancing, etc.	**6 Hrs**
11. Film Making • Introduction of filmmaking • Short videos, Reels • Visit to Film Industry Kolhapur, • Information regarding instrument used in film industry	**30 Hrs**
12.Coding Club • Basics of C programming • Introduction • Datatypes • Operators • Keywords	**6 Hrs**

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Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Control Structure • If • If Else • Else If • For • While • Switch	**6 Hrs**
Functions • Types of Functions • Overloading & Overriding • Examples	**4 Hrs**
Arrays • Basics of Arrays • One Dimensional Array • Two-Dimensional Array	**4 Hrs** **4 Hrs**
Practice Problems	**4 Hrs**

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Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Capstone Project	
Course Code: 241ELEMC104	**Semester:** II
Teaching Scheme: L-T-P:0-0-0	**Credits:** Grade (Mandatory Course)
Evaluation Scheme ISE: 50	**ESE Marks:** --

Course Objectives:

1	To inculcate independent learning by problem-solving in a social context.
2	To engage students in rich and authentic learning experiences.
3	To emphasize learning activities that are long-term, interdisciplinary, and student-centric.
4	To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Curriculum Details
As per the approved structure of the curriculum, students will be allowed to do capstone projects during the second semester of B. Tech. program.

Topics:

A Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, new equipment fabrication, correlation and analysis of data, software development, or a combination of these.

Group Structure:

Working in supervisor/mentor-monitored groups; the students plan, manage, and complete a task/project/activity which addresses the stated problem.

1. There should be a team/group of 4 -5 students
2. A supervisor/mentor teacher assigned to individual groups

Selection of Project:

The project demo model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyze the problem within an articulated interdisciplinary or subject frame or based on Rural/Social internship.

A problem can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases.

By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry.

There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and structure of the activity.

1. A few hands-on activities that may or may not be multidisciplinary.

2. Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize, and present their learning.

3. Activities may include- Solving real life problem, investigation, /study and Writing reports of in-depth study, fieldwork.

Recommended Guidelines and phases:

Capstone project is learning through activity. One of the teachers can be appointed as guide for capstone project group. Following are the recommended guidelines that will work as an initiator and facilitator in process of completion of Capstone project.

1. In first week of commencement of 2nd semester, let the guide create awareness about capstone project (what, why, and how) among the students. Convey students expected outcomes, assessment process and evaluation criteria.
2. Get groups of students registered preferably 4-5 students per group.
3. Assign guide to each group.
4. Provide guidelines for title identification (Problem can be some real-life situation that needs technology solutions. This situation can be identified by rural/social internship, by meeting people around, visiting various industries, society, and institutes. The solution can be prototype, model, convertible solutions, survey and analysis, simulation, and similar).

5. Let students submit the problem identified in prescribed format (Problem Statement, Initial Survey for topic finalization, Abstract, Software, Hardware required, Title)

6. Guide can approve the problem statements based on feasibility and learning outcomes expected for first year engineering students
7. Guide is to monitor progress of the task during phases of project work. Broadly phases may include- requirements gathering, preparing a solution, technology design for the solution.
8. Weekly monitoring and continuous assessment record are to be maintained by guide.
9. Get the report submitted at the end of semester.

Student is required to prepare a capstone project and file containing documentary proofs of the activities done by him. The evaluation will be done by expert committee constituted by HoD/Departmental capstone project In-charge/ faculty mentor.

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School of Engineering & Management
Department of First-Year Engineering

Electrical Engineering Curriculum
(As Per National Education Policy 2020)

Course Title: Rural/Social Internship	
Course Code: 241ELEMC102	**Semester:** I
Teaching Scheme: L-T-P :0-0-0	**Credits:** Grade (Mandatory Course)
Evaluation Scheme ISE: 50	**ESE Marks:** --

Course Objectives:

1	To provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
2	To exposure to the current technological developments relevant to the subject area of training.
3	To expose students to the engineer's responsibilities and ethics.
4	To understand the social, economic and administrative considerations that influence the working environment of industrial organizations
5	To gain experience in writing technical reports/projects.
6	To understand the social, economic, and administrative considerations that influence the working environment of industrial organizations

Curriculum Details

As per the approved structure of curriculum, students will be allowed to do internship during the first semester of B. Tech. program. During the internship, students are required to visit villages/wards/small industries/organizations etc

For following activities

1. Prepare and implement a plan to create local job opportunities.
2. Prepare and implement a plan to improve education quality in the village.
3. Preparing an actionable DPR for Doubling the village Income.
4. Developing a Sustainable Water Management system.
5. Prepare and improve a plan to improve the health parameters of villagers.
6. Developing and implementing Low-Cost Sanitation facilities
7. Prepare and implement a plan to promote Local Tourism through Innovative Approaches
8. Implement/Develop Technology solutions that will improve quality of life.
9. Prepare and implement solutions for energy conservation.
10. Prepare and implement a plan to Skill village youth and provide employment.
11. Develop localized techniques for Reduction in construction Costs.
12. Prepare and implement a plan for sustainable growth of the village.
13. Setting of Information imparting club for women leading to contribution to social and economic issues.
14. Developing and managing an Efficient garbage disposable system.
15. Contribution to any national-level initiative of the Government of India. For eg. Digital India/ Skill India/ Swachh Bharat Internship etc

Every student is required to prepare a file containing documentary proofs of the activities done by him. The evaluation will be done by an expert committee constituted by the HoD/Departmental Internship In-charge/ faculty mentor.

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F.Y. To B. Tech.
Electrical Engineering
Curriculum Structure

Scheme 2024-28

Department of Electrical Engineering

w. e. f. A.Y.: 2024-25

F.Y. B. Tech Electrical Engineering Structure 24-25

Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
			Credits	Contact Hrs.			ISE	MSE	ESE	INT	OE/ PoE	
				L	P	T						
SEMESTER – I												
Basic Sciences	BSC	Linear Algebra & Calculus	4	3	-	1	20	30	50	25	-	125
	BSC	Applied Chemistry	4	3	2	-	20	30	50	25	-	125
Engineering Science	ESC	Problem Solving through Programming	4	3	2	-	20	30	50	25	-	125
Ability EnhancementCourse	AEC	Professional Communication	2	1	2	-	25	-	-	25	-	50
Vocational Skills Enhancement Course	VSEC	Python Programming	2	1	2	-	25	-	-	25	-	50
Indian Knowledge System	IKS	Historical Places in and Around Kolhapur District	2	2	-	-	20	30	-	-	-	50
Co-Curricular Activities	CCA	Liberal Learning - I	2	-	4	-	-	-	-	50	-	50
Mandatory Course	MC	Finishing School Training - I	-	3	-	-	50	-	-	-	-	Grade
		Rural/Social Internship	-	-	-	-	-		-	50	-	Grade
		Total	**20**	**13**	**12**	**1**	**180**	**120**	**150**	**225**	-	**575**
SEMESTER – II												
Basic Sciences	BSC	Differential Equations & Numerical Techniques	4	3	-	1	20	30	50	25	-	125
	BSC	Applied Physics	4	3	2	-	20	30	50	25	-	125
Engineering Science	ESC	Generative AI	4	3	2	-	20	30	50	25	-	125
	ESC	Digital Logic Design	4	3	2	-	20	30	50	25	-	125
Co-CurricularActivities	CCA	Liberal Learning - II	2	-	4	-	50	-	-	-	-	50
Program Core Courses	PCC	Basics of Analog Electronics	2	2	-	-	-	-	50	-	-	50
Vocational Skills Enhancement Cours	VSEC	Design Thinking Through Innovation	2	1	2	-	25	-	-	25	-	50
Mandatory Course	MC	Capstone Project	-	-	-	-	-	-	-	50	-	Grade
		Finishing School Training - II	-	3	-	-	50	-	-	-	-	Grade
		Total	**22**	**15**	**12**	**1**	**205**	**120**	**250**	**175**	-	**650**

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School of Engineering & Management
Department of First-Year Engineering
Electrical Engineering Curriculum
(As Per National Education Policy 2020)

F. Y. B. Tech. Scheme of Teaching and Examination w. e. f. A. Y. 2024-2025

Semester -I

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme		
				L	P	T			Type	Max. Marks	Minimum Marks For Passing
Students Induction Program as Per AICTE Guidelines											
1	241ELEBSCL101	BSC	Linear Algebra & Calculus	03	--	--	03	100	ISE MSE ESE	20 30 50	40
2	241ELEBSCL107	BSC	Applied Chemistry	03	--	--	03	100	ISE MSE ESE	20 30 50	40
3	241ELEESCL101	ESC	Problem Solving through Programming	03	--	--	03	100	ISE MSE ESE	20 30 50	40
4	241ELEIKSL101	IKS	Historical Places in and Around Kolhapur District	02	--	--	02	50	ISE MSE	20 30	20
5	241ELEVSECL103	VSEC	Python Programming	01	--	--	01	25	ISE	25	10
6	241ELEAECL102	AEC	Professional Communication	01	--	--	01	25	ISE	25	10
7	241ELEBSCP102	BSC	Linear Algebra & Calculus Tutorial	--	--	01	01	25	ISE	25	10
8	241ELEBSCP108	BSC	Applied Chemistry Laboratory	--	02	--	01	25	ISE	25	10
9	241ELEESCP102	ESC	Problem Solving through Programming Laboratory	--	02	--	01	25	ISE	25	10
10	241ELEVSECP104	VSEC	Python Programming Laboratory	--	02	--	01	25	ISE	25	10
11	241ELEAECP103	AEC	Professional Communication Laboratory	--	02	--	01	25	ISE	25	10
12	241ELECCAP101	CCA	Liberal Learning - I	--	04	--	2	50	ISE	50	20
Total				**14**	**14**	**01**	**20**	**575**	--	--	--	--
Mandatory Courses											
1	241ELEMC102	MC	Rural/Social Internship	--	--	--	--	50	ISE	Grade	--	--
2.	241ELEMC101	MC	Finishing School Training - I	03	--	--	--	50	ISE	Grade	--	--

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D. Y. Patil Education Society
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Electrical Engineering Curriculum
(As Per National Education Policy 2020)

F. Y. B. Tech. Scheme of Teaching and Examination w. e. f. A. Y. 2024-2025

Semester -II

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation Scheme		
				L	P	T			Type	Max. Marks	Minimum Marks for Passing
1	241ELEBCSL103	BSC	Differential Equations & Numerical Techniques	03	--	--	03	100	ISE MSE ESE	20 30 50	40
2	241ELEBSCL105	BSC	Applied Physics	03	--	--	03	100	ISE MSE ESE	20 30 50	40
3	241ELEESCL105	ESC	Generative AI	03	--	--	03	100	ISE MSE ESE	20 30 50	40
4	241ELEESCL103	ESC	Digital Logic Design	03	--	--	03	100	ISE MSE ESE	20 30 50	40
5	241ELEPCCL101	PCC	Basics of Analog Electronics	02	--	--	02	50	ESE	50	20
6	241ELEVSECL101	VSEC	Design Thinking Through Innovation	01	--	--	01	25	ISE	25	10
7	241ELEBSCP104	BSC	Differential Equations & Numerical Techniques Tutorial	--	--	01	01	25	ISE	25	10
8	241ELEBSCP106	BSC	Applied Physics Laboratory	--	02	--	01	25	ISE	25	10
9	241ELEESCP106	ESC	Generative AI Laboratory	--	02	--	01	25	ISE	25	10
10	241ELEESCP104	ESC	Digital Logic Design Laboratory	--	02	--	01	25	ISE	25	10
11	241ELEVSECP102	VSEC	Design Thinking Through Innovation Laboratory	--	02	--	01	25	ISE	25	10
12	241ELECCAP102	CCA	Liberal Learning - II	--	04	--	02	50	ISE	50	20
			Total	**14**	**10**	**1**	**22**	**650**	--	--	--
Mandatory Courses											
1	241ELEMC104	MC	Capstone Project	--	--	--	--	50	ISE	Grade	--
2.	241ELEMC103	MC	Finishing School Training - II	03	--	--	--	50	ISE	Grade	--

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Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)

Department of Electrical Engineering

S.Y B.Tech SEMESTER-III

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credit	L	P	T	ISE	MS E	ESE	INT	OE/ PoE	
24ELEU3P01	Program Core Courses	PCC	Electrical Measurement and Instrumentation	3	3	-	-	20	30	50	-	-	100
24ELEU3P02			Electric Circuit Analysis	3	3	-	-	20	30	50	-	-	100
24ELEU3P03			Applied Mathematics	2	2	-	-	20	30	50	-	-	100
24ELEU3P04			Electrical Measurement and Instrumentation Lab	1	-	2	-	-	-	-	25	25	50
24ELEU3P05			Electric Circuit Analysis Lab	1	-	2	-	-	-	-	25	25	50
24ELEU3F06	Comm.Engg. Project(CEP)/Field Project (FP)	CEP/FP	Society based Mini- Project	2	-	4	-	-	-	-	50	-	50
24ELEU3M07	Multidisciplinary Minor	MDM-1	Fundamental and Architecture of Electric Vehicle	2	2	-	-	-	-	50	-	-	50
24ELEU3V08	Value Education Course	VEC	Personal Values and Ethics	2	2	-	-	50	-	-	-	-	50
24ELEU3O09	Open Elective Course	OEC-1	Basic Electric Circuits (ODL)	3	3	-	-	20	30	50	-	-	100
24ELEU3O10			Basic Electric Circuits Lab (ODL)	1	-	2	-	-	-	-	25	-	25
24ELEU3H11	Humanities Social Science and Management	Entrepreneurship/ Economics/ Management course	Financial Management	2	2	-	-	50	-	-	-	-	50
24ELEU3D12	MandatoryCourse	MC	Finishing School Training III	Audit	3*	-	-	50	-	-	-	-	Grade
24ELEU3C13	Co-Curricular Activities	CCA	Liberal Learning-I	Audit	2#	-	-	50	-	-	-	-	Grade
24ELEU3C14			Liberal Learning-II										
			Total	22	17	10		280	120	250	125	50	725

*-Values not included in total, #-2 contact hrs per club, Min Marks for passing: 40% of total marks of individual course

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Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)

Department of Electrical Engineering

S.Y B.Tech SEMESTER-IV

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/POE	
24ELEU4P01	ProgramCore Courses	PCC	DC Machines and Transformers	3	3	-	-	20	30	50	-	-	100
24ELEU4P02			Power Electronics	3	3	-	-	20	30	50	-	-	100
24ELEU4P03			Generation, Transmission & Distributions	2	2	-	-	20	30	50	-	-	100
24ELEU4P04			DC Machine and Transformers Lab.	1		2	-	-	-	-	25	25	50
24ELEU4P05			Power ElectronicsLab	1		2	-	-	-	-	25	25	50
24ELEU4M06	Multidisciplinary Minor	MDM-2	Energy Storage System for Electric Vehicles	2	2	-	-	-	-	50	-	-	50
24ELEU4V07	Value Education Course	VEC (Environmental Study)	Environmental Studies	2	2	-	-	-	-	50	-	-	50
24ELEU4H08	Humanities Social Science and Management	Entrepreneurship /Economics/ Management course	Industrial Management & Startups	2	2	-	-	50	-	-		-	50
24ELEU4A09	Ability Enhancement course	AEC	Electronics Workshop	2	1	2	-	-	-	-	25	25	50
24ELEU4O10	OpenElective Course	OEC-II	Basics of Energy Auditing and Management	2	2	-	-	-	-	50	-	-	50
24ELEU4N11	Vocational Skills EnhancementCourse	VSEC	Model Based Programming & Simulation	2	-	2	-	-	-	-	25	25	50
24ELEU4D12	MandatoryCourse	MC	Finishing School Training IV	Audit	2*	-	-	50	-	-	-	-	Grade*
24ELEU4C13	Co-Curricular Activities	CCA	Liberal Learning-I	Audit	2#	-	-	50	-	-	-	-	Grade*
24ELEU4C14			Liberal Learning-II										
			Total	**22**	**17**	**8**	-	**210**	**90**	**300**	**100**	**100**	**700**
24ELEU4Z01	Honors Courses/Double (Minor)	HC(Optional)	Honors Paper-I (ODL only) Transducers and Signal Conditioning	4	4	-	-	20	30	50	-	-	100

*-Values not included in total, #-2 contact hrs per club, Min Marks for passing: 40% of total marks of individual course

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Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)

Department of Electrical Engineering

T.Y B.Tech SEMESTER V

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/PoE	
24ELEU5P01	Program Core Courses	PCC	Signal & Systems	3	3	-	-	20	30	50	-	-	100
24ELEU5P02			AC Machines	3	3	-	-	20	30	50	-	-	100
24ELEU5P03			Feedback control System	4	4	-	-	20	30	50	-	-	100
24ELEU5P04			Signal & Systems Lab	1	-	2	-	-	-	-	25	50	75
24ELEU5P05			AC Machines Lab	1	-	2	-	-	-	-	25	50	75
24ELEU5M06	Multidisciplinay Minor	MDM-3	Electric Drives and Controllers for Electric Vehicles	3	3	-	-	20	30	50	-	-	100
24ELEU5M07			Electric Drives and Controllers for EV Lab	1	-	2	-	-	-	-	25	-	25
24ELEU5O08	Open Elective	OEC-III	PLC & SCADA	2	2	-	-	-	-	50	-	-	50
24ELEU5E09	Professional Elective	PEC1	Renewable Energy Systems	4	4	-	-	20	30	50	-	-	100
24ELEU5E10			Analog and Digital Circuit										
24ELEU5E11			Electrical Distribution Systems										
24ELEU5D12	Mandatory Course	MC	Finishing School Training V	Audit	3*	-	-	50	-	-	-	-	Grade
24ELEU5C13	Co-Curricular Activities	CCA	Liberal Learning-I	Audit	2#	-	-	50	-	-	-	-	Grade
24ELEU5C14			Liberal Learning-II										
			Total	**22**	**19**	**6**	-	**200**	**150**	**300**	**75**	**100**	**725**
24ELEU5Z02	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper-II (ODL) Control Systems	4	4	-	-	20	30	50	-	-	100

***-Values not included in total, #-2 contact hrs per club, Min Marks for passing: 40% of total marks of individual course**

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Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)

Department of Electrical Engineering

T.Y B.Tech SEMESTER VI

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/PoE	
24ELEU6P01	Program Core Courses	PCC	High Voltage Engineering	3	3	-	-	20	30	50	-	-	100
24ELEU6P02			Power System Analysis	3	3	-	-	20	30	50	-	-	100
24ELEU6P03			Electromagnetic Engineering	2	2	-	-	-	-	50	-	-	50
24ELEU6P04			High Voltage Engineering Lab	1	-	2	-	-	-	-	25	25	50
24ELEU6P05			Power System Analysis Lab.	1	-	2	-	-	-	-	25	25	50
24ELEU6M06	Multidisciplinary Minor	MDM-4	Plug in Electric Vehicles in Smartgrid	2	2	-	-	-	-	50	-	-	50
24ELEU6E07	Professional Elective	PEC-2	Power System Economics And Control Techniques	3	3	-	-	20	30	50	-	-	100
24ELEU6E08			Microcontroller & Application										
24ELEU6E09			Industrial Automation										
24ELEU6E10		PEC-2	Power System Economics And Control Techniques Lab	1	-	2	-	-	-	-	25	-	25
24ELEU6E11			Microcontroller & Application Lab										
24ELEU6E12			Industrial Automation Lab										
24ELEU6E13		PEC-3	Illumination Engineering	4	4	-	-	20	30	50	-	-	100
24ELEU6E14			Automotive Electrical and Electronics System										
24ELEU6E15			Smart Grid Technology										
24ELEU6N16	Vocational Skills Enhancement	VSEC	Data Structures & Algorithms using C++	2	1	2	-	-	-	-	25	25	50
24ELEU6D17	Mandatory Course	MC	Finishing School Training VI	Audit	3*	-	-	50	-	-	-	-	Grade
24ELEU6C18	Co-Curricular Activities	CCA	Liberal Learning-I	Audit	2#	-	-	50	-		-	-	Grade
24ELEU6C19			Liberal Learning-II										
			Total	**22**	**18**	**8**	**-**	**180**	**120**	**300**	**100**	**75**	**675**
24ELEU6Z03	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper-III (Online) Process Control Engineering	4	4	-	-	20	30	50	-	-	100

*-Values not included in total, #-2 contact hrs per club. Min. Marks for passing: 40% of total marks of individual course

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Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)

Department of Electrical Engineering

B.Tech SEMESTER-VII

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/PoE	
24ELEU7P01	Program Core Courses	PCC	Electrical Drives	3	3		-	20	30	50	-	-	100
24ELEU7P02			Flexible AC Transmission Systems	2	2	-	-	-	-	50	-	-	50
24ELEU7P03			Electrical Drives lab	1		2		-	-	-	25	25	50
24ELEU7M04	Multidisciplinary Minor	MDM-5	Minor Project	2	2	-	-	-	-	50	-	-	50
24ELEU7M05	Research Methodology	RM	Research Methodology (ODL)	4	4	-	-	20	30	50	-	-	100
24ELEU7E06	Professional Elective	PEC-4	Switch gear & Protection	3	3	-	-	20	30	50	-	-	100
24ELEU7E07			Power Quality Harmonics										
24ELEU7E08			Computer Methods in Power Systems										
24ELEU7E09	Professional Elective	PEC-5	Electrical Vehicles	3	3	-	-	20	30	50	-	-	100
24ELEU7E10			Installation Maintenance & Testing of Electrical Equipment										
24ELEU7E11			Electrical Generation & Utilization										
24ELEU7J12	Project	PR	Project	4	-	4	-	-	-	-	100	50	150
24ELEU7C13	Co-Curricular Activities	CCA	Liberal Learning-I	Audit	2#	-	-	50	-	-	-	-	Grade
24ELEU7C14			Liberal Learning-II										
Total				**22**	**17**	**6**	**0**	**130**	**120**	**300**	**125**	**75**	**700**
24ELEU7Z04	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper-IV (ODLonly) Industrial Automation	4	4	-	-	20	30	50	-	-	100

***-Values not included in total, #-2 contact hrs per club, Min Marks for passing: 40% of total marks of individual course**

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Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)

Department of Electrical Engineering

B.Tech SEMESTER-VIII

CourseCode	CourseCategory	Course Type	CourseName	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/PoE	
24ELEU8P01	Program Core Courses	PCC	Electric Machine Design(ODL)	4	4		-	20	30	50	25		125
24ELEU8E02	Professional Elective	PEC-6	Basics of Machine learning (ODL)	2	2	-	-	-	-	50	-	-	50
24ELEU8E03			Internet of Things(ODL)										
24ELEU8E04			Introduction to Artificial Intelligence (ODL)										
24ELEU8I05	Internship	INT	Internship	12	-	8	-	-	-	-	100	100	200
24ELEU8M06	Multidisciplinary Minor	MDM-6	Capstone Project	2	2		-	-	-	50	-	-	50
Total				**20**	**8**	**8**	**-**	**20**	**30**	**150**	**125**	**100**	**425**
24ELEU8Z05	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper-V(ODL) Robotics	2	2	-	-	-	-	50	-	-	50

***-Values not included in total, #-2 contact hrs per club, Min Marks for passing: 40% of total marks of individual course**

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Department of Electrical Engineering

S.Y. B. Tech. Semester-III
Structure and Curriculum

Scheme 2024-2028

Academic Year 2025-26

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Course Code Draft Formats

Format: {YY}{DDD}{U/P/D}{S}{T}{NN}

Abbr	: Meaning
YY	: Year -> Last 2 digits of Year
DDD	: Dept Abbr.
L	: Level -> UG/PG/Doctoral
S	: Semester Number
T	: Type -> NEP bucket (*list)
NN	: Serial Number
A	: Assessment -> Theory / Lab / Tutorial

eg. 24DSEU3A01

NEP Bucket List

NEP Course Category	Abbr.	Code
Ability Enhancement Courses	AEC	A
Basic Science Courses	BSC	B
Co-Curricular Activities	CCA	C
Audit Course	AC	D
Program Elective Courses	PEC	E
Community Engagement Project /. Field Project	CEP/FP	F
Humanities/Social Science, Management	HSSM	H
Internship	INT	I
Project	PR	J
Indian Knowledge System	IKS	K
Multi-Disciplinary Minor	MDM	M
Vocation Skill Enhancement Courses	VSEC	N
Open Elective Courses	OEC	O
Program Core Courses	PCC	P
Research Methodology	RM	R
Engineering Science Courses	ESC	S
Value Education Courses	VEC	V
Honors Courses	HON	Z

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Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)

Department of Electrical Engineering

S.Y B.Tech SEMESTER-III

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credit	L	P	T	ISE	MS E	ESE	INT	OE/ P.E	
24ELEU3P01	Program Core Courses	PCC	Electrical Measurement and Instrumentation	3	3	-	-	20	30	50	-	-	100
24ELEU3P02			Electric Circuit Analysis	3	3	-	-	20	30	50	-	-	100
24ELEU3P03			Applied Mathematics	2	2	-	-	20	30	50	-	-	100
24ELEU3P04			Electrical Measurement and Instrumentation Lab	1	-	2	-	-	-	-	25	25	50
24ELEU3P05			Electric Circuit Analysis Lab	1	-	2	-	-	-	-	25	25	50
24ELEU3F06	Comm.Engg. Project(CEP)/Field Project (FP)	CEP/FP	Society based Mini- Project	2	-	4	-	-	-	-	50	-	50
24ELEU3M07	Multidisciplinary Minor	MDM-1	Fundamental and Architecture of Electric Vehicle	2	2	-	-	-	-	50	-	-	50
24ELEU3V08	Value Education Course	VEC	Personal Values and Ethics	2	2	-	-	50	-	-	-	-	50
24ELEU3O09	Open Elective Course	OEC-1	Basic Electric Circuits (ODL)	3	3	-	-	20	30	50	-	-	100
24ELEU3O10			Basic Electric Circuits Lab (ODL)	1	-	2	-	-	-	-	25	-	25
24ELEU3H11	Humanities Social Science and Management	Entrepreneurship/ Economics/ Management course	Financial Management	2	2	-	-	50	-	-	-	-	50
24ELEU3D12	MandatoryCourse	MC	Finishing School Training III	Audit	3*	-	-	50	-	-	-	-	Grade
24ELEU3C13	Co-Curricular Activities	CCA	Liberal Learning-I	Audit	2#	-	-	50	-	-	-	-	Grade
24ELEU3C14			Liberal Learning-II										
			Total	22	17	10		280	120	250	125	50	725

*-Values not included in total, #-2 contact hrs per club, Min Marks for passing: 40% of total marks of individual course

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S.Y. B. Tech. Curriculum
(As Per National Education Policy 2020)

Semester-III

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3P01,Electrical Measurements and Instrumentation**
Prerequisite/s			Basic Electrical Engineering
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: This course covers the principles and techniques of measuring electrical quantities such as voltage, current, resistance, and power. Students learn about various electrical instruments, their calibration, and their applications in engineering. Topics include measurement errors, sensors, transducers, data acquisition systems, and the interpretation of measurement results.

Course Objectives:

1	This course intends to provide basic concepts of errors in measurements and basic fundamentals of Measuring systems. Formal representation, computational methods, notation, and vocabulary of linear models.
2	It is aimed to impart skills to classify bridges, measuring instruments and equipment's and also demonstrates digital instruments, advance instruments.
3	To impart basic knowledge of transducer.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3P01.1	Grasp fundamental concepts of measurement and identify errors in measurement and its statistics.
24ELEU3P01.2	Explain working principle and mechanism of measuring instrument.
24ELEU3P01.3	Use a proper measuring instrument and modern techniques for measurement of electrical parameters for given application.
24ELEU3P01.4	Implement the instrumentation system for measurement of physical parameters.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3P01.1	3	3											2	2
24ELEU3P01.2	3												2	2
24ELEU3P01.3	3	3		2	3								2	2
24ELEU3P01.4	3	2	2										2	2

Content	Hrs.
Unit I: Introduction Units, Dimensions and Standards, Structure of Measurement Systems, Instrument Types- Active, Passive, Examples of Laboratory Instruments, Static Characteristics & Dynamic Characteristics of Instruments, Measurement Errors, Sensors and Transducers - Overview, Definition, Classification, Selection Criteria.	6
Unit II: Measuring Instruments Indicating, Integrating, Recording Instruments, Analog & Digital Ammeter and Voltmeter. Essentials of Indicating Instruments Deflecting, Controlling And Damping Systems. Construction, Working Principle, Torque Equation, Advantages & Disadvantages of Moving Iron (MI) (Attraction And Repulsion), Permanent Magnet Moving Coil (PMMC) & Dynamometer Type Instruments, Range Extension of MI Instruments.	7
Unit III: Measurement of Power and Energy Active And Reactive Power Measurement In Three Phase System for Balanced and Unbalanced Load Using Two Wattmeter Method & One Wattmeter Method. Construction, Working Principle, Torque Equation of Single Phase Conventional (Induction Type) Energy Meter, Calibration of Energy Meter, Digital Energy Meter	7
Unit IV: Measurement of Electrical Quantities Measurement of Low, Medium and High Resistance, Wheatstone Bridge, Kelvin's Double Bridge, Ammeter-Voltmeter Method, Megger, Earth Tester for Earth Resistance Measurement, Maxwell's Bridge, Hay's Bridge, Anderson's Bridge, Schering Bridge and Wien's Bridge.	6
Unit V: Measurement of Non-electrical Quantities Force Measurement Using Strain Gauges, Displacement Measurements Using LVDT, Temperature Measurement Using RTD, Thermistor, Thermocouple, Bellows and Diaphragm. Flow Measurement Using Rotameter, Electromagnetic Flow Meter. Speed Measurement Using Magnetic Pick-Up And Photoelectric Pick-Up.	7
Unit VI: Recent Developments DSO, Power Analyzer, Wave Analyzer, Harmonic Distortion Analyzer, Instrument Transformers, Digital Ammeter & Voltmeter	6

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Text Books:

1	Alan Morris "Principles of measurement and instrumentation", Prentice Hall- India, 2004 ISBN: 0134897099.
2	A. K. Sawhney, "A Course in Electrical and Electronics Measurement and Instrumentation", Dhanapat Rai & Company, New Delhi, reprint, 17th Edition, 2005.
3	Rangan, Mani and Sharma, "Instrumentation Devices and Systems", Tata McGraw Hill, New Delhi, 2nd Edition.
4	Helfrick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques" Pearson, 2007
5	C. D. Johnson, "Process Control Instrumentation Technology", Pearson Education.

Reference Books:

1	M. A. Baldwin, "Fundamentals of Electrical Measurements", Publication – Lyall Book Depot, Ludhiyana.
2	Albert D. Helfric, "Modern Electronics measurement & instruments", PHI Ltd, 2003.
3	Doebelin E. O., "Measurement Systems", McGraw Hill Book Co.
4	Patranabis D, "Sensors and Transducers", Wheeler Publishing Co., Ltd. New Delhi.
5	Murthy D. V. S., "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi.

	Useful Links
1	https://nptel.ac.in/courses/108/105/108105153
2	https://nptel.ac.in/courses/108/105/108105064
3	elearning.vtu.ac.in/, nptel.iitg.ernet.in/

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Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3P02, Electric Circuit Analysis**
Prerequisite/s			Engineering Mathematics I
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: Electric Circuit Analysis is a foundational course that explores the principles and techniques for analyzing electrical circuits. It covers topics such as Ohm's law, Kirchhoff's laws, network theorems, and transient and steady-state analysis of AC and DC circuits, equipping students with essential skills for understanding and designing electrical systems

Course Objectives:

1	This course intends to develop an understanding of the fundamental laws and elements of electric circuits.
2	It will make students to learn a number of powerful engineering circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and several methods of simplifying networks.
3	The course intends to introduce open circuit, short circuit, transmission, hybrid parameters and their interrelationship

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3P02.1	Determine voltages, currents, powers, and equivalence of a.c. and d.c. circuits using electrical circuit theorems.
24ELEU3P02.2	Calculate the transient and steady state response of first and second order circuits.
24ELEU3P02.3	Analyze the parameters of two port electrical circuits and networks.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3P02.1	3	3	2										2	2
24ELEU3P02.2	3	3	3										1	1
24ELEU3P02.3	3	3	1										1	1

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Content	Hrs.
Unit I: DC Circuits Ohm's law, Kirchhoff's law, dependent and independent sources, nodes, branches, loops, voltage and current division, Wye Delta transformations, nodal analysis, mesh analysis, linearity property, superposition theorem, source transformation, Thevenin's and Norton's theorem, maximum power transfer.	8
Unit II: First Order Circuits Capacitors, Series and Parallel Capacitors, Inductors, Series and Parallel Inductors, Source free RC, RL circuits, step response of RC, RL, circuits	5
Unit III: Second Order Circuits Finding initial and final values, source free series and parallel RLC circuits, step response of series and parallel RLC circuits, general second order circuits.	6
Unit IV: AC Circuits Sinusoids, phasors, impedance and admittance, sinusoidal steady state analysis, nodal and mesh analysis, superposition theorem, source transformation, Thevenin's and Norton's equivalent circuit.	8
Unit V: Power in AC Circuits Instantaneous and Average Power, Maximum Average Power, RMS Value, Apparent Power and Power factor, Complex Power, mutual inductance, dotconvention, energy in coupled circuits.	6
Unit VI: Two Port Network Impedance parameters, admittance parameters, hybrid parameters, transmission parameters, series connection of two two-port network, parallel connection of two two-port network, cascade connection of two two-port network	6

Text Books:

1	C. K. Alexandar and M.O. Sadiku, "Fundamentals of Electric Circuits", McGraw Hill EducationMH, 6th Edition,2018, ISBN: 9780078028229
2	Hayt, Kemmerly, Durbin, "Engineering Circuit Analysis", TMH, 8th Edition, 2012, ISBN: 9781259098635

Reference Books:

1	James W. Nilsson and Susan A. Riedel "Electric Circuits" Prentice Hall, 10th Edition, 2015,ISBN: 0131989251
2	L.P. Huelsman, "Basic Circuit Theory", Prentice Hall, 3rd Edition, 2009, ISBN: 9788120309715

Useful Links	
1	https://nptel.ac.in/courses/108/106/108106172/
2	https://nptel.ac.in/courses/108/105/108105159/
3	https://nptel.ac.in/courses/108/104/108104139/

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3P03**,Applied Mathematics
Prerequisite/s			LAC and DET
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: This course introduces essential mathematical techniques used in electrical engineering, including differential equations, Laplace and Z-transforms, Fourier series, and probability distributions. It equips students with a strong foundation for analyzing and modeling engineering systems.

Course Objectives:

1	To develop the ability to apply Laplace and Z-transforms for solving linear differential and difference equations, especially in initial value problems relevant to engineering systems.
2	To enable students to represent periodic and piecewise continuous functions using Fourier series, including sine and cosine expansions, for signal analysis and system modeling.
3	To impart knowledge of solving linear differential equations using operator methods and apply them to model and analyze electrical circuits and dynamic systems.
4	To introduce the fundamentals of probability theory and probability distributions, empowering students to model and analyze random processes and uncertainties in engineering applications.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3P03.1	Solve differential and difference equations by applying Laplace and Z-transforms.
24ELEU3P03.2	**Develop Fourier series representations** of periodic functions, including half-range expansions, to analyze signals and waveforms in communication and electronic systems.
24ELEU3P03.3	Solve linear differential equations using methods for finding complementary functions and particular integrals.
24ELEU3P03.4	Solve basic problems in probability theory, including problems involving the binomial, Poisson and normal distributions.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3P03.1	3	2	--	--	1	---	--	--	--	--	--	1	-	-
24ELEU3P03.2	3	2	--	--	1	--	--	--	--	--	--	1	-	-
24ELEU3P03.3	3	2	--	--	1	--	--	--	--	--	--	1	-	-
24ELEU3P03.4	3	2	--	--	1	--	--	--	--	--	--	1	-	-

Content	Hrs.
Unit I:Laplace Transform andZ – Transform Introduction of Laplace transform, Laplace transform ofderivatives, Laplace transform of integral, Convolution theorem,Applications to initial value boundary problems. Introduction of z-transform, applications to difference equations.	7
Unit II: Fourier series Introduction, Expansion of Functions, Even and oddfunctions, Change of Interval and functions having arbitrary period, Half rangeFourier sine and cosine series.	7
Unit III: Linear differential Equations and Its applications Definitions, complete solutions, operator D, Rules for finding complementary functions, Inverse operator, Rules for finding the particular integral, Applications of linear Differential equations to oscillatory electrical circuit.	7
Unit IV: Probability Introduction, Elementary theory of probability, Random variable, Discrete probability distribution, Continuous probability distribution, Binomial distribution, Poisson distribution, Normal distribution.	7

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Text Books:

1	Advanced Engineering Mathematics, Erwin Kreyszig Wiley Eastern Ltd.Publication, 1st Edition,1978.
2	A TextBook Of Applied Mathematics,VolI and II,P.N.and J.N.Wartikar, VidyarthiGrihaPrakashan,Pune, 2006.
3	Higher EngineeringMaths,B.S.Grewal,KhannaPublication,39th Edition,2005.
4	Fundamental of Mathematical Statistics, Guptaand Kapoor, Exclusive publication, 10th Edition,2000.

Reference Books:

1	AdvancedEngineeringMathematics,WylieC.R.,TataMcGrawHillPublication,8th Edition,1999.
2	Advanced Engineering Mathematics,H.K.Dass, S.Chand andcompanyLtd.,1st Edition1988.
3	An Introduction to probability and Statistics,VijayRohatgi,Wiley India Pvt. Ltd, 2nd Edition, 2008.

	UsefulLinks
1	https://www.youtube.com/watch?v=lkAvgVUvYvY
2	https://www.youtube.com/watch?v=c9NibpoQjDk

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School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3P04, Electrical Measurements and Instrumentation Lab**
Prerequisite/s			Basic Electrical Engineering
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25/00/25**
		Total	**50**

Course Description: This course covers the principles and techniques of measuring electrical quantities such as voltage, current, resistance, and power. Students learn about various electrical instruments, their calibration, and their applications in engineering. Topics include measurement errors, sensors, transducers, data acquisition systems, and the interpretation of measurement results. Practical sessions focus on hands-on experience with instruments and techniques used in electrical engineering applications.

Course Objectives:

1	This course explain and physically identify the parts like moving coil, control system, damping systems, pointer, shunts, multipliers etc. of different types of deflection systems.
2	It aims to develop an ability to select and implement various bridges for measuring electrical quantities.
3	It aims to recognize various transducers and use them in the measurement of various electrical and non-electrical quantities.
4	It intends to develop skills for measurement and instrumentation system.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3P04.1	Explain the principles and operation of various measurement devices, their characteristics, limitations.
24ELEU3P04.2	Execute measurement of electrical parameters using various bridges.
24ELEU3P04.3	Apply proper method, sensors and transducers for specific applications and measurement.
24ELEU3P04.4	Explain the principles and operation of various measurement devices, their characteristics, limitations.

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Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3P04.1	3	3			2								2	2
24ELEU3P04.2	3	3			3								2	2
24ELEU3P04.3	3	2			3								2	2
24ELEU3P04.4	3	2											2	2

List of Experiments	
Expt. No.	**Name of Experiment**
1	Study of Moving iron, PMMC and Dynamometer type instruments (Basic moving systems)
2	Measurement of power in three phase balanced and unbalanced circuits by conventional two wattmeter method.
3	Calibration of Single-phase energy meter for energy measurement
4	Measurement of R, L and C Using Different Bridges and confirmation with analytical calculations.
5	Measurement of temperature using RTD
6	Comparative study of temperature measurement using RTD and thermocouple
7	Study of strain gauge and measurement of force using it
8	Study of construction of LVDT and measurement of displacement, force and pressure by using it.
9	Measurement of Light intensity using Lux-meter and to realize the light intensity distribution with change in distance.
10	Speed measurement using photoelectric pick up, magnetic pick up and stroboscope

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Text Books:

1	Alan Morris "Principles of measurement and instrumentation", Prentice Hall- India, 2004 ISBN: 0134897099.
2	A. K. Sawhney, "A Course in Electrical and Electronics Measurement and Instrumentation", Dhanapat Rai & Company, New Delhi, reprint, 17th Edition, 2005.
3	Rangan, Mani and Sharma, "Instrumentation Devices and Systems", Tata McGraw Hill, New Delhi, 2nd Edition.
4	C. D. Johnson, "Process Control Instrumentation Technology", Pearson Education.

Reference Books:

1	Albert D. Helfric, "Modern Electronics measurement & instruments", PHI Ltd, 2003.
2	Doebelin, E. O., "Measurement Systems", McGraw Hill Book Co.
3	Patranabis, D," Sensors and Transducers", Wheeler Publishing Co., Ltd. New Delhi.
4	Murthy, D. V. S., "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi.

	Useful Links
1	https://nptel.ac.in/courses/108/105/108105153
2	https://nptel.ac.in/courses/108/105/108105064

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3P05, Electric Circuit Analysis Lab**
Prerequisite/s			Basic Electrical Engineering Lab
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25/00/25**
		Total	**50**

Course Description: Electric Circuit Analysis Lab provides hands-on experience in building and analyzing electrical circuits. Through practical experiments, students apply theoretical concepts, use measurement instruments, and develop skills in circuit troubleshooting and design, enhancing their understanding of AC and DC circuit behaviors and reinforcing classroom learning

Course Objectives:

1	This course intends to provide basic practical knowledge of electrical circuit theorems.
2	It intends to develop skills to demonstrate transient and steady state response of first and second order electrical circuit.
3	It aims to develop an ability to simulate and implement various basic electrical circuits.
4	It intends to develop skills for measurement and instrumentation system.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3P05.1	**Determine** parameters of electrical circuits and two port network usinghardware and simulation.
24ELEU3P05.2	**Explain** the transient and steady state response of first and second ordercircuit using hardware and simulation.
24ELEU3P05.3	**Employ** measurement and instrumentation system for measurement of electrical and physical parameters.

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Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3P05.1	3	3	3		3								2	2
24ELEU3P05.2	3	3			3								2	2
24ELEU3P05.3	3	2			3								2	2

List of Experiments	
Expt. No.	**Name of Experiment**
1	Implementation of Mesh and Node analysis to measure current and voltage in D.C. circuit usingsoftware tool PSpice.
2	Verification of Superposition Theorem to measure current and voltage in electrical circuit usinghardware and validate the result using software tool PSpice.
3	Verification of Thevenin's and Norton's Theorem to obtain equivalent circuit using hardware andvalidate the result using software tool PSpice.
4	Determine transient and steady state behaviour of a first order circuit (R-C circuit) on hardware andvalidate the results using software tool PSpice.
5	Determine transient and steady state behaviour of a second order circuit (R-L-C circuit) using softwaretool PSpice.
6	Determine Impedance, Admittance, Transmission and Hybrid parameters of two port electrical networkusing hardware and validate the result manually.
7	Implementation of Mesh and Node analysis to measure current and voltage in A.C. circuit usingsoftware tool PSpice.
8	Determine active power using two wattmeter method and reactive power using one wattmeter methodin a three-phase circuit and validate the result manually.
9	Determine error in single phase energy meter by calibration.
10	Determine physical parameters using different type of transducers and validate the result manually

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869, 'E', Kasaba Bawada, Kolhapur-416006.

Text Books:

1	C. K. Alexandar and M.O. Sadiku, "Fundamentals of Electric Circuits", McGraw Hill Education, 6th Edition,2018, ISBN: 9780078028229
2	H. S. Kalsi "Electronic Instrumentation", McGraw Hill Education, Third edition, 2010, ISBN: 9780070702066

Reference Books:

1	James W. Nilsson and Susan A. Riedel "Electric Circuits" Prentice Hall, 10th Edition, 2015, ISBN: 0131989251
2	A. K. Sawhney, "A Course in Electrical and Electronics Measurement and Instrumentation",Dhanapat Rai& Company, New Delhi, reprint, 19th Edition, 2010, ISBN: 9788177001006

	Useful Links
1	https://nptel.ac.in/courses/108/105/108105153/
2	https://nptel.ac.in/courses/108/105/108105064/

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Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3F06, Society based Mini- Project**
Prerequisite/s			
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**04**
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**50**/00/00
		Total	**50**

Course Description: This course gives introduction of electric hardware systems and provides hands-on training with identification, testing, assembling, dismantling, and fabrication of societal electrical project

Course Objectives:

1	To design working, reliable electric circuits to meet specifications
2	To understand concepts of interfacing different electric peripherals.
3	To design and implement the solution using hardware / software or both
4	To create an interest in the field of electrics design as a prospective career option.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3F06.1	Apply the fundamental concepts and working principles of electric devices to design electric circuits to solve Societal problems.
24ELEU3F06.2	Analyze datasheets and select appropriate components and devices.
24ELEU3F06.3	Demonstrate simulation using software's.
24ELEU3F06.4	Enable the Students to develop application-based projects and estimate project cost.

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Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
24ELEU3F06.1	3	-	-	-	-	-	-	-	-	-	-	1		
24ELEU3F06.2	3	1	-	-	1	-	-	-	-	-	-	1		
24ELEU3F06.3	3	2	3	-	3	-	-	-	-	-	-	1		
24ELEU3F06.4	3	2	3	-	3	-	-	-	3	-	-	1		

Sr. No.	Mini project work should consist of following steps
1	Students should propose societal problem based project ideas & finalize the project idea in consultation with guide. (Problem statement).
2	Students should submit implementation plan to the subject incharge. This will cover weekly activity of project report.
3	Problem definition and specification development in the form of synopsis.
4	Design of circuit with calculation & should include a) Analog part b) digital part c) Power supply d) Test strategy if firmware is required produce flow chart.
5	Simulation of design using tools like eSim, OrCAD, Matlab, etc.
6	Design calculation component selection.
7	Fabrication & assembly of PCB & enclosure.
8	Testing, Measurement of specifications & calibration.
9	Bill of Material.
10	Final Demo and Project Report.

References:

1. The First Book of Electronics Workshop: Can't Beat a Practical Approach - River Publishers Series in Communications.
2. Handbook of Electronic projects, by ArsathNatheem.
3. Fundamentals of Electrical Engineering – BharatiDwivedi and AnurasgTripathi – Willey Precise
4. Electronics Devices and Circuit Theory- Robert L. Boylestad and Louis Nashelsky, Pearson Education Publication

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School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3M07, Fundamental and Architecture of Electric Vehicle**
Prerequisite/s			
Teaching Scheme: Lecture/Tutorial/Practical			**02**/00/00
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**00**/00/**50**
	P	**INT / OE/POE**	00/00/00
		Total	**50**

Course Description: Fundamentals and Architecture of Electric Vehicles is a course that delves into the core principles and design aspects of electric vehicles. It covers topics such as electric powertrains, battery technology, vehicle dynamics, and charging infrastructure, providing students with a comprehensive understanding of EV systems and their integration.

Course Objectives:

1	Understand the fundamental principles of electric vehicle propulsion systems
2	Analyze the architecture and components of electric vehicles
3	Explore the environmental impact and sustainability considerations of electric vehicles compared to traditional internal combustion engine vehicles
4	Evaluate the integration of electric vehicle subsystems
5	Discuss the current trends and future developments in electric vehicle technology
6	Apply theoretical knowledge through practical exercises, including vehicle design simulations, case studies on real-world EV implementations.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3M07.1	**Understand** the basic principles of electric vehicle operation.
24ELEU3M07.2	**Analyze** the components and subsystems of electric vehicles.
24ELEU3M07.3	**Evaluate** the advantages and limitations of electric vehicle technologies.
24ELEU3M07.4	**Design** basic electric vehicle architectures.
24ELEU3M07.5	**Assess** the environmental impacts of electric vehicles.
24ELEU3M07.6	**Discuss** emerging trends and future prospects in electric vehicle technology

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D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3M07.1	3												2	2
24ELEU3M07.2	3	3											2	2
24ELEU3M07.3	3	2	3										2	2
24ELEU3M07.4	3	3											2	2
24ELEU3M07.5	3	3											2	2
24ELEU3M07.6	3	3											2	2

Unit	Contents	Hours
1	**Introduction to Electric Vehicles** History and evolution of electric vehicles, Types and classifications of electric vehicles: BEVs, PHEVs, and FCEVs, Global market trends and forecasts, Environmental benefits: emissions reduction and sustainability, Challenges and barriers to adoption: range anxiety and infrastructure development	6
2	**Electric Vehicle Powertrains** Electric motors: types (induction, permanent magnet, synchronous), operation principles, and efficiency characteristics, Power electronics: inverters, converters, and motor controllers, Energy storage systems: lithium-ion batteries, battery management systems (BMS), and thermal management, Fuel cell technology: hydrogen fuel cells, working principles, and applications in FCEVs, Comparison of different powertrain configurations: series, parallel, and series-parallel hybrid systems	7
3	**Vehicle Dynamics and Control Systems** Chassis design considerations for electric vehicles: weight distribution, center of gravity, and vehicle dynamics, Powertrain integration and optimization for efficiency and performance, Control strategies: regenerative braking systems, traction control, and stability control, Vehicle-to-Grid (V2G) technology: bidirectional power flow and grid stabilization, Impact of electric drivetrains on handling characteristics and driver experience	6
4	**Charging Infrastructure and Grid Integration** Charging technologies: AC charging (Level 1 and Level 2), DC fast charging (CHAdeMO, CCS, Tesla Supercharger), and wireless charging, Charging standards and protocols: interoperability issues and standardization efforts, Smart charging strategies: peak load management, demand response, and grid-friendly charging, Integration of renewable energy sources with EV charging infrastructure, Business models and investment trends in charging infrastructure development	7
5	**Environmental and Economic Aspects** Life cycle analysis of electric vehicles: cradle-to-grave environmental impacts, Economic feasibility: total cost of ownership (TCO), payback period, and financial incentives, Regulatory frameworks and government policies promoting electric vehicle adoption, Market dynamics: consumer preferences, adoption rates, and market penetration forecasts, Impact of electric vehicles on urban air quality and noise pollution	6

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	reduction initiatives	
6	**Future Trends and Innovations** Advances in battery technology: solid-state batteries, graphene-based batteries, and beyond lithium-ion technologies, Autonomous electric vehicles: technologies, challenges, and implications for urban mobility, Connectivity and smart mobility solutions: vehicle-to-everything (V2X) communication, internet of vehicles (IoV), and cloud-based services, Energy management and optimization: predictive analytics, AI-driven algorithms, and energy-efficient routing, Global initiatives and collaborations advancing electric vehicle technology and infrastructure development	7

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	"Electric and Hybrid Vehicles: Design Fundamentals"	Iqbal Husain	CRC Press	2nd	2017
2	"Introduction to Electric Circuits"	Richard C. Dorf, James A. Svoboda	Wiley	9th	2019
3	"Electric Vehicle Technology Explained"	James Larminie, John Lowry	Wiley	2nd	2012
4	"Electric Drives and Electromechanical Systems: Applications and Control"	Richard Crowder	Academic Press	1st	2019
5	"Energy Storage for Sustainable Microgrid"	N. Mithulananthan, D. Srinivasan	Springer	1st	2015
6	"Electric Vehicles: Design and Build Your Own"	Michael Hackleman	McGraw-Hill Education	1st	2013

Reference Books:

01	"Electric Vehicles and Plug-In Hybrids: Advanced Simulation Methodologies"	Gianfranco Pistoia	Elsevier	1st	2017
02	"Electric Vehicle Integration into Modern Power Networks"	Sumedha Rajakaruna, Nick Jenkins	Springer	1st	2013
03	"Battery Management Systems for Large Lithium Ion Battery Packs"	Davide Andrea	Artech House	1st	2010
04	"Introduction to Power Electronics"	Daniel W. Hart	Pearson	1st	2011
05	"Electric Vehicle Technology"	Ching-Yao Chan	CRC Press	1st	2013
06	"Electric Vehicle Technology and Expectations in the Automobile Industry"	Alexander Voronov	IGI Global	1st	2020

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School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3V08, Personal Values and Ethics**
Prerequisite/s			Personal Communication
Teaching Scheme: Lecture/Tutorial/Practical			**02**/00/00
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**50**/00/00
	P	**INT / OE/POE**	00/00/00
		Total	**50**

Course Description: This course introduces students to the ethical considerations and professional values necessary for a career in electric engineering. It covers foundational principles, ethical decision-making frameworks, responsibilities towards society, and professional conduct

Course Objectives:

1	To understand the importance of professional ethics in engineering.
2	To apply ethical decision-making frameworks to engineering scenarios.
3	To analyze case studies related to ethical dilemmas in Electrical engineering.
4	To develop awareness of societal responsibilities and environmental impact of Electric technologies.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3V08.1	Identify and analyze ethical issues in electric engineering practices.
24ELEU3V08.2	Apply ethical theories and principles to resolve ethical dilemmas.
24ELEU3V08.3	Evaluate the social and environmental impact of electric technologies.
24ELEU3V08.4	Demonstrate awareness of professional codes of conduct and responsibilities.

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)			3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3V08.1	2	3	1	-	-	3	-	3	-	1	-	-	1	1
24ELEU3V08.2	2	3	1	-	-	3	-	3	-	1	-	-	1	1
24ELEU3V08.3	2	3	2	-	-	3	3	3	-	1	-	-	1	1
24ELEU3V08.4	2	3	1	-	-	3	3	3	1	2	-	2	1	1

Content	Hrs
Unit 1 – Introduction to Professional Ethics Importance of ethics in engineering; Professional codes of conduct; Ethical theories and frameworks; Case studies on ethical issues in electric engineering	7
Unit 2 –Ethical Decision-Making Ethical decision-making models; Stakeholder analysis; Handling conflicts of interest; Case studies and role-play exercises	7
Unit 3 - Societal Responsibilities) Social impacts of electronic technologies; Environmental considerations; Sustainable engineering practices; Corporate social responsibility (CSR) in electrical industry.	7
Unit 4-Professional Conduct and Development Professional integrity and honesty; Career development and lifelong learning; Professional organizations and networking; Personal and professional growth in electrical engineering	7

Note: Subject incharge should conduct any of the activities listed

List of Activities:

- Group discussions on case studies;
- Debates on ethical dilemmas;
- Guest lectures by industry professionals on CSR and environmental sustainability;
- Field visits to understand real-world implications of electronic technologies

Text Books:

1. "Engineering Ethics: Concepts and Cases" by Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins, Cengage Learning.
2. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger, McGraw-Hill Education.

Reference Books:

1. "Professional Ethics in Engineering" by William H. Frey and Christopher G. Brusaw, Pearson Education.
2. "Ethical Issues in Engineering" by Deborah G. Johnson and Helen Nissenbaum, IEEE Press.

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3O09, Basic Electric Circuits**
Prerequisite/s			
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: Basic Electric Circuits provides a foundational understanding of electrical circuit theory. It covers essential topics such as Ohm's Law, Kirchhoff's Laws, network theorems, and the analysis of AC and DC circuits, equipping students with the skills to analyze and design basic electrical circuits

Course Objectives:

1	Understand the fundamental concepts and principles of electric circuits, including voltage, current, power, and energy.
2	Apply Ohm's Law and Kirchhoff's Laws to analyze and solve simple electrical circuits.
3	Learn and implement various network theorems, such as Thevenin's, Norton's, and Superposition Theorem, for circuit simplification and analysis.
4	Analyze AC and DC circuits using phasor and time-domain methods.
5	Develop skills in using circuit analysis techniques to design and troubleshoot basic electrical circuits.
6	Gain practical knowledge through solving real-world circuit problems and applying theoretical concepts to practical scenarios.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3O09.1	Demonstrate a clear understanding of fundamental electric circuit concepts, including voltage, current, resistance, and power.
24ELEU3O09.2	Apply Ohm's Law and Kirchhoff's Laws effectively to analyze and solve complex electrical circuits.
24ELEU3O09.3	Utilize various network theorems, such as Thevenin's, Norton's, and Superposition Theorem, to simplify and analyze electrical circuits.
24ELEU3O09.4	Analyze both AC and DC circuits using appropriate methods, such as phasor analysis for AC circuits.
24ELEU3O09.5	Design and troubleshoot basic electrical circuits, applying theoretical knowledge to practical situations.
24ELEU3O09.6	Solve real-world electrical circuit problems, demonstrating proficiency in circuit analysis techniques and critical thinking skills

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3O09.1	3	2											2	2
24ELEU3O09.2	3	3	2										2	2
24ELEU3O09.3	3	3	2										2	2
24ELEU3O09.4	3	2	2										2	2
24ELEU3O09.5	3	3	2										2	2
24ELEU3O09.6	3	3	2										2	2

Content	Hrs.
Unit 1: Introduction to Electric Circuits Overview of Electric Circuits, Basic Electrical Quantities: Voltage, Current, Power, and Energy, Circuit Elements: Resistors, Capacitors, Inductors, and Voltage and Current Sources, Types of Circuits: Series and Parallel Circuits	7
Unit 2: Fundamental Laws and Theorems Ohm's Law and its Applications, Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL), Voltage and Current Division Rules, Mesh Analysis and Nodal Analysis	7
Unit 3: Network Theorems Thevenin's Theorem,Norton's Theorem, Superposition Theorem, Maximum Power Transfer Theorem, Reciprocity and Millman's Theorem	7
Unit 4: AC Circuit Analysis Introduction to Alternating Current (AC), Sinusoidal Waveforms and Phasors, Impedance and Admittance, AC Circuit Analysis using Phasors, Resonance in AC Circuits	7
Unit 5: Transient Analysis Introduction to Transients in Electric Circuits, RC and RL Circuits: Natural and Forced Response, RLC Circuits: Overdamped, Underdamped, and Critically Damped Responses, Transient Response of AC Circuits	7
Unit 6: Two-Port Networks Introduction to Two-Port Networks, Parameters of Two-Port Networks: Z-parameters, Y-parameters, H-parameters, and ABCD-parameters, Interconnection of Two-Port Networks, Applications of Two-Port Networks	7

Text Books:

1	"Electric Circuits" by James W. Nilsson and Susan Riedel, 11th Edition, Pearson, 2018
2	"Engineering Circuit Analysis" by William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin, 8 th Edition, McGraw-Hill Education, 2011
3	"Introductory Circuit Analysis" by Robert L. Boylestad, 13 th Edition, Pearson, 2015
4	"Fundamentals of Electric Circuits" by Charles K. Alexander and Matthew N.O. Sadiku, 6 th Edition, McGraw-Hill Education, 2016
5	"The Analysis and Design of Linear Circuits" by Roland E. Thomas, Albert J. Rosa, and Gregory J. Toussaint, 7 th Edition, Wiley, 2012

Head of Department
Department of Electrical Engg
School of Engineering & Management
B/9, 'E', Kasaba Bawada, Kolhapur-416006.

Reference Books:

1	"Circuit Analysis: Theory and Practice" by Allan H. Robbins and Wilhelm C. Miller, 5 th Edition, Cengage Learning, 2012
2	"Basic Engineering Circuit Analysis" by J. David Irwin and R. Mark Nelms, 11 th Edition, Wiley, 2015
3	"Microelectronic Circuits" by Adel S. Sedra and Kenneth C. Smith, 7 th Edition, Oxford University Press, 2014
4	"Linear Circuit Analysis" by Raymond A. DeCarlo and Pen-Min Lin, 2nd Edition, Oxford University Press, 2001
5	"Schaum's Outline of Electric Circuits" by Mahmood Nahvi and Joseph Edminister, 6 th Edition, McGraw-Hill Education, 2013

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
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School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3O10, Basic Electric Circuits Lab**
Prerequisite/s			
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/00
		Total	**25**

Course Description: The Basic Electric Circuits (Practical) course introduces students to the fundamental principles of electric circuit analysis through hands-on experiments. It covers the study of electrical quantities, circuit elements, laws, network theorems, AC and transient circuit behavior, and two-port network analysis. This course emphasizes practical problem-solving skills and prepares students for advanced studies in electrical engineering

Course Objectives:

1	To develop teamwork skills by engaging in collaborative activities and projects, fostering an essential competency for industrial and research environments.
2	To bridge theoretical knowledge with practical applications by integrating concepts from related courses to address industry-relevant challenges.
3	To enhance communication and presentation abilities through team-based presentations, preparing students for professional and academic scenarios.
4	To cultivate critical evaluation and peer learning by analyzing and assessing the work of other teams, promoting a culture of constructive feedback and continuous improvement.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3O10.1	Understand and explore hardware components and their operation, including control mechanisms using relevant software tools.
24ELEU3O10.2	Apply theoretical knowledge from related courses to solve practical problems and meet industry requirements.
24ELEU3O10.3	Develop the ability to work collaboratively in teams, fostering essential skills for industrial and professional environments
24ELEU3O10.4	Enhance teamwork-based presentation skills, focusing on effective communication essential for research and industry settings

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3O10.1	2	1						3			2		2	2
24ELEU3O10.2	2	2	1		2			3			2		2	2
24ELEU3O10.3	2	2	1		2			3			2		2	2
24ELEU3O10.4								3		3	3	3	2	2

Content	Hrs.
The plan of conducting this course is given below: **1. Team Formation** Form groups of 4–5 students. Assign roles **2. Problem Statement** Select a project topic from the list or propose a new idea (subject to faculty approval). Define a clear objective and scope for the project. **3. Circuit Design and Simulation** Design the circuit using theoretical concepts. Perform simulations using software tools (e.g., MATLAB, Multisim, Proteus). **4. Hardware Implementation** Assemble the circuit using appropriate components. Test and troubleshoot the circuit for functionality and performance. **5. Documentation** Prepare a detailed report that includes: Project title Objective and scope Circuit diagram and theoretical background Components used (with specifications) Procedure and observations Results and analysis Challenges faced and solutions Conclusion and future scope **6. Presentation** Create a concise 10-minute presentation with visuals to showcase your project. Include objectives, methodology, results, and challenges. Each team member must contribute to the presentation.	2

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

Text Books:

1	"Electric Circuits" by James W. Nilsson and Susan Riedel, 11th Edition, Pearson, 2018
2	"Engineering Circuit Analysis" by William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin, 8 th Edition, McGraw-Hill Education, 2011
3	"Introductory Circuit Analysis" by Robert L. Boylestad, 13 th Edition, Pearson, 2015
4	"Fundamentals of Electric Circuits" by Charles K. Alexander and Matthew N.O. Sadiku, 6 th Edition, McGraw-Hill Education, 2016
5	"The Analysis and Design of Linear Circuits" by Roland E. Thomas, Albert J. Rosa, and Gregory J. Toussaint, 7 th Edition, Wiley, 2012

Reference Books:

1	"Circuit Analysis: Theory and Practice" by Allan H. Robbins and Wilhelm C. Miller, 5 th Edition, Cengage Learning, 2012
2	"Basic Engineering Circuit Analysis" by J. David Irwin and R. Mark Nelms, 11 th Edition, Wiley, 2015
3	"Microelectronic Circuits" by Adel S. Sedra and Kenneth C. Smith, 7 th Edition, Oxford University Press, 2014
4	"Linear Circuit Analysis" by Raymond A. DeCarlo and Pen-Min Lin, 2nd Edition, Oxford University Press, 2001
5	"Schaum's Outline of Electric Circuits" by Mahmood Nahvi and Joseph Edminister, 6 th Edition, McGraw-Hill Education, 2013

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- III
Course Code and Course Title			**24ELEU3H11, Financial Management**
Prerequisite/s			
Teaching Scheme: Lecture/Tutorial/Practical			**02/00/00**
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**50**/00/00
	P	**INT / OE/POE**	00/00/00
		Total	**50**

Course Description: Financial Management is a course that explores the principles and techniques of managing an organization's financial resources. It covers topics such as financial planning, budgeting, investment analysis, and risk management, equipping students with the skills to make informed financial decisions and optimize financial performance

Course Objectives:

1	Overview of Indian financial system, their instruments and market.
2	Basic concepts of Time Value of Money, returns and risks
3	Knowledge about of Corporate Finance &Capital Budgeting, NPV, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)
4	Knowledge about sources of finance, capital structure, Trade Credit, Bank Finance, Commercial Paper, Project Finance.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU3H11.1	Understand Indian finance system and Financial Markets.
24ELEU3H11.2	Evaluate of Time Value of Money, returns and risks.
24ELEU3H11.3	to apply the knowledge of Corporate Finance & Capital Budgeting, NPV, MIRR, IRR
24ELEU3H11.4	to develop the knowledge about sources of finance &capital structure.

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Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3H11.1	2	2	1	1	1	-	-	-	-	-	1	-	1	1
24ELEU3H11.2	1	1	1	1	1	-	-	-	-	-	2	-	1	1
24ELEU3H11.3	2	2	1	1	1	-	-	-	-	-	2	-	1	1
24ELEU3H11.4	2	2	2	2	2	-	-	-	-	-	2	-	1	1

Content	Hrs
Unit -1 **Overview of Indian Financial System** Characteristics, Components and Functions of Financial System. Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Capital Market, Money Market and Foreign Currency Market Financial Institutions- Commercial Banks, Merchant banks & Stock Exchanges.	4
Unit -2 **Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future& present Value of a Lump Sum, Ordinary Annuity. Continuous Compounding and Continuous Discounting.	3
Unit -3 **Overview of Corporate Finance:** Objectives of Corporate Finance. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement. **Capital Budgeting:** Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)	4

Head of Department
Department of Electrical Engg.
School of Engineering & Management
809, 'E', Kasaba Bawada, Kolhapur-416006.

Unit -4 **Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure. Relation between Capital Structure and Corporate Value	3

Expt. No.	Name of Experiment	Hrs
1	Find FRA,LR for following financial statements.	2
2	Find efficiency & activity ratio for following financial statements.	2
3	Find rate of return ,PP,DPP for following financial statements.	2
4	Find net present value(NPV)for following financial statements.	2
5	Estimate the working capital for following different businesses.	2
6	Prepare a project report for any one businesses.	2
7	Illustrate bank project finance process in detail.	2
8	Income tax and PF calculation of employee.	2
9	Examples on balance sheet.	2
10	Visit to bank/industry to see FM strategies.	2

Reference Books:

1. Fundamentals of Financial Management, 13th Edition(2015) by Eugene F. Brigham and Joel F.Houston; Publisher: Cengage Publications, NewDelhi.
2. AnalysisforFinancialManagement,10thEdition(2013)byRobertC.Higgins;Publishers:McGraw Hill Education, New Delhi.
3. IndianFinancialSystem,9thEdition(2015)byM.Y.Khan;Publisher:McGrawHillEducation,NewDelhi.
4. FinancialManagement,11thEdition(2015)byI.M.Pandey;Publisher:S.Chand(G/L)&CompanyLimited, New Delhi.
5. Financial Management: Theory and Practice Twelfth Edition Eugene F. Brigham and Michael C. Ehrhardt by Thomson.

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Course Title: Liberal Learning Course-I (IoT and Automation Club)	
Course Code: 24ELEU3C13	**Semester: III**
Teaching Scheme: L-T-P: 2-0-0	**Credits: Audit**
Evaluation Scheme: ISE: 50, MSE: NA	**ESE Marks: NA**

Course Description:
The club has vision to provide a platform for learning, networking, staying updated on the latest advancements in IoTand automation technology and explore, innovate, and collaborate on IoT-Automation related projects.

Aim:

1. Providing members with opportunities to learn about IoTtechnologies, protocols, and applications through workshops, seminars, and online resources.
2. Encouraging members to explore and develop innovative IoTand automation based projects, fostering creativity and problem-solving skills.
3. Facilitating collaboration among members to work on joint projects, share ideas, and build a supportive community.
4. Creating a platform for members to connect with industry professionals, researchers, and promoting the practical application of IoT and Automation in various domains, encouraging them to work on real-world projects.
5. Enhancing members' skills in programming, data analytics, hardware integration, and other relevant areas crucial for IoTand Automation development.

Course Objectives:

1	To better understand IoTand Automation technologies, applications, and their implications through workshops, seminars, and knowledge-sharing sessions.
2	Provide opportunities for members to acquire and enhance technical skills relevant to IoTincluding programming, hardware integration, and data analytics.
3	Encourage members to collaborate on IoTand Automation projects, enhancing teamwork and hands- on experience in developing real-world applications.
4	Promote a culture of innovation by supporting members in exploring new ideas, conducting research, and developing novel IoTand automation solutions.
5	Create a supportive community where members can share knowledge, seek advice. and collaborate on various IoTand Automation related endeavors.

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

Course Outcomes (COs):

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

24ELEU3C13.1	Understand IoTand Automation technologies and their applications.
24ELEU3C13.2	Implement the technical skills relevant to IoT and Automation.
24ELEU3C13.3	Analyze and solve the real world problem with innovative thinking.
24ELEU3C13.4	Create the systems by contributing and work as team member.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3C13.1	3	3		2									3	2
24ELEU3C13.2	3	3	2	2	3								3	3
24ELEU3C13.3	3	3											2	3
24ELEU3C13.4			3		3				3	3			2	3

Prerequisite: Basic knowledge of programming, cloud computing, automation systems.

Contents	Hours
• Seminars • Workshops • Short courses • Certifications • Hackathons • Project competitions • Industrial Projects • Research and Development	30

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

Evaluation Guidelines:

- Attendance: Regular attendance in Expert lectures, workshops, and club meetings.
- Engagement: Active participation in discussions, Q&A sessions, and group activities.
- Teamwork: Collaboration with peers on projects and challenges.
- Technical Proficiency: Ability to operate lot development boards, use relevant software and troubleshoot common issues.
- Project Execution: Successful completion of assigned projects and tasks within the given timeframe.
- Innovation: Demonstration of creativity and innovative thinking in project design and implementation
- Event Participation: Involvement in organizing and participating in competitions, workshops, and awareness campaigns.
- Community Building: Contribution to building a supportive and collaborative club environment.
- Competition Performance: Participation and performance in internal and external competitions.
- Project Showcase: Presentation of completed projects during club meetings or events.
- Awards and Accolades: Recognition received for outstanding work and contributions.

Certification Levels:

1. Beginner Level Certification:

- Attend at least 75% of the boot camps and workshops.
- Complete a basic robotics project (e.g. designing and assembling a simple robot).
- Demonstrate understanding of basic robotics concepts and equipment operation.

2. Intermediate Level Certification:

- Successfully complete multiple robotics projects, including a complex design.
- Participate in at least one internal competition or challenge.
- Show proficiency in troubleshooting and maintaining robotics equipment.

3. Advanced Level Certification:

- Lead a team in a major robotics project or competition,
- Organize or contribute significantly to a club event or workshop.
- Conduct a presentation or seminar on a specialized robotics topic.
- Publish a research article in a Journal or Conference.

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Course Title: Liberal Learning Course-II (Drone Club)	
Course Code: 24ELEU3C14	**Semester: III**
Teaching Scheme: L-T-P: 2-0-0	**Credits: Audit**
Evaluation Scheme: ISE: 50, MSE: NA	**ESE Marks: NA**

Course Description: This course imparts knowledge of drone parts and components and the principles of flying applied to the drone technology. It takes the technician through the process of understanding the setting up of drone parameters through the use of a simulator. It also imparts the knowledge related to performing testing and quality cheek on the drone prior to dispatch and commissioning of the Drone.

Aim:

1. Providing members with opportunities to learn about drone technologies, protocols, and applications through workshops, seminars, and online resources.

2. Encouraging members to explore and develop innovative drone projects, fostering creativity and problem-solving skills.

3. Facilitating collaboration among members to work on joint projects, share ideas, and build a supportive community.

4. Creating a platform for members to connect with industry professionals, researchers, and promoting the practical application of drone technology in various domains, encouraging them to work on real-world projects like agro drone, surviliience drone

5. Enhancing members' skills in programming, data analytics, hardware integration, and other relevant areas crucial for drone projects.

Course Objectives:

1	Understanding the components, operational basics of a Drone.
2	Understanding flying principles with a Drone flight Simulation
3	Performing Manufacture, Assembly, Testing and Quality check of the Drone
4	Commissioning of the Drone

Head of Department
Department of Electrical Engg
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

Course Outcomes (COs):

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

24ELEU3C14.1	To Understanding the components, operational basics of a Drone
24ELEU3C14.2	To Understanding Flying principles with a Drone flight Simulator
24ELEU3C14.3	To Performing Manufacture, Assembly, Testing and Quality check of the Drone

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3C14.1	3	3			2								3	2
24ELEU3C14.2	3	2		3									3	2
24ELEU3C14.3	3		3	3	3								3	3

Prerequisite: Basic knowledge of communication System & Circuit Designs

Contents	Hours
• Operational basics of a Drone • Flying principles with a Drone flight Simulator • Performing Manufacture, Assembly, Testing and Quality check of the Drone • Seminars • Workshops • Short courses • Certifications • Hackathons • Project competitions • Industrial Projects • Research and Development	30

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

Evaluation Guidelines:

- Attendance: Regular attendance in Expert lectures, workshops, and club meetings.
- Engagement: Active participation in discussions, Q&A sessions, and group activities.
- Teamwork: Collaboration with peers on projects and challenges.
- Technical Proficiency: Ability to operate drone design, use relevant software and troubleshoot common issues.
- Project Execution: Successful completion of assigned projects and tasks within the given timeframe.
- Innovation: Demonstration of creativity and innovative thinking in project design and implementation.
- Event Participation: Involvement in organizing and participating in competitions. workshops, and awareness campaigns.
- Community Building: Contribution to building a supportive and collaborative club environment.
- Competition Performance: Participation and performance in internal and external competitions.
- Project Showcase: Presentation of completed projects during club meetings or events.
- Awards and Accolades: Recognition received for outstanding work and contributions.

Certification Levels:

1. Beginner Level Certification:

- Attend at least 75% of the boot camps and workshops.
- Complete a basic drone designs project (e.g., designing and implementing simple projects).
- Demonstrate understanding of basic drone concepts operations & their components

2. Intermediate Level Certification:

- Successfully complete multiple drone design projects, including a complex design.
- Participate in at least one internal competition or challenge.
- Show proficiency in troubleshooting and maintaining drone technology applications.

3. Advanced Level Certification:

- Lead a team in a major drone technology project or competition.
- Find and work on industrial consultancy & social Projects
- Organize or contribute significantly to a club event or workshop.
- Conduct a presentation or seminar on a specialized drone applications topic.
- Publish a Research Article in Journal or Conference.

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Course Title: Liberal Learning Course-III (Robotics Club)	
Course Code: 24ELEU3C15	**Semester: III**
Teaching Scheme: L-T-P: 2-0-0	**Credits: Audit**
Evaluation Scheme: ISE: 50, MSE: NA	**ESE Marks: NA**

Course Description:
The Robotics Club envisions a dynamic and collaborative environment where students passionately explore and advance the field of robotics. As a student-led initiative within the Electronics and Telecommunication Engineering Department, our mission is to foster innovation, learning, and competition in robotics. By providing structured activities such as boot camps, awareness sessions, and competitions, we aim to cultivate a profound understanding and practical expertise in robotics technologies among our members. Our ultimate goal is to empower students to become leaders in robotics, contributing to technological advancements and solving real-world challenges.

Aim:
1. Cultivate Interest and Enthusiasm: Inspire a passion for robotics among students.
2. Provide Hands-on Experience: Offer practical training with robotics technologies.
3. Encourage Innovation: Foster creativity in design and manufacturing processes.
4. Bridge Theory and Practice: Connect theoretical knowledge with real-world applications.
5. Build a Community. Create a network of individuals passionate about robotics.

Course Objectives:

1	Train students in both fundamental and advanced Robotics techniques.
2	Enable experienced members to guide beginners.
3	Motivate students to undertake cutting-edge projects and research.
4	Foster teamwork and collaborative problem solving through group projects and peer-to-peer learning sessions
5	Create connections with industry professionals and academic experts to enhance learning.
6	Acknowledge outstanding achievements in various robotics challenges.

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Course Outcomes (COs):

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

24ELEU3C15.1	Apply foundational knowledge in robotics, programming, and electronics to design and build functional robotic systems.
24ELEU3C15.2	Analyze and solve complex problems through hands-on projects and challenges in robotics.
24ELEU3C15.3	Collaborate effectively with team members, enhancing their communication and teamwork skills through group projects and competitions.
24ELEU3C15.4	Innovative and unique robotic solutions, contributing to advancements in the field.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
24ELEU3C15.1	3		3		3	2							3	3
24ELEU3C15.2	3	3	3	3	2								2	3
24ELEU3C15.3	2								3	3			2	3
24ELEU3C15.4	3	2	3	3	2								2	3

Prerequisite: Basic knowledge of Electronics and telecommunication engineering and any programming language.

Contents	Hours
• Seminars • Workshops • Short courses • Certifications • Hackathons • Project competitions • Industrial Projects • Research and Development	30

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Evaluation Guidelines:

- Attendance: Regular attendance in Expert lectures, workshops, and club meetings.
- Engagement: Active participation in discussions, Q&A sessions, and group activities.
- Teamwork: Collaboration with peers on projects and challenges.
- Technical Proficiency: Ability to operate lot development boards, use relevant software and troubleshoot common issues.
- Project Execution: Successful completion of assigned projects and tasks within the given timeframe.
- Innovation: Demonstration of creativity and innovative thinking in project design and implementation
- Event Participation: Involvement in organizing and participating in competitions, workshops, and awareness campaigns.
- Community Building: Contribution to building a supportive and collaborative club environment.
- Competition Performance: Participation and performance in internal and external competitions.
- Project Showcase: Presentation of completed projects during club meetings or events.
- Awards and Accolades: Recognition received for outstanding work and contributions.

Certification Levels:

1. Beginner Level Certification:

- Attend at least 75% of the boot camps and workshops.
- Complete a basic robotics project (e.g. designing and assembling a simple robot).
- Demonstrate understanding of basic robotics concepts and equipment operation.

2. Intermediate Level Certification:

- Successfully complete multiple robotics projects, including a complex design.
- Participate in at least one internal competition or challenge.
- Show proficiency in troubleshooting and maintaining robotics equipment.

3. Advanced Level Certification:

- Lead a team in a major robotics project or competition,
- Organize or contribute significantly to a club event or workshop.
- Conduct a presentation or seminar on a specialized robotics topic.
- Publish a research article in a Journal or Conference.

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KOLHAPUR

Department of Electrical Engineering

S.Y. B. Tech. Semester-IV
Structure and Curriculum

Scheme 2024-2028

Academic Year 2025-26

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Course Code Draft Formats

Format: {YY}{DDD}{U/P/D}{S}{T}{NN}

Abbr	: Meaning
YY	: Year -> Last 2 digits of Year
DDD	: Dept Abbr.
L	: Level -> UG/PG/Doctoral
S	: Semester Number
T	: Type -> NEP bucket (*list)
NN	: Serial Number
A	: Assessment -> Theory / Lab / Tutorial

eg. 24DSEU3A01

NEP Bucket List

NEP Course Category	Abbr.	Code
Ability Enhancement Courses	AEC	A
Basic Science Courses	BSC	B
Co-Curricular Activities	CCA	C
Audit Course	AC	D
Program Elective Courses	PEC	E
Community Engagement Project /. Field Project	CEP/FP	F
Humanities/Social Science, Management	HSSM	H
Internship	INT	I
Project	PR	J
Indian Knowledge System	IKS	K
Multi-Disciplinary Minor	MDM	M
Vocation Skill Enhancement Courses	VSEC	N
Open Elective Courses	OEC	O
Program Core Courses	PCC	P
Research Methodology	RM	R
Engineering Science Courses	ESC	S
Value Education Courses	VEC	V
Honors Courses	HON	Z

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Teaching and Evaluation Scheme from Year 2024-25 (as per NEP-2020)

Department of Electrical Engineering

S.Y B.Tech SEMESTER-IV

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/POE	
24ELEU4P01	ProgramCore Courses	PCC	DC Machines and Transformers	3	3	-	-	20	30	50	-	-	100
24ELEU4P02			Power Electronics	3	3	-	-	20	30	50	-	-	100
24ELEU4P03			Generation, Transmission & Distributions	2	2	-	-	20	30	50	-	-	100
24ELEU4P04			DC Machine and Transformers Lab.	1		2	-	-	-	-	25	25	50
24ELEU4P05			Power ElectronicsLab	1		2	-	-	-	-	25	25	50
24ELEU4M06	Multidisciplinary Minor	MDM-2	Energy Storage System for Electric Vehicles	2	2	-	-	-	-	50	-	-	50
24ELEU4V07	Value Education Course	VEC (Environmental Study)	Environmental Studies	2	2	-	-	-	-	50	-	-	50
24ELEU4H08	Humanities Social Science and Management	Entrepreneurship /Economics/ Management course	Industrial Management & Startups	2	2	-	-	50	-	-		-	50
24ELEU4A09	Ability Enhancement course	AEC	Electronics Workshop	2	1	2	-	-	-	-	25	25	50
24ELEU4O10	OpenElective Course	OEC-II	Basics of Energy Auditing and Management	2	2	-	-	-	-	50	-	-	50
24ELEU4N11	Vocational Skills EnhancementCourse	VSEC	Model Based Programming & Simulation	2	-	2	-	-	-	-	25	25	50
24ELEU4D12	MandatoryCourse	MC	Finishing School Training IV	Audit	2*	-	-	50	-	-	-	-	Grade*
24ELEU4C13	Co-Curricular Activities	CCA	Liberal Learning-I	Audit	2#	-	-	50	-	-	-	-	Grade*
24ELEU4C14			Liberal Learning-II										
			Total	**22**	**17**	**8**	-	**210**	**90**	**300**	**100**	**100**	**700**
24ELEU4Z01	Honors Courses/Double (Minor)	HC(Optional)	Honors Paper-I (ODL only) Transducers and Signal Conditioning	4	4	-	-	20	30	50	-	-	100

***-Values not included in total, #-2 contact hrs per club, Min Marks for passing: 40% of total marks of individual course**

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S.Y. B. Tech. Curriculum
(As Per National Education Policy 2020)

Semester-IV

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4P01, DC Machine and Transformers**
Prerequisite/s			Basic Electrical Engineering
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: DC Machines and Transformers is a specialized course that delves into the principles, construction, and operation of direct current machines and transformers. It covers topics such as electromagnetism, machine dynamics, performance analysis, and applications, equipping students with the knowledge to design, operate, and maintain these critical electrical devices

Course Objectives:

1	This course intends to provide basic concept of DC machines and transformers
2	It intends to develop skills to evaluate ratings of DC machines and transformers for various applications.
3	It intends to solve problems on DC machines and transformers.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4P01.1	Explain the working principles, Construction, operation and application of DC machines, universal motors and transformers.
24ELEU4P01.2	Discuss numerical problems on DC machines, transformer and universal motor
24ELEU4P01.3	Analyze the performance of DC machines, transformers and universal motor

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
24ELEU4P01.1	3	3	2										3	2	II
24ELEU4P01.2	3	2	1										3	2	III
24ELEU4P01.3	3	2	1										3	2	III

Content	Hrs.
Unit I: DC Machines **Constructional Details:** Construction of D.C. machines, magnetic circuit of DCmachines, commutator and brush arrangement, EMF equation, torque equation, power flow diagram of D.C. machines. **Armature Winding:** Simple lap winding and wave winding, winding diagram and tables, brush position, dummy coils. **Armature Reaction:** MMF due to armature winding, flux distribution due to armature current and resultant flux distribution in a machine. Demagnetization and cross magnetization ampere turns, principle of compensation, compensating winding and its use in machines.	8
Unit II: D.C. Motors Concept of back e.m.f., characteristics of D.C. motors, Method of speed controls, electro braking, parallel and series operation of motor. **Testing of D.C. Machines:** Losses and efficiency, Break test, Swinburn's test, Hopkinson's test, Retardation test, Field test on D.C. series motor.	8
Unit III: Single Phase Transformer Construction and type, EMF equation phasor diagram, equivalent circuit, efficiency, losses, regulation, Experimental determination of equivalent circuit parameters and calculation of efficiency and regulation, parallel operation, auto transformer principle and connections.	8
Unit IV: Poly Phase Transformer Construction, single phase bank, polarity test, transformer winding, V-V connection and Scott connection, Vector Grouping YD1, YD11, DY1, DY11, DZ0, DZ 6, YZ1, YZ11.	5
Unit V: Performance of Transformers Switching inrush current, on load and off load tap changing, Harmonics in exciting current causes and effects, Harmonics with different transformer connections, tertiary winding, oscillating neutral, Testing of transformer as per IS, heat run test, Sumpner's test and equivalent delta test.	6
Unit VI: Universal Motor Development of torque & power, rotational and transformer emf in commutator winding, commutation in universal motor, complex or diagram, circle diagram, operation on A.C. and D.C. supply, compensated winding, applications.	4

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Text Books:

1	A. E. Clayton and Hancock, *"The Performance and Design of Direct Current Machines"*, CBS Publishers, 1st Edition, 2004.
2	M. G. Say. *"The Performance and Design of Alternating Current Machines"*, CBS Publishers, 3rd Edition, 2004.
3	O. E. Taylor, *"Performance Design of AC commutator motors"*, Wheeler Publisher, 15th Reprint.

Reference Books:

1	Purkait and Bandyopadhyay *"Electrical Machines"*, Oxford University Press, 1st Edition, 2017.
2	J. B. Gupta, *"Theory and Performance of Electrical Machines"*, S. K. Kataria and Sons, 1stEdition, 2013.
3	Fitzerald and Kingsley, *"Electric Machines"*, Tata McGraw Hill, 7th Edition, 2007.
4	Kothari and Nagrath, *"Electric Machines"*, McGraw Hill, 5th Edition, 2018.

	Useful Links
1	https://nptel.ac.in/courses/108/105/108105017/

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Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4P02, Power Electronics**
Prerequisite/s			Analog and Digital Circuits
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: Power Electronics is a course that explores the principles and applications of electronic devices and circuits used for power conversion and control. It covers topics such as rectifiers, inverters, converters, and their applications in industries, providing students with the knowledge to design and implement efficient power electronic systems

Course Objectives:

1	This course intends to provide basic knowledge of different power electronic devices, rectifiers, converters, inverters and choppers.
2	It is aimed to impart skills of analysis for different types of converters such as rectifiers, controlled converters, inverters and choppers.
3	Make the students acquainted with design of different types of converters such as rectifiers, controlled converters, inverters, choppers and their associated control circuit.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4P02.1	Describe the basics of semiconductor switches, rectifier, control converter, inverter, choppers, and cyclo-converter and matrixconverter circuits.
24ELEU4P02.2	Calculate the performance of semiconductor switches, rectifier,converter, inverter, choppers, and cyclo-converter and matrix converter circuits.
24ELEU4P02.3	Analyze the Power Electronic Circuits such as rectifier, converter, inverter, choppers, and cyclo-converter and matrix converter circuits.

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Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
24ELEU4P02.1	3	2											3	2	II
24ELEU4P02.2	2	3											3	2	III
24ELEU4P02.3	2	3											3	2	III

Content	Hrs.
Unit I: Power Semiconductor Switches: Characteristics of ideal switch, V-I Characteristics, Rating, protection and cooling of power semiconductor devices such as power diodes, transistor, MOSFET, IGBT and GTO, Study of the driver circuits for thyristor, GTO and IGBT, Introduction to smart power modules, Comparative study of MOSFET, thyristor, GTO, BJT and IGBT.	6
Unit II: Single Phase and Three Phase AC to DC rectifiers Single phase half wave and single-phase full wave diode bridge. Three phasehalf wave and three phase full wave diode bridge, Transformer power rating for above configurations. Source current and output voltage analysis.	6
Unit III: Phase Controlled AC to DC Converters Classification of converters, Single phase half controlled and fully controlled thyristor converters, three pulse and six pulse controlled converters, operation of converter with freewheeling diode. Effect of source inductance on the performance of the converter, overlap – angle. Performance factors for the converter such as displacement factor, distortion factor, total harmonic distortion, ripple factor and transformer utilization factor. Introduction to 12 pulse converter, single phase and three phase dual converter, firing scheme for 1 phase and three phase converter, Brief introduction to commutation methods. Introduction to PWM converters.	8
Unit IV: DC to DC Converters Control of DC-to-DC converters, step down (buck) converter, Analysis of buck converter with RLE load, step up converter, buck – boost converter, full bridgeDC to DC converter, concept of multiphase choppers, cuk converter.	6
Unit V: Switch Mode DC – AC Inverters Basic concepts of switch mode inverters, types: VSI and CSI, single phase half bridge and full bridge inverter, three phase six step inverter, 1200 mode of conduction, 1800 mode of conduction, three phase PWM Inverter, sinusoidal PWM and selective harmonics elimination methods of PWM. Effect of blanking time on output voltage in PWM inverters, auto sequentially commutated CSI, Solar Inverters, Introduction to multilevel inverters.	7
Cycloconverters and Matrix Converter Introduction to Single phase and three phase cycloconverters. Working and topologies of Matrix converter, control methods, performance analysis of matrix converter.	6

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Text Books:

1	M. H. Rashid "Power Electronics, Circuits, Devices and Applications", Pearson Education Inc., 4th Edition, November 2017.
2	P. S. Bhimra, "Power Electronics",3rd Edition, Khanna Publishers, 2002.

Reference Books:

1	B.K. Bose, "Modern Power Electronics and A.C. Drives", Prentice Hall of India Pvt. Ltd. Publication, 2002.
2	Mohan, UndelandRobins, "Power Electronics, Converter Applications and Design", John Wiley and sons (Asia) Pvt. Ltd., 3rd Edition, 2010.
3	G. K. Dubey and Others "Thyristorised Power Controller", New Edge International Publishers, 1st Edition Reprint, 2005.

Useful Links	
1	NPTEL lectures on Power Electronics

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Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4P03, Generation Transmission & Distributions**
Prerequisite/s			Electrical Circuit Analysis
Teaching Scheme: Lecture/Tutorial/Practical			**02**/00/00
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: Generation, Transmission & Distribution is a course that covers the comprehensive process of electrical power generation, its transmission over long distances, and distribution to end-users. Topics include power plants, grid infrastructure, system reliability, and efficiency, providing students with an understanding of the entire electrical power delivery system

Course Objectives:

1	Power system forms a major part of electrical systems. This course will appraise the students about the structure and performance analysis of power systems.
2	This course will develop analytical skills in the students for investigating issues related to power systems.
3	This course will help students in preparing for competitive examinations.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	**Summarize** structure and performance parameters of power system
2	**Interpret** the performance of generation, transmission and distribution system.
3	**Scrutinize** voltage and power factor control methods for improving performance of transmission and distribution systems

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Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
24ELEU4P03.1	3	2											3	3	II
24ELEU4P03.2	2	3											3	3	II
24ELEU4P03.3	2		2										3	3	II

Content	Hrs.
Unit I: Structure of Power Systems and parameters of transmission lines Generation, transmission, distribution and utilization of electrical power, types of lines, types of conductors, voltage levels, R, L, C parameters, Electrical clearances, safety norms, Sag calculations, effect of wind and ice covering of sag, types of insulators, support structures, corona.	7
Unit II: Transmission line representation and performance calculation Single Line Diagram (SLD), String Efficiency of insulators, PU quantities, short, medium and long line models, performance calculations, ABCD constants, Power Circle Diagram.	7
Unit III: Distribution Systems and Underground Cables Types of feeders, distributors, AC and DC distribution systems, sub-stations,UG cables for LT and HT systems.	6
Unit IV: Economic operation of power systems Basics of Economic load sharing, Incremental fuel cost, Economic dispatch neglecting transmissions losses, penalty factor, General Loss Formula, optimum load dispatch considering transmissions losses.	6

Text Books:

1	Ashfaq Husain, Electrical Power Systems, CBS, 5th Edition, 2007.
2	Glover, Sharma, OverbyePower Systems Analysis and Design, Thompson, 5th Ed., 2012.

Reference Books:

1	Nagrath, Kothari, Modern Power System Analysis, TMH, 2nd Edition, 2015
2	HadiSaadat, Power System Analysis, TMH, 1st Edition, 2002.
3	Stevenson W.D., Elements of Power System Analysis, TMH, 4th Edition, 2014.

Useful Links	
1	https://nptel.ac.in/courses/108/105/108105104/

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Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4P04, DC Machine and Transformers Lab**
Prerequisite/s			Basic Electrical Engineering Lab
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/**25**
		Total	**50**

Course Description: DC Machine and Transformers Lab offers practical experience with direct current machines and transformers. Students perform experiments to understand the construction, operation, and performance characteristics of these devices, gaining valuable skills in testing, analysis, and troubleshooting of electrical machinery.

Course Objectives:

1	To develop skills to demonstrate performance operation of DC motors & transformers using different tests.
2	To develop skills to analyze operation and performance of DC machines & transformers.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4P04.1	Experiment for verification of electrical characteristics and performance of DC Machines and transformer.
24ELEU4P04.2	Analyse the performance of DC Machines and transformer.
24ELEU4P04.3	Develop appropriate circuit connections and determine ratings of meters to conduct an experiment as a group activity.
24ELEU4P04.4	Explain the principles and operation of various measurement devices, their characteristics, limitations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
24ELEU4P04.1	2	2			3								3	2	III
24ELEU4P04.2	1	2		3									3	2	III

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24ELEU4P04.3	2	2		2	1								3	2	III
24ELEU4P04.4	3	2											3	2	II

List of Experiments	
Expt. No.	**Name of Experiment**
1	Speed control of dc shunt motor (i) Armature control method (ii) Field control method.
2	Determination of efficiency of DC motor by Swinburne's test.
3	Determination of efficiency of DC motor by Hopkinson's test.
4	Brake test on shunt motor to determine its performance and efficiency.
5	Load test on compound motor i) cumulative ii) differential.
6	To perform open circuit and short circuit test for determining equivalent circuit parameters of a single-phase transformer.
7	Parallel operation of single-phase transformer to demonstrate load sharing.
8	Scott connections for converting 3 phase to 2 phase supply.
9	Equivalent Delta test or Heat run Test for determination of temperature rise and efficiency of 3 phasetransformer.
10	Parallel connection of 3 phase DY1 and DY11 transformers to demonstrate load sharing.
11	Load test on transformer (single and three phase) to determine losses and efficiency using Sumpner'stest.
12	Develop a circle diagram of Universal motor using load test.

Text Books:

1	A. E. Clayton and Hancock, "The Performance and Design of Direct Current Machines", CBS Publishers, 1st Edition, 2004.
2	M. G. Say. "The Performance and Design of Alternating Current Machines", CBS Publishers, 3rd Edition, 2004.
3	O. E. Taylor, "Performance Design of AC Commutator motors", Wheeler Publisher, 15th Reprint.

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Kasaba Bawada, Kolhapur-416006

Reference Books:

1	Purkaitand Bandyopadhyay "Electrical Machines", Oxford University Press, 1st Edition, 2017.
2	J. B. Gupta, "Theory and Performance of Electrical Machines", S. K. Kataria and Sons, 1st Edition, 2013.
3	Fitzerald and Kingsley, "Electric Machines", Tata McGraw Hill, 7th Edition, 2007.
4	Kothari and Nagrath, "Electric Machines", McGraw Hill, 5th Edition, 2018.

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School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4P05, Power Electronics Lab**
Prerequisite/s			Analog and Digital Circuits
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/**25**
		Total	**50**

Course Description: Power Electronics Lab provides practical experience in designing and testing power electronic circuits. Students conduct experiments on rectifiers, inverters, and converters, learning to apply theoretical concepts, use diagnostic tools, and troubleshoot power electronic systems, thereby reinforcing their understanding of power conversion and control techniques.

Course Objectives:

1	This course intends to provide the practical knowledge of different power electronics devices.
2	It is aimed to impart skills of working of different power electronic converter through simulation and experimentation.
3	Make the students acquainted with simulation, analysis and design of power electronic converters.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4P05.1	Demonstrate experiments on basics of converters such as rectifier, inverter, and Chopper etc.
24ELEU4P05.2	Construct different types of converters such as rectifier, inverter and Chopper with their control techniques using simulation.
24ELEU4P05.3	Measure the performance of converters such as rectifier, inverter, and Chopper.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
24ELEU4P05.1	3	2		3					2				3	2	III
24ELEU4P05.2	2	2			3								3	2	III

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

24ELEU4P05.3	1	2		3					2				3	2	III

List of Experiments	
Expt. No.	**Name of Experiment**
1	Verify the Voltage and current relationship in 3 phase full wave diode bridge rectifier and evaluatethe input current harmonic spectrum.
2	Evaluate the load side performance of single-phase full wave half control converter.
3	Evaluate the load side performance of single-phase full wave full control converter.
4	Evaluate the load side performance of three phase full wave half-controlled converter.
5	Evaluate the load side performance of three phase full wave full controlled converter.
6	Develop the firing angle control scheme for single phase full wave, half controlled and fullcontrolled converters.
7	Develop the firing angle control scheme for three phase full wave half-controlled converter.
8	Develop the firing angle control scheme for three phase full wave full controlled converter.
9	Evaluate the performance of MOSFET based buck converter.
10	Evaluate the performance of MOSFET based boost converter.
11	Develop the control circuit for single phase PWM Inverter.
12	Develop the control circuit for three phase square wave Inverter.

Text Books:

1	M.H.Rashid "Power Electronics, Circuits, Devices and Applications", Pearson Education Inc., 4th Edition, November 2017.
2	P. S. Bhimra, "Power Electronics",3rd Edition, Khanna Publishers, 2002.

Reference Books:

1	B.K. Bose, "Modern Power Electronics and A.C. Drives", Prentice Hall of India Pvt. Ltd. Publication, 2002.
2	Mohan, Undeland and Robins, "Power Electronics, Converter Applications and Design", John Wiley and sons (Asia) Pvt. Ltd., 3rd Edition, 2010.
3	G. K. Dubey and Others "Thyristorised Power Controller", New Edge International Publishers, 1st Edition Reprint, 2005.

Head of Department
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D.Y. Patil Education Society, Kolhapur
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School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4M06, Energy Storage System for Electric Vehicles**
Prerequisite/s			
Teaching Scheme: Lecture/Tutorial/Practical			**02**/00/00
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/**50**
		Total	**50**

Course Description: Energy Storage System for Electric Vehicles delves into the design, operation, and optimization of energy storage systems for electric vehicles. The course covers key topics such as battery technologies, charging infrastructure, energy management strategies, and the integration of renewable energy sources, equipping students with the knowledge to innovate in the rapidly evolving electric vehicle industry.

Course Objectives:

1	**Identify** and describe the fundamental components and types of energy storage systems used in electric vehicles, including various battery technologies.
2	**Explain** the principles of operation and the chemical processes involved in different battery technologies for electric vehicles.
3	**Compare** and contrast the performance characteristics of various energy storage systems, evaluating their advantages and limitations for electric vehicle applications.
4	**Apply** knowledge of energy storage systems to assess and select suitable battery technologies for specific electric vehicle applications based on performance criteria and requirements

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4M06.1	**Identify and describe** the key components and characteristics of energy storage systems used in electric vehicles.
24ELEU4M06.2	**Explain** the working principles and chemical processes involved in various battery technologies for electric vehicles.
24ELEU4M06.3	**Compare and contrast** the advantages and limitations of different energy storage systems for electric vehicle applications.
24ELEU4M06.4	**Apply** knowledge of energy storage systems to select appropriate battery technology for specific electric vehicle applications.

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
24ELEU4 M06.1	3	2	2												
24ELEU4 M06.2	2	2	1												
24ELEU4 M06.3	1	2	1												
24ELEU4 M06.4															

Content	Hrs.
Unit I: Introduction to Energy Storage Systems Overview of Energy Storage in EVs- Importance of energy storage in EVs, Basic principles and terminology, Historical development and current trends, Types of Energy Storage Systems- Batteries, supercapacitors, flywheels, and fuel cells, Key characteristics and applications ,Density vs. Power Density- Trade-offs between energy density and power density.	6
Unit II: Battery Technologies for Electric Vehicles Lithium-Ion Batteries (LIBs)- Structure and working principles of LIBs, Advantages and disadvantages, Other Battery Technologies- Nickel-Metal Hydride (NiMH) batteries, Solid-state batteries and emerging technologies, Battery Design and Configuration- Cell, module, and pack design, Series and parallel configurations, Battery Management Systems (BMS)- Purpose and components of a BMS, Thermal management and safety considerations,	7
Unit III: Charging Infrastructure and Technologies Charging Methods- AC vs. DC charging, Slow, fast, and rapid charging technologies, Charging Standards and Protocols- CHAdeMO, CCS, and Tesla Superchargers, Communication protocols between EVs and chargers, Wireless Charging and Future Trends- Inductive charging principles, Future innovations in charging technologies	6
Unit IV: Performance Analysis and Testing Battery Performance Metrics- State of Charge (SOC) and State of Health (SOH), Cycle life and capacity fade, Testing and Diagnostics- Methods for testing battery performance, Tools for diagnostics and analysis, Energy Efficiency and Optimization- Energy recovery systems (e.g., regenerative braking), Strategies for optimizing energy use in EVs	7

Text Books:

1	Sandeep Dhameja. "Electric Vehicle Battery Systems," Newnes, 1st Edition, 2001.
2	Reiner Korthauer. "Lithium-Ion Batteries: Basics and Applications," Springer, 1st Edition, 2018.

Head of Department
Department of Electrical Engg.
School of Engineering & Management

3	Robert A. Huggins. "Energy Storage: Fundamentals, Materials and Applications," Springer, 2nd Edition, 2015.
4	Davide Andrea. "Battery Management Systems for Large Lithium-Ion Battery Packs," Artech House, 1st Edition, 2010.

Reference Books:

1	John T. Warner. "The Handbook of Lithium-Ion Battery Pack Design: Chemistry, Components, Types and Terminology," Elsevier, 1st Edition, 2015.
2	Pengwei Du, Ning Lu. "Energy Storage for Smart Grids: Planning and Operation for Renewable and Variable Energy Resources (VERs)," Academic Press, 1st Edition, 2014.
3	Rui Xiong, Wei Liu, Zhongdong Yin. "Advanced Battery Management Technologies for Electric Vehicles," Elsevier, 1st Edition, 2020.
4	Lance Noel, Joshua M. Pearce. "Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid," Elsevier, 1st Edition, 2019.

	Useful Links
1	https://onlinecourses.nptel.ac.in/noc21_ee112/preview

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4V07,** Environmental Studies
Prerequisite/s			
Teaching Scheme: Lecture/Tutorial/Practical			**02**/00/00
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/**50**
	P	**INT / OE/POE**	00/00/00
		Total	50

Course Description: The main objective of course is to create awareness among students regarding environmental issues and its impact on society. Knowledge regarding environmental components, its degradation and protection of environment is need for sustainable future ahead

Course Objectives:

1	**Understand** the scope and importance of Environmental Studies and sustainable development
2	**Understand** connection between environmental health and developmental activities
3	**Understand** the importance of Environmental Management for its protection through technical and legislative point of view
4	**Acquire** problem solving skills through visits to different locations, identifying the Environmental problems and proposing solution for societal benefits

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4V07.1	**Understand** the scope and importance of Environmental awareness and Sustainable development
24ELEU4V07.2	**Understand** various Environmental issues due to development
24ELEU4V07.3	**Understand** various modes of Environmental management through technology and legislation
24ELEU4V07.4	**Acquire** problem solving attitude through actual field experience, reporting it in the form of Field project work.

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
24ELEU4 V07.1	-	-	-	-	-	1	3	2	-	-	-	2	-	-	II
24ELEU4 V07.2	-	-	-	-	-	1	3	1	-	-	-	2	-	-	II
24ELEU4 V07.3	-	-	-	-	-	1	3	1	-	-	-	2	-	-	III
24ELEU4 V07.4	-	-	-	-	-	2	3	1	-	1	1	2	-	-	III

Content	Hours
Unit 1: Our Environment Introduction to Environment, Scope of Environmental studies, importance of environmental awareness, Concept of sustainability, Sustainable Development- history and Goals, environmental ethics, Sustainability ethics, Population growth of world and reduced health content of the environment.	05
Unit 2: Development and Environmental health Natural resources:Types(renewable and non-renewable), developmental benefitsForest- Benefits, problems (Deforestation), Biodiversity-- importance, threats, conservationEcosystems- importance, problem associated with major ecosystems, ecological restorationAir- Benefits, problems (Pollution, climate change), Water- Benefits, problems (Depletion, pollution), Soil/ Land- Benefits, problems (Degradation, loss of fertility, desertification)Mineral- Benefits, problems (Mining, over exploitation, depletion, pollution), Energyresources- Benefits, problems (depletion, energy crisis) Urbanization and Environmental health (2):Urban problems, Solid waste- Effects of MSW, Plastic waste, Hazardous waste, E- waste	9
Unit 3: Environmental Management Renewable energy technologies- current, new(Bio gas, Bio fuel, hydrogen, etc) (1), Pollution abetment –5R, ZLD, carbon credit, bio remedies (1), Soil/ land reclamation, Sustainable agriculture (1), Concept of EIA, Environmental audit, ISO certification (ISO 14001) (2), Role of CPCB and MPCB in Environmental protection of India (1), Emerging technologies	

Head of Department
Department of Electrical Engg.
School of Engineering & Management
B/9, 'E', Kasaba Bawada, Kolhapur-416006

for environmental management- GIS, Remote sensing, Smart bin, IoT integration, Waste-to-Energy Technologies, Recycling Automation, Advanced Data Analytics, Circular Economy Practices, Sustainable Packaging Solutions, Community Engagement and Education, Decentralized Waste Treatment, Zero-Waste Initiatives, Legislative and Regulatory Changes (2), Environmental legislation- Environmental Protection Act, Air Act, Water Act, Solid waste Management Act, Hazardous waste Management Rule, E- Waste (Management) Rules, 2022 (2)	**09**
Unit 4: Field project work Case studies based on site visit (Each candidate has to go for field visit and complete a project work on Environmental issues and probable solutions)	**05**

Text Books:

1. Handbook of Environmental Studies by Dr. G. R. Parihar, Publisher: Satyam Publishers and Distributors (1 January 2013),ISBN-10 : 9382664408,ISBN-13 : 978-9382664406
2. Environmental Studies by Anubha Kaushik, New Age International Private Limited (1 January 2007), ISBN-10 : 8122422403, ISBN-13 : 978-8122422405
3. Introduction to Environmental Engineering and Science 3e, by Masters, Publisher : Pearson Education India; 3rd edition (1 January 2015), ISBN-10 : 9332549761, ISBN-13 : 978-9332549760
4. Solid Waste Management in developing countries, by Bhide A. D. and Sundersen B. B.- Indian National Scientific Documentation Centre, New Delhi,

Reference Books:

1. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I &II, Environmental Media
2. Ecology And Environment Pb, by P. D. Sharma, Rastogi Publications (1 January 2011)

Online Resources:

1. Environmentat English Book 1-3-2022 Final Corrected copy_compressed.pdf
2. Manual on Municipal Solid Waste Management- Ministry of Urban Development, Govt. of India

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4H08, Industrial Management and Start-ups**
Prerequisite/s			Commercial aspects
Teaching Scheme: Lecture/Tutorial/Practical			**02**/00/00
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**50**/00/00
	P	**INT / OE/POE**	00/00/00
		Total	**50**

Course Description: This course covers essential concepts in industrial management and entrepreneurship, including management principles, electronic product design and quality control, and entrepreneurial processes. It also addresses challenges and opportunities for MSMEs and start-ups, highlighting government schemes and incentives. Students will gain the skills to manage effectively and innovate within industrial and startup environments

Course Objectives:

1	To understand the core principles and functions of management and their application in various organizational contexts.
2	To learn the comprehensive design process for electronic products, focusing on quality control and various design for Electronic system.
3	To understand the key elements of entrepreneurship and the processes involved in creating and managing a new business venture.
4	To gain knowledge about the challenges and support mechanisms for MSMEs and start-ups, including government schemes and the application process for proposals.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4H08.1	Explain the fundamental principles of management and effectively analyze and apply these principles within an organizational setting.
24ELEU4H08.2	Design electronic products that meet high standards of quality and reliability while considering factors like cost, manufacturability, and environmental impact.
24ELEU4H08.3	Assess business opportunities, create viable business models, and develop strategies for launching and managing successful entrepreneurial ventures.
24ELEU4H08.4	Identify the challenges of MSMEs, utilize government schemes effectively, and develop well-structured project proposals for new business start-ups.

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'F', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
24ELEU4 H08.1	-	-	-	2	-	2	2	2	1	1	2	2	1	1	III
24ELEU4 H08.2	-	-	-	2	-	2	2	2	1	1	2	2	3	3	V
24ELEU4 H08.3	-	-	-	2	-	2	2	2	1	1	2	2	1	1	IV
24ELEU4 H08.4	-	-	-	2	-	2	2	2	1	1	2	2	1	1	III

Content	Hrs
Unit 1: Fundamentals of management History of industrial development, Introduction, Definition of management, characteristics of management, functions of management, Principles of Management, Administration and management, Nature and levels of management, managerial skills, managerial roles, Forms of Organization. Forms of ownerships introduction to Globalisation	7
Unit 2: Design Process & Quality Control for Electronic products General Electronic product Design, Process, Design for: Reliability (DFR), Security, Compliance, Supply Chain (DFSC), Cost, Assembly (DFA), Testability (DFT), Manufacturing (DFM), Serviceability (DFS), Environment, Recyclability, Disassembly & Serviceability, Energy Efficiency, Compliance, Managing for Quality in the Electronics Industry: . product quality, reliability, availability, defect level	7
Unit 3: Fundamentals of Entrepreneurship Definition characteristics of entrepreneur Entrepreneurial traits, true motivation & leadership, understanding of the Entrepreneurial process, Opportunity assessment for new ventures, creating a business model with technology differentiators, launching and managing venture, Human resource aspects, understanding of personal aspirations, Entrepreneurial personality development, Entrepreneurial communication, determinants of winning business model, building a balanced team, and sources of capital for creating fixed and working assets including government incentives Entrepreneurship in Indian Scenario and Future prospects in India and emerging economies.	7
Unit 4: MSME, DPIIT and various government schemes for start-ups Challenges of MSMEs, Preventing Sickness in Enterprises Specific Management Problems; Industrial Sickness; Industrial Sickness in India Symptoms, process and Rehabilitation of Sick Units. Various schemes of government for new start-ups, Process of applying for MSME, SSI proposal and writing a project proposal for a new business start-up	7

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

Reference Books:

1. Stephen P. Robbins, Mary ,June 2016, "Fundamentals of Management 9th edition Pearson Education India.
2. Management: A Global, Innovative, and Entrepreneurial Perspective by Heinz Weihrich, Mark V.
3. Electronic Product Design by J. D. Andrews
4. Design for Manufacturability and Concurrent Engineering by David M. Anderson
5. Design for Reliability" by Dev G. Raheja and Louis J. Gullo

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D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4A09, Electronics workshop (Ability Enhancement Course)**
Prerequisite/s			Society based Mini-Project
Teaching Scheme: Lecture/Tutorial/Practical			**01**/00/**02**
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/**25**
		Total	50

Course Description: This course gives introduction of electronic hardware systems and provides hands-on training with familiarization, identification, testing, assembling, dismantling, fabrication and repairing such systems by makinguseofthevarioustoolsandinstrumentsavailableintheElectronics Workshop.

Course Objectives:

1	To Identify and familiarize with the tools used in electronic shop.
2	To enhance the knowledge of electronics components and their applications.
3	To make students familiar with Interfacing of analog and digital electronics.
4	To enable students to design & fabricate their own Hardware.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4A09.1	Illustrate the different types of Electronics tools and their application.
24ELEU4A09.2	Analyze the working of semiconductor devices and their application.
24ELEU4A09.3	Integrate the knowledge of basic Sensors and digital electronics.
24ELEU4A09.4	Enable the Students to develop application-based micro-projectsand estimate project cost.

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

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(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
24ELEU4 A09.1	3	-	-	-	-	-	-	-	-	-	-	1	2	1	IV
24ELEU4 A09.2	3	-	-	-	-	-	-	-	-	-	-	1	2	1	IV
24ELEU4 A09.3	3	2	-	-	-	-	-	-	-	-	-	1	2	1	IV
24ELEU4 A09.4	3	2	1	-	-	-	-	-	1	-	-	1	2	1	IV

Course Contents	Hrs
Unit – I: Safety Measures: Familiarization/Identificationof electroniccomponentswith specification (Functionality,type, size, colour coding, package, symbol,costetc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals	2
Unit - II :Electronic Component Testing: Testing ofelectroniccomponents[Resistor,Capacitor,Diode, Transistor, UJT and JFET usingmulti-meter.] [Multi-meter,Functiongenerator,Power supply,CROetc.]	2
Unit – III:Applications of Diode and Transistor: To familiarisewithdiodeapplication likeReverseCurrent Protection Circuits,LogicGates usingdiode, VoltageMultiplier etc. Applications of transistor like switch, transistor as driver, transistor as logicgates etc,	2
Unit No-IV: Applications of Sensor: To familiarisewithSensors likeIR Digital Sensor, ColourIR Sensor,Light Sensor ,Sound Sensor, Ultrasonicsensor, moisture sensor etc,	2
Unit No –V:PCB Design ,Soldering and Circuit Simulation: PCB Design using CAD,Types of soldering,Circuit Simulation using CAD.	2
Unit No- VI:Open Source Hardware Platforms: Overview of Arduino, its Programming, Interfacing.	2

Head of Department
Department of Electrical Engg.
School of Engineering & Management
BPO, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

List of Experiments		
Expt. No.	**Name of Experiment**	**Hrs.**
1	To study Testing of Electronic components- resistors, capacitors, inductor, diode, transistor, LED and switches.	2
2	To study Testing of Electronic components- resistors, capacitors, inductor, diode, transistor, LED and switches using multi-meter & C.R.O.	2
3	Familiarization/Application of testing instruments and commonly used tools Multi-meter, Function generator, Power supply, CRO etc.	2
4	To familiarize with diode application like Reverse Current Protection Circuits, Logic Gates using diode, Voltage Multiplier	2
5	To familiarize with Transistor application like switch, transistor as driver, transistor as logic gates etc.	2
6	To familiarizewithIC555 Timer application likeTimer, LED flip flop, LED chaser or sequencer	2
7	To familiarize Logic gates & its applications like Burglar Alarm & Buzzers, Push button switches, lights ON/OFF, Digital Lock, Fire Alarm etc.	2
8	To Familiarize with PCB Design, Simulation of CAD	2
9	To familiarize with Arduino, Introduction to Arduino open source platform, Arduino Simulation software	2
10	To familiarize with Sensors like IR Digital sensor, Color IR sensor, Light sensor, Sound sensor, Ultrasonic sensor, Moisture sensor etc. & its interfacing to Arduino.	2
11	Development of Project to solve real world problem.	4

* Minimum 10 experiments and one Mini project should be performed to cover the entire curriculum of course.

ReferenceBooks:

1. Fundamentals of Electrical Engineering , BharatiDwivedi and AnurasgTripathi, Willey Precise, 2013
2. Electronics Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson Education 2009

Web Resources:

https://archive.nptel.ac.in/courses/122/106/122106025/

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D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4O10, Basics of Energy Auditing and Management**
Prerequisite/s			
Teaching Scheme: Lecture/Tutorial/Practical			**02**/00/00
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/**50**
		Total	**50**

Course Description: Basics of Energy Auditing and Management involve understanding how to evaluate and improve energy use in various systems. The course covers fundamental techniques for auditing energy consumption, identifying inefficiencies, and implementing strategies to enhance energy efficiency. It equips learners with the skills to assess energy usage, recommend improvements, and manage energy resources effectively.

Course Objectives:

1	**Identify** key terms and concepts related to energy auditing and management.
2	**Explain** the basic steps involved in conducting an energy audit.
3	**Apply** simple techniques to perform an energy audit.
4	**Recognize** common energy inefficiencies and suggest ways to improve energy use.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4O10.1	**Identify** important terms and concepts related to energy auditing.
24ELEU4O10.2	**Explain** how to conduct a basic energy audit.
24ELEU4O10.3	**Perform** a simple energy audit using basic tools and methods.
24ELEU4O10.4	**Recognize** and suggest improvements for common energy inefficiencies.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
24ELEU4O10.1	3	2	2										3	3	II
24ELEU4O10.2	2	2	1										3	3	II

Head of Department
Department of Electrical Engg.
School of Engineering & Management
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24ELEU4 O10.3	2	2	1									3	3	III
24ELEU4 O10.4	2	2	1									3	3	II

Content	Hrs.
Unit I: Introduction to Energy Auditing and Management Introduction to Energy Auditing, Importance of Energy Management, Key Terms and Concepts, Types of Energy Audits, Energy Management Standards and Guidelines, Overview of Energy Audit Process, Case Studies in Energy Management	7
Unit II: Energy Audit Procedures Planning an Energy Audit, Data Collection Methods, Energy Metering and Measurement Techniques, Performing Preliminary Assessments, Conducting Detailed Energy Audits, Documentation and Reporting, Analyzing Audit Results	7
Unit III: Basic Tools and Techniques for Energy Audits Overview of Energy Audit Tools, Using Energy Meters, Thermal Imaging and Inspections, Energy Management Software, Calculating Energy Consumption and Savings,	6
Unit IV: Identifying Energy Inefficiencies Common Sources of Energy Loss, Analyzing Energy Consumption Patterns, Identifying Inefficiencies in Lighting Systems, Identifying Inefficiencies in HVAC Systems, Identifying Inefficiencies in Industrial Processes, Case Studies of Energy Inefficiencies, Exercises on Identifying Inefficiencies	6

Text Books:

1	Frank Kreith and D. Yogi Goswami. "Energy Management and Conservation Handbook," CRC Press, 2nd Edition, 2014.
2	Michael R. Blasnik. "Energy Audits and Retrofits: A Guide for Commercial Buildings," John Wiley & Sons, 1st Edition, 2021.
3	Alberto G. Ruggieri. "Fundamentals of Energy Engineering," CRC Press, 1st Edition, 2017.
4	Moncef Krarti. "Energy Audit of Building Systems: An Engineering Approach," CRC Press, 2nd Edition, 2017.

Reference Books:

1	Albert Thumann and D. Paul Mehta. "Handbook of Energy Audits," Fairmont Press, 8th Edition, 2018.
2	Craig B. Smith and James A. R. McDaniel. "Energy Management: Principles and Practices," Wiley, 3rd Edition, 2015
3	2007 Energy Efficiency Manual, The Fairmont Press, 2nd Edition, 2011.
4	Barney L. Capehart, Wayne C. Turner, and William J. Gorse. "Practical Guide to Energy Management," CRC Press, 7th Edition, 2019.

Useful Links	
1	https://archive.nptel.ac.in/courses/108/106/108106022/

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Class			S.Y. B. Tech, Semester- IV
Course Code and Course Title			**24ELEU4N11, Model Based Programming & Simulation**
Prerequisite/s			
Teaching Scheme: Lecture/Tutorial/Practical			**00**/00/**02**
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/**25**
		Total	**50**

Course Description: This course will introduce students to computer programming and problem solving using Matlab. It is an introductory course for students aimed at developing their skill in scientific computing. Matlab is a language designed especially for processing, evaluating and graphical displaying of numerical data. The class is lab-focused, so students will spend much more time doing hands-on exercises in computer lab. There are no maths or programming prerequisites; however elementary skills in computer science will be an advantage.

Course Objectives:

1	To introduce the fundamental features of MATLAB and enable students to manage variables, perform basic operations, and control the workspace effectively.
2	To develop skills in using MATLAB for mathematical computations, matrix operations, data visualization, and basic programming.
3	To equip students with the ability to write, debug, and optimize MATLAB scripts and functions for solving engineering and scientific problems.

Course Outcomes (COs):
At the end of the course the student will be able to:

24ELEU4N11.1	Understand the Basics of MATLAB
24ELEU4N11.2	Apply MATLAB Functions for Mathematical and Visualization Tasks
24ELEU4N11.3	Develop MATLAB Scripts and Functions
24ELEU4N11.4	Analyze and Debug MATLAB Programs

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Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
24ELEU4 N11.1	3	2	1		2										II
24ELEU4 N11.2	2	2	1		2										III
24ELEU4 N11.3	2	2	1		2										III
24ELEU4 N11.4	2	2	2		2										III

Course Contents	Hrs
Unit 1 – Introduction to MATLAB Basic features, A minimum MATLAB session , Starting MATLAB, Using MATLAB as a calculator, Quitting MATLAB, Getting started : Creating MATLAB variables, Overwriting variable, Error messages, Making corrections, Controlling the hierarchy of operations or precedence, Controlling the appearance of floating point number, Managing the workspace, Keeping track of your work session, Entering multiple statements per line, Miscellaneous commands, Getting help	4
Unit 2 –MATLAB functions Mathematical functions, Basic plotting: overview, Creating simple plots, Adding titles, axis labels, and annotations, Multiple data sets in one plot, Specifying line styles and colours, Matrix generation: Entering a vector, Entering a matrix, Matrix indexing, Colon operator, Linear spacing, Colon operator in a matrix, Creating a sub-matrix, Deleting row or column , Dimension, Continuation, Transposing a matrix, Concatenating matrices, Matrix generators, Special matrices, Arra operations and Linear equations:: Matrix arithmetic operations, Array arithmetic operations, Matrix functions, Matrix inverse	4
Unit 3 –Introduction to programming in MATLAB Introduction, M-File Scripts , M-File functions: Anatomy of a M-File function, Input and output arguments, Input to a script file, Output commands, Control flow and operators: Introduction , Control flow: The ''if...end'' structure, Relational and logical operators, The ''for...end'' loop, The ''while...end'' loop, Other flow structures, Operator precedence	4

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Unit 4-Debugging M-files Introduction, Debugging process: Preparing for debugging, Setting breakpoints, Running with breakpoints, Examining values, Correcting and ending debugging, Ending debugging, Correcting an M-file, Summary of commands	4

List of Experiment

Experiment No.	Name of Experiment	S/O	Hours
1	Introduction to MATLAB Environment	S	2
2	Basic Arithmetic and Variables	O	2
3	Matrix Creation and Indexing	O	2
4	Array Operations (Element-wise Operations)	O	2
5	Plotting Basic Graphs	O	2
6	Using Functions and Scripts	O	2
7	Control Flow with Loops (For and While loops)	O	2
8	Control Flow with Conditional Statements (If-else)	O	2
9	Solving Equations using MATLAB	O	2
10	Vectorization in MATLAB	O	2
11	Basic Statistical Analysis	O	2
12	Basic File I/O Operations	O	2

(S: Study O: Operational)

Text Book:

Introduction to MATLAB for engineering students, School of Engineering and Applied Science (Northwestern University), David Houcque Northwestern University, August 2005

Automatic Control Systems, 8th edition, B. C. Kuo John wiley and son's, 2003

Reference Books:

Introduction to MATLAB for Engineers, 3rd Edition ,William J.Palm III , paperback 2008

MATLAB Programming for Engineers, 4th Edition, Stephen, J.Chapman paperback 2007, paperback Ogata

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Department of Electrical Engineering
T.Y. B. Tech. Semester-V
Structure and Curriculum

Scheme 2023-2027

Academic Year 2025-26

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Course Code Draft Formats

Format: {YY}{DDD}{U/P/D}{S}{T}{NN}

Abbr	: Meaning
YY	: Year -> Last 2 digits of Year
DDD	: Dept Abbr.
L	: Level -> UG/PG/Doctoral
S	: Semester Number
T	: Type -> NEP bucket (*list)
NN	: Serial Number
A	: Assessment -> Theory / Lab / Tutorial

eg. 24DSEU3A01

NEP Bucket List

NEP Course Category	Abbr.	Code
Ability Enhancement Courses	AEC	A
Basic Science Courses	BSC	B
Co-Curricular Activities	CCA	C
Audit Course	AC	D
Program Elective Courses	PEC	E
Community Engagement Project /. Field Project	CEP/FP	F
Humanities/Social Science, Management	HSSM	H
Internship	INT	I
Project	PR	J
Indian Knowledge System	IKS	K
Multi-Disciplinary Minor	MDM	M
Vocation Skill Enhancement Courses	VSEC	N
Open Elective Courses	OEC	O
Program Core Courses	PCC	P
Research Methodology	RM	R
Engineering Science Courses	ESC	S
Value Education Courses	VEC	V
Honors Courses	HON	Z

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Teaching and Evaluation Scheme from Year 2023-24 (as per NEP-2020)

Department of Electrical Engineering

T.Y B.Tech SEMESTER V

Course Code	Course Category	Course Type	CourseName	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/PoE	
23ELEU5P01	Program Core Courses	PCC	Signal & Systems	3	3	-	-	20	30	50	-	-	100
23ELEU5P02			AC Machines	3	3	-	-	20	30	50	-	-	100
23ELEU5P03			Feedback control System	4	4	-	-	20	30	50	-	-	100
23ELEU5P04			Signal & Systems Lab	1	-	2	-	-	-	-	25	50	75
23ELEU5P05			AC Machines Lab	1	-	2	-	-	-	-	25	50	75
23ELEU5M06	Multidisciplinay Minor	MDM-3	Electric Drives and Controllers for Electric Vehicles	3	3	-	-	20	30	50	-	-	100
23ELEU5M07			Electric Drives and Controllers for EV Lab	1	-	2	-	-	-	-	25	-	25
23ELEU5O08	Open Elective	OCE-III	PLC & SCADA	2	2	-	-	-	-	50	-	-	50
23ELEU5E09	Professional Elective	PEC1	Renewable Energy Systems	4	4	-	-	20	30	50	-	-	100
23ELEU5E10			Analog and Digital Circuit										
23ELEU5E11			Electrical Distribution Systems										
23ELEU5D12	Mandatory Course	MC	Finishing School Training V	Audit	3*	-	-	50	-	-	-	-	Grade
23ELEU5C13	Co-Curricular Activities	CCA	Liberal Learning-I	Audit	2#	-	-	50	-	-	-	-	Grade
23ELEU5C14			Liberal Learning-II										
			Total	**22**	**19**	**6**	**-**	**200**	**150**	**300**	**75**	**100**	**725**
23ELEU5Z02	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper-II (ODLonly) Control Systems	4	4	-	-	20	30	50	-	-	100

***-Values not included in total, #-2 contact hrs per club, Min Marks for passing: 40% of total marks of individual course**

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T.Y. B. Tech. Curriculum
(As Per National Education Policy 2020)

Semester-V

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5P01, Signal & Systems**
Prerequisite/s			Applied Mathematics
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: This course introduces the fundamentals of signals and systems, focusing on their classification, representation, and behavior in time and frequency domains. It emphasizes system analysis using differential equations and Fourier Transform techniques for both continuous and discrete-time signals.

Course Objectives:

1	To familiarize students with the classification and properties of different types of signals and systems.
2	To develop analytical skills to determine the time-domain response of linear time-invariant systems using differential equations.
3	To apply signal transformation and construction techniques for understanding complex signals.
4	To introduce Fourier Transform methods for analyzing the frequency domain characteristics of signals.

Course Outcomes (COs):
At the end of the course the student will be able to:

23ELEU5P01.1	Identify and classify different types of continuous and discrete-time signals and systems based on their characteristics such as periodicity, symmetry, energy, and determinism.
23ELEU5P01.2	Determine the time-domain response of LTI systems using convolution, impulse, and step responses for both continuous and discrete time
23ELEU5P01.3	Analyze linear time-invariant systems using Laplace transform and evaluate system behavior through transfer functions, poles, and zeros
23ELEU5P01.4	Apply Z-transform techniques to evaluate the behavior and stability of discrete-time systems in the Z-domain
23ELEU5P01.5	Utilize Fourier series and Fourier transform to analyze the frequency components of continuous-time signals and understand signal sampling

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
23ELEU5P01.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU5P01.2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
23ELEU5P01.3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
23ELEU5P01.4	3	3	2	-	-	-	-	-	-	-	-	-	-	-
23ELEU5P01.5	3	3		-	-	-	-	-	-	-	-	-	-	-
23ELEU5P01.6	3	3	2	-	-	-	-	-	-	-	-	-	-	-

Content	Hrs.
Unit I: Introduction to Signals Signals, Continuous and discrete time signals, Standard test signals, Basic Operation on SignalsClassification of Signals, Periodic aperiodic, even & odd energy and power signals, deterministic and random signals, complex exponential andsinusoidal signals, periodicity properties of discrete time signals, complex exponential, unit impulse, unit step, impulse functions	8
Unit II: Time domain analysis of discrete and continuous time signals Zero state response, Zero input response, Impulse response, Step response, Convolution sum and convolution integral, Graphical representation of convolution, Direct form I & direct form II, FIR and IIR systems	7
Unit III: System Analysis using Laplace transform Introduction , ROC, S-plane, properties of Laplace and inverse Laplace transform, transfer function analysis, solution of LTI differential equation, Poles & Zeros, Analysis of electrical networks	6
Unit IV: System analysis using Z-transform A brief introduction to Z–transform, its properties & inverse – Z transform ROC, connection between Laplace transform and Z–transform, transfer function analysis, solution of LTI difference equation, and stability in Z-domain.	7
Unit V: Fourier analysis of continuous signals Periodic representation by trigonometric Fourier series, Fourier spectrum, Fourier transform and its properties, Sampling Theorem, Nyquist criterion Relation between Fourier and Laplace Transform	7

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Unit VI: Fourier analysis of discrete signal Introduction, properties of D.T.F.T., relation between DTFT & Z-transform, DFT,IDFT, DIT-FFT,DIF-FFT , IDFT using FFT algorithm	7

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Signals and Systems	Alan V. Oppenheim, Alan S. Willsky, S. Hamid	Pearson Education	2nd	2015
2	Signals and Systems	Simon Haykin, Barry Van Veen	Wiley India	2nd	2007
3	Linear Systems and Signals	B. P. Lathi	Oxford University Press	2nd	2009
4	Signals and Systems	A. Nagoor Kani	McGraw Hill Education	2nd	2012

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Schaum's Outline of Signals and Systems	Hwei P. Hsu	McGraw Hill	2nd	2011
2	Fundamentals of Signals and Systems	Michael J. Roberts	McGraw Hill	2nd	2008
3	Signals and Systems: Continuous and Discrete	Rodger E. Ziemer, William H. Tranter	Pearson	4th	2009
4	Signals and Systems	Tarun Kumar Rawat	Oxford University Press	1st	2010

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Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5P02, AC Machines**
Prerequisite/s			Basic electrical concepts, AC fundamentals
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**20/30/50**	**ISE / MSE / ESE**	**20/30/50**
	00/00/00	**INT / OE/POE**	00/00/00
	100	**Total**	**100**

Course Description: This course provides a comprehensive study of alternating current (AC) machines, including the construction, working principles, performance, characteristics, and applications of synchronous machines, induction motors, and alternators, with emphasis on analysis, testing, and control methods.

Course Objectives:

1	To understand the constructional features and working principles of various AC machines, including induction and synchronous machines
2	To study and evaluate the influence of system parameters on AC machine behavior under both steady-state and dynamic operating conditions.
3	To develop the ability to solve numerical problems related to performance parameters and characteristics of AC machines in different operating states.
4	To analyze machine performance through appropriate testing techniques and select suitable starting and speed control methods for different types of rotating AC machines.

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
23ELEU5P02.1	Explain the constructional details and working principle of AC machines
23ELEU5P02.2	Describe the effects of system parameters during steady state and dynamic conditions
23ELEU5P02.3	Solve numerical problems to determine the essential parameters of machines at steady state and dynamic conditions
23ELEU5P02.4	Analyze the performance of a AC machine by using appropriate testing methods
23ELEU5P02.5	Select the suitable types of speed control methods and starting methods for rotating machines

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2

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School of Engineering & Management

23ELEU5P02.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU5P02.2	3	2		2	-	-	-	-	-	-	-	-	-	-
23ELEU5P02.3	3	3	2	2	-	-	-	-	-	-	-	-	-	-
23ELEU5P02.4	3	2	3	3	-	-	-	-	-	-	-	-	-	-
23ELEU5P02.5	2	2	3		2	-	-	-	-	-	-	-	-	-
23ELEU5P02.1	2	2	3		2	-	-	-	-	-	-	-	-	-

Unit	Course Contents	Hours
1	**Unit-I Three Phase Induction Motor** Construction Details, Principle of operation, Torque-Slip Characteristics, Necessity of starters, types of starters (DOL, star-delta, rotor resistance starter), Speed control methods from stator side (Stator voltage control, Stator frequency control) & rotor side (rotor resistance control), Braking Methods, Applications of 3 ph. Induction motors to Electric vehicle (Numerical Expected)	7
2	**Unit-II Performance of Induction Motor** Losses and Efficiency, Direct load test, No load & blocked rotor test, equivalent circuit of 3 phase induction motor, power flow diagram, Phasor diagram of 3 phase induction motor, performance of 3 phase induction motor using circle diagram, crawling & cogging, Induction motor as induction generator, Double cage induction motor(Numerical Expected)	8
3	**Unit-III Three Phase Alternator** Construction Details, principle of operation, Emf equation, parameters of armature winding (Resistance & leakage reactance), armature reaction (at unity, lagging zero and leading zero power factor), concept of synchronous reactance and synchronous impedance. Equivalent circuit of 3 phase alternator, alternator on load (resistive, inductive & capacitive)(Numerical Expected)	8
4	**Unit-IV Performance of Alternator** Direct load test,OC test & SC test on 3 Phase alternator, voltage regulation methods (EMF, MMF and direct loading method), Losses and efficiency, Necessity for parallel operation of alternators, conditions for parallel operation, synchronizing procedures, hunting and oscillation in alternators(Numerical Expected)	6
5	**Unit-V Synchronous Motor** Construction and principle of operation, Starting methods of synchronous motors, Phasor Diagrams of three phase synchronous motor at Unity, lagging and leading power factor, Effect of Varying Field Current and Load, V & inverted V Curves, Operation of Synchronous motor as Synchronous	7

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School of Engineering & Management

	Condenser, Hunting	
6	**Unit-VI Single phase induction motors** Single Phase Induction Motor- Double field Revolving theory, Equivalent Circuit, Split phase induction motor, Capacitor start induction motor, Capacitor start capacitor run induction motor (two value capacitor method), shaded pole induction motor, universal motor	6

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Principles of Electrical Machines	V. K. Mehta	S. Chand	Second	2009
2	Electric Machinery	BimbhraP.S	Khanna Publisher	Seventh	2021
3	Electric machines	Ashfaq Husain	Dhanpatrai And Co.Publication	Third	2024
4	Electric Machinery	A.E Fitzgerald StephenKingsly	Tata Mcgraw Hill	Seventh	2014

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Generalized Machine Theory	BhimraP.S	Khanna Publisher	Seventh	2021
2	Electric Machines	Kothari D.P Nagrath I.J	THM Publications	Fifth	2017
3	Electric machines	M.V.Deshpande	PHI Publication	First	2011
4	Electric machines	Samarjit Ghosh	Pearson	Second	2012

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Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5P03, Feedback Control System**
Prerequisite/s			Control System
Teaching Scheme: Lecture/Tutorial/Practical			**04**/00/00
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: This course introduces the fundamentals of control systems, focusing on modeling, analysis, and design of feedback systems in electrical and mechanical domains. It emphasizes system stability, time and frequency response, and controller implementation

Course Objectives:

1	To understand the basic concepts of feedback control systems and develop mathematical models using block diagrams and signal flow graphs
2	To analyze the dynamic behavior of electrical and mechanical systems in both time and frequency domains
3	To evaluate system performance through transient, steady-state, and stability analysis techniques.
4	To design and implement basic controllers and state-space models for practical control applications

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
23ELEU5P03.1	Determine the transfer function using block diagram reduction and signal flow graph.
23ELEU5P03.2	Analyze the mathematical model of electrical and mechanical systems.
23ELEU5P03.3	Compute the transient and steady state response parameters of systems.
23ELEU5P03.4	Analyze the stability of system in time & frequency domain.
23ELEU5P03.5	Analyze the control system using state space representation.
23ELEU5P03.6	Implement controllers for simple control systems.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
23ELEU5P03.1	3	2	-	2	-	-	-	-	-	-	-	-	-	-
23ELEU5P03.2	3	3	2	2	-	-	-	-	-	-	-	-	-	-
23ELEU5P03.3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU5P03.4	3	3	3	3	-	-	-	-	-	-	-	-	-	-
23ELEU5P03.5	3	3	3	3	-	-	-	-	-	-	-	-	-	-
23ELEU5P03.6	3	2	3	2	-	-	-	-	-	-	-	-	-	-

Unit	Course Contents	Hours
1	**Unit-I Introduction to Control System and Mathematical Modeling** Introduction, types of systems, feedback control system, Mathematical modeling of electrical, mechanical systems, Force Voltage and Force current analogy, Determination of the transfer function using block diagram reduction and signal flow graph, Components of control systems and its transfer function, Pole zero concept.	8
2	**Unit-II Time Domain Analysis and Stability** Time response of first order systems, second order systems, Analysis of steady state error, static error constants and type of system, Time response specifications, Concept of stability, Routh-Hurwitz criteria for stability.	7
3	**Unit-III Root Locus** Definition of root locus, rules for plotting root loci, root contour, stability analysis using root locus, effect of addition of pole and zero on root locus.	6
4	**Unit-IV Frequency Response Analysis of Control system** Introduction to frequency response, frequency domain performance specifications, stability analysis of system using Bode plots, Polar plot, Nyquist plot, co-relation between time domain and frequency domain.	7
5	**Unit-V State Space Representation** Introduction to State space, phase variable form, canonical form, conversion of transfer function to state space and vice versa, state transition matrix and its significance, Eigen values, Eigen vectors, solution of state equations, controllability and observability.	7

Head of Department
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School of Engineering & Management

6	**Unit-VI PID Controller** Introduction to P, PI, PID controller, Ziegler and Nicholas rules for controller tunning, PID controller applications: Temperature control system, motion control system, level control system.	7

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Control System Engineering	I.J. Nagrath M. Gopal	New Age International Publication	Fifth	2020
02	Control System Engineering	Norman Nise	Wiley Publication	Seventh	2014
03	Modern Control Engineering	Ogata	Prentice Hall	Fifth	2010
04	Feedback Control Systems	U. A. Bakshi & S. C. Goyal	Technical Publications	Second	2008

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Automatic Control System	Kuo &Golnaraghi	Wiley	Ninth	2014
02	Control Systems: Theory and Applications	Smarajit Ghosh	Pearson Education	Second	2012
03	Control Systems	N. C. Jagan	B. S. Publications	Third	2015
04	Feedback Control Systems	C.L. Phillips, R.D. Harbor,	Prentice Hall	Fifth	2011

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Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5P04, Signal & Systems Lab**
Prerequisite/s			Applied Mathematics
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/**25**
		Total	**50**

Course Description: This course provides hands-on experience with MATLAB and SIMULINK for signal generation, analysis, and visualization. It emphasizes continuous and discrete-time signal processing, including Fourier, Laplace, and Z-transforms, with practical validation of theoretical concepts.

Course Objectives:

1	Develop proficiency in using MATLAB for signal generation, manipulation, analysis, and visualization, including understanding and utilizing different operators and commands effectively.
2	Gain practical experience in generating and analyzing various types of continuous-time (CT) and discrete-time (DT) signals.
3	Apply Fourier series and Fourier transform techniques to analyze signals in both time and frequency domains.
4	Validate theoretical concepts such as the sampling theorem, Laplace transform (LT), and Z-transform (ZT) through practical experiments in MATLAB.

Course Outcomes (COs):
At the end of the course the student will be able to:

23ELEU5P04.1	Demonstrate proficiency in using MATLAB for signal generation, manipulation, analysis, and visualization.
23ELEU5P04.2	Analyze the characteristics of these signals in both time and frequency domains, including understanding the effects of sampling and aliasing.
23ELEU5P04.3	Apply Fourier series and Fourier transform techniques to analyze signals.
23ELEU5P04.4	Apply their knowledge and skills acquired in MATLAB and SIMULINK to solve real-world signal processing and system analysis problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2

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(POs)														
23ELEU5P04.1	3	3	-	-	2	-	-	-	-	-	-	-	-	-
23ELEU5P04.2	3	2	-	-	2	-	-	-	-	-	-	-	-	-
23ELEU5P04.3	3	2	-	-	2	-	-	-	-	-	-	-	-	-
23ELEU5P04.4	3	2	-	-	1	-	-	-	-	-	-	-	-	-

List of Experiments	
Expt. No.	**Name of Experiment**
1	Introduction to simulation tools (MATLAB) for Signal Processing Lab
2	Generation of elementary continuous and discrete time signals
3	Perform various operations on signals and sequences such as addition, multiplication, scaling, shifting, folding, computation of energy and average power
4	Study of linear convolution and circular convolution
5	Compute auto correlation and cross correlation between signals
6	Perform waveform synthesis using Laplace Transform and Z Transform of a given signal
7	Locate the zeros and poles and plotting the pole zero maps in s-plane and Z-plane for the given transfer function
8	Study Fourier Transform of a given signal and plot its magnitude and phase spectrum
9	Calculate Discrete Fourier Transform and Inverse Discrete Fourier Transform of given digital signal.
10	Verification of sampling signal
11	Introduction to SIMULINK
12	Mini Project based on various Signals and Systems

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School of Engineering & Management

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Department of Electrical Engineering

Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Signals and Systems	Alan V. Oppenheim, Alan S. Willsky, S. Hamid	Pearson Education	2nd	2015
2	Signals and Systems	Simon Haykin, Barry Van Veen	Wiley India	2nd	2007
3	Linear Systems and Signals	B. P. Lathi	Oxford University Press	2nd	2009
4	Signals and Systems	A. Nagoor Kani	McGraw Hill Education	2nd	2012
5	Signals and Systems	Ramesh Babu	Scitech Publications (India) Pvt Ltd	4th	-

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Schaum's Outline of Signals and Systems	Hwei P. Hsu	McGraw Hill	2nd	2011
2	Fundamentals of Signals and Systems	Michael J. Roberts	McGraw Hill	2nd	2008
3	Signals and Systems: Continuous and Discrete	Rodger E. Ziemer, William H. Tranter	Pearson	4th	2009
4	Signals and Systems	Tarun Kumar Rawat	Oxford University Press	1st	2010

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Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5P05, AC Machines Lab**
Prerequisite/s			Basic electrical concepts, AC fundamentals
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	00/00/00	**ISE / MSE / ESE**	00/00/00
	25/00/25	**INT / OE/POE**	**25/00/50**
	50	**Total**	**75**

Course Description: This course provides hands-on experience in testing and analyzing the performance of AC machines. It covers construction, working principles, parameter determination, and control methods through practical experiments.

Course Objectives:

1	To enable students to understand the constructional features and working principles of various AC machines through hands-on experiments.
2	To demonstrate the effects of system parameters under steady-state and dynamic conditions using practical testing setups.
3	To develop students' skills in performing calculations and measurements necessary to determine key machine parameters through laboratory procedures.
4	To provide practical exposure to performance analysis, testing methods, starting techniques, and speed control methods for AC rotating machines.

Course Outcomes (COs): After successful completion of this course, the student will be able to:	
23ELEU5P05.1	Explain the constructional details and working principle of AC machines
23ELEU5P05.2	Describe the effects of system parameters during steady state and dynamic conditions
23ELEU5P05.3	Solve numerical problems to determine the essential parameters of machines at steady state and dynamic conditions
23ELEU5P05.4	Analyzethe performance of a AC machine by using appropriate testing methods
23ELEU5P05.5	Select the suitable types of speed control methods and starting methods for rotating machines

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
23ELEU5P05.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU5P05.2	3	2	-	2	-	-	-	-	-	-	-	-	-	-
23ELEU5P05.3	3	3	2	3	-	-	-	-	-	-	-	-	-	-
23ELEU5P05.4	3	2	3	3	-	-	-	-	-	-	-	-	-	-
23ELEU5P05.5	2	2	3	-	2	-	-	-	-	-	-	-	-	-

Expt. No	Title of the Experiment
1	Speed control of 3 Ph. Squirrel Cage Induction Motor (SCIM) by using stator voltage control
2	Speed control of 3 Ph. Slip Ring Induction Motor (SRIM) by using rotor resistance control.
3	Determination of efficiency & speed regulation of 3 Phase SCIM by conducting No Load & Blocked Rotor Test.
4	Determination of efficiency & speed regulation of 3 phase SCIM by direct loading method
5	Determination of efficiency & speed regulation of 3 phase SCIM by indirect loading method
6	Determination of efficiency & speed regulation of 1 phase induction motor by direct loading method.
7	Determination of Voltage regulation of an alternator by EMF method.
8	Determination of Voltage regulation of an alternator by MMF method.
9	Determination of regulation of Alternator by direct loading method
10	Determination of V and Inverted V curves of a synchronous motor.
11	Synchronization of three phase alternator by using 1 dark & 2 bright method
12	Synchronization of three phase alternator by using synchroscope
13	Mini /Micro Project
14	Industrial Visit

Minimum **ten** experiments should be performed from the above list.

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Department of Electrical Engineering

Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Principles of Electrical Machines	V. K. Mehta	S. Chand	Second	2009
2	Electric Machinery	BimbhraP.S	Khanna Publisher	Seventh	2021
3	Electric machines	Ashfaq Husain	Dhanpatrai And Co.Publication	Third	2024
4	Electric Machinery	A.E Fitzgerald StephenKingsly	Tata Mcgraw Hill	Seventh	2014

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Generalized Machine Theory	BhimraP.S	Khanna Publisher	Seventh	2021
2	Electric Machines	Kothari D.P Nagrath I.J	THM Publications	Fifth	2017
3	Electric machines	M.V.Deshpande	PHI Publication	First	2011
4	Electric machines	Samarjit Ghosh	Pearson	Second	2012

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Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5M06, Electric Drives and Controllers for Electric Vehicles**
Prerequisite/s			Basic knowledge of electrical circuits and machines, fundamental concepts of control systems.
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description:
This course explores electric drive systems in EVs, covering motor control, power electronics, and advanced control techniques.

Course Objectives:

1	Analyze the fundamental concepts, components, and characteristics of electric drives
2	Explain the principles of torque generation and speed control methods for three-phase induction motors.
3	Apply different speed control techniques for slip-ring induction motors.
4	Discuss the construction, operation, and control of special drives like switched reluctance motors and solar/battery-powered electric vehicle drives

Course Outcomes (COs):
At the end of the course the student will be able to:

23ELEU5M06.1	Identify the key elements of electric drive systems.
23ELEU5M06.2	Design appropriate speed control, starting, and braking circuits for DC motors.
23ELEU5M06.3	Implement different speed control techniques for three-phase induction motors.
23ELEU5M06.4	Apply various slip power recovery methods to develop efficient speed control strategies.
23ELEU5M06.5	Compare the operating principles and control techniques of synchronous motor drives and brushless DC motor drives.
23ELEU5M06.6	Understand the working principles and control schemes for switched reluctance motors and solar/battery-operated vehicle drives.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
23ELEU5M06.1	2	1	-	-	-	-	-	-	-	-	-	1	2	1
23ELEU5M06.2	3	2	3	1	2	-	-	-	-	1	-	1	3	1
23ELEU5M06.3	3	2	3	2	2	-	-	-	-	1	-	1	3	1
23ELEU5M06.4	3	3	3	2	2	-	2	-	-	1	-	1	3	1
23ELEU5M06.5	3	3	2	2	1	-	-	-	-	1	-	2	2	1
23ELEU5M06.6	3	2	2	1	1	2	2	-	-	1	-	2	2	1

Unit	Course Contents	Hours
1	**Unit1 Basics of power electronics:** Power devices: SCR, TRIAC, BJT, MOSFET and IGBT. power conversion – DC-DC converters, DC-AC converters and AC-DC converters used in EV applications, voltage source inverter, current source inverter.	7
2	**Unit-2 EV Motors and Characteristics:** Requirement of EV motors, Review of motor principles, Motor load dynamics; Specifications of motors, Characteristic Curves of motors; Motion profile: acceleration, steady operation, and deceleration profiles; Starting, braking, speed and torque control of motors; Constant-Torque Mode, Constant-Power Mode; Efficiency Map	6
3	**Unit-3 EV Motors Drive Topologies -1:** AC Motors: permanent-magnet ac synchronous motor- constructional details and Characteristic Curves; Variable-Voltage Variable-Frequency Control (VVVF), Field-Oriented Control (FOC), Direct Torque Control (DTC); Field Weakening Control	7
4	**Unit-4 EV Motors Drive Topologies -2:** DC motor - DC Motor dynamics, Characteristic Curves, Basic principles of BLDC Motor, motor construction, Types of BLDC motors, BLDC Motor Control: Trapezoidal back EMF BLDC motor control, sensored control	6
5	**Unit-5 Vehicle mechanics** Roadway fundamentals, laws of motion, vehicle kinetics, dynamics of vehicle motion, propulsion power, force-velocity characteristics, maximum gradability, velocity and acceleration, constant FTR, level road, velocity profile, distance	7

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	traversed, tractive power, energy required, nonconstant FTR, general acceleration, propulsion system design	
6	**Unit-6 Design of electric vehicle drivetrain** EV transmission configurations, transmission components, gears, automobile differential, clutch, brakes, ideal gearbox: steady state model, gear ratio (GR), torque-speed characteristics, EV motor sizing, initial acceleration, rated vehicle velocity, maximum velocity, maximum gradability	7

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Husain	CRC Press	3rd edition	2021
2	Electric and Hybrid Electric Vehicles	James D. Halderman, Curt Ward	Pearson	1st	2023
3	Electric Vehicle Technology Explained	James Larminie John Lowry	John Wiley &Sons,Ltd	2nd	2012
4	Electric and Hybrid Vehicles	A. K. Babu	CRC PRess	2nd	2022

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles	JG Hayes G. Abas Goodarzi	Wiley	1st	2018
02	Emerging Power Converters for Renewable Energy and Electric Vehicles	Md. Rabiul Islam (Editor), Md. Rakibuzzaman Shah (Editor), Mohd. Hasan Ali	CRC Press	1st	2021

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Course Code and Course Title			**23ELEU5M07, Electric Drives and Controllers for Electric Vehicles Lab**
Prerequisite/s			Basic knowledge of electrical circuits and machines, fundamental concepts of control systems.
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/00
		Total	**25**

Course Description: This course explores electric drive systems in EVs, covering motor control, power electronics, and advanced control techniques.

Course Objectives:

1	Analyze the fundamental concepts, components, and characteristics of electric drives
2	Explain the principles of torque generation and speed control methods for three-phase induction motors.
3	Apply different speed control techniques for slip-ring induction motors.
4	Discuss the construction, operation, and control of special drives like switched reluctance motors and solar/battery-powered electric vehicle drives

Course Outcomes (COs):At the end of the course the student will be able to:

23ELEU5M07.1	Identify the key elements of electric drive systems.
23ELEU5M07.2	Design appropriate speed control, starting, and braking circuits for DC motors.
23ELEU5M07.3	Implement different speed control techniques for three-phase induction motors.
23ELEU5M07.4	Apply various slip power recovery methods to develop efficient speed control strategies.
23ELEU5M07.5	Compare the operating principles and control techniques of synchronous motor drives and brushless DC motor drives.
23ELEU5M07.6	Understand the working principles and control schemes for switched reluctance motors and solar/battery-operated vehicle drives.

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Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
23ELEU5 M07.1	2	1	-	-	-	-	-	-	-	-	-	1	-	-
23ELEU5 M07.2	3	2	3	1	2	-	-	-	-	1	-	1	-	-
23ELEU5 M07.3	3	2	3	2	2	-	-	-	-	1	-	1	-	-
23ELEU5 M07.4	3	3	3	2	2	-	2	-	-	1	-	1	-	-
23ELEU5 M07.5	3	3	2	2	1	-	-	-	-	1	-	2	-	-
23ELEU5 M07.6	3	2	2	1	1	2	2	-	-	1	-	2	-	-

List of Experiments	
Expt. No.	**Name of Experiment**
1	Verify Speed – Torque characteristics of chopper fed D. C. series motor.
2	Analyze the performance of chopper fed D. C. drive for closed – loop speed control
3	Demonstrate operation and application of single-phase full wave, half controlled converter for open loop speed control of D. C. shunt motor.
4	Demonstrate operation and application of single-phase full wave, full controlled converter for open loop speed control of D. C. shunt motor.
5	Analyze the performance of converter fed D. C. drive for closed loop speed control.
6	Study the operation of two quadrant single phase converter fed 5 HP DC drive
7	Study the four-quadrant operation of 5 HP DC motor using single phase converter.
8	Study the operation of four quadrant chopper fed DC drive
9	Assess the performance of rotor resistance control method for speed control of Slip – Ring Induction motor.
10	Demonstrate speed control of Induction motor using V/f method.
11	Analyze the operation of Induction motor drive with Six – step VSI control
12	Demonstrate the operation of brushless DC motor drive with software Simulation.
13	Demonstrate speed control of Induction motor using Kramer speed control method.

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School of Engineering & Management

Text Books:

1	"Fundamentals of Electrical Drives", G. K. Dubey, Narosa publication, 2nd edition.
2	"Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", Mehrdad Ehsani, Yimin Gao, and Ali Emadi.
3	"Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Chris Mi, M. Abul Masrur, and David Wenzhong Gao.

Reference Books:

1	"Electrical Drives - Concept and application", Vedam Subramanyam.
2	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design by Mehrdad Ehsani, Yimin Gao, and Ali Emadi.
3	Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives by Chris Mi, M. Abul Masrur, and David Wenzhong Gao.
4	Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and the Market by Gianfranco Pistoia.

	Useful Links
1	http://acl.digimat.in/nptel/courses/video/108104140/L26.html

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Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5O08, PLC & SCADA**
Prerequisite/s			Basics of Electronics and Electrical
Teaching Scheme: Lecture/Tutorial/Practical			**02**/00/00
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**--/--/50**
	P	**INT / OE/POE**	00/00/00
		Total	**50**

Course Description:
This course introduces students to the fundamentals of industrial automation, focusing on the application of PLCs, SCADA, and DCS in automated control systems. It emphasizes system architecture, programming, and integration of industrial communication protocols in process industries.

Course Objectives:

1	To provide knowledge of basic concepts and principles of industrial automation systems.
2	To familiarize students with the fundamentals of logic development for automation processes.
3	To develop the ability to design and simulate ladder logic programs for real-time industrial applications using PLCs.
4	To impart hands-on skills in testing, debugging, and troubleshooting of digital and analog automation programs.
5	To explore SCADA and DCS architecture and their applications in monitoring and controlling large-scale industrial operations.

Course Outcomes (COs):
At the end of the course the student will be able to:

23ELEU5O08.1	Summarize the fundamental principles of industrial automation
23ELEU5O08.2	Apply the concepts of fundamentals of logic for various processes of automation.
23ELEU5O08.3	Analyze and formulate the requirements of appropriate ladder programs to provide solutions using PLCs.
23ELEU5O08.4	Construct, debug and test the programs developed for digital and analog operations.
23ELEU5O08.5	Build architecture of SCADA and explain the importance of SCADA in critical infrastructure
23ELEU5O08.6	Identify the knowledge of PLC, SCADA and DCS with industrial networking protocols for process industries.

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Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
23ELEU5O 08.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU5O 08.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU5O 08.3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
23ELEU5O 08.4	3	3	3	2	-	-	-	-	-	-	-	-	-	-
23ELEU5O 08.5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU5O 08.6	3	2	2	-	2	-	-	-	-	-	-	-	-	-

Unit	Course Contents	Hours
1	**Unit-I Programmable logic Controller:** Fundamentals of industrial automation, Definition and Goals of Automation, need and role of automation, evolution of automation. Types of processes, comparison, evolution of PLC, Types of Automation Hardware Components, Basic PLC structure, Types of PLC, Inputs and Outputs, Factors to consider in selecting PLC, General PLC Programming Procedure, PLC Programming Languages, Processor Memory Organization, Creating ladder diagram for real time task, Mnemonic Programming Code	7
2	**Unit-II PLC Functions:** Programming Timers, Programming Counters, Program control instructions, Data Manipulation Instructions, Math Instructions, Sequence rand Shift Register Instructions, Creating ladder diagram from process control descriptions,program editing ,commissioning and monitoring, preventive maintenance and troubleshooting	7
3	**Unit-III Introduction to SCADA systems:** Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture),	7
4	**Unit-IV SCADA Protocols and SCADA systems in industries:** Open systems interconnection (OSI) Model, TCP/IP protocol, DNP3 protocol,	6

Head of Department
Department of Electrical Engg.
School of Engineering & Management

	IEC61850 layered architecture, Control and Information Protocol (CIP), Device Net, Control Net, Ether Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus).Implementation of SCADA Systems.	

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Programmable Logic Controllers: Principles and Application	John Webb, Resis Ronald,	Prentice hall of India	Fifth	2007
2	Programmable Logic Controllers: Programming Methods and Applications	Hackworth	Pearson India	First	2008
3	Programmable Logic Controllers	Frank Fetruzella	Elsevier India	Third	2007
4	Concept of SCADA System and its Evolution	Mini S. Thomas, John Douglas, McDonald	CRC Press	First	2015
5	Handbook of SCADA Control-System Security	Robert Radvonovsky, Jacob Brodsky	CRC Press	First	2013

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Programmable Controllers	Batten G. L	McGraw Hill Inc	Second	2005
2	Real Time Computer Control	Bennett Stuart	Prentice Hall	First	1988
3	Measurement Systems	Doebelin E. O.	McGraw-Hill International Editions	Fourth	1990

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Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5E09, Renewable Energy Systems**
Prerequisite/s			Basic Mechanical Engineering & Basic Electrical Engineerings
Teaching Scheme: Lecture/Tutorial/Practical			04/00/00
Credits			04
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description:
This course provides an overview of renewable energy sources such as solar, wind, biomass, hydro, and geothermal. It covers the principles, technologies, and integration of these systems into the power grid. Emphasis is placed on sustainability, energy conversion methods, and practical applications in modern energy systems.

Course Objectives:

1	To create awareness about the importance of renewable resources and their classification for sustainable future.
2	To impart the knowledge of solar power generation and wind power generation.
3	To introduce other renewable resources and their technologies.
4	To study energy storage systems in renewable generation

Course Outcomes (COs):
At the end of the course the student will be able to:

23ELEU5E09.1	Describe need and types of renewable energy resources with sustainability
23ELEU5E09.2	Interpret working of solar and wind power generation and its utilization.
23ELEU5E09.3	Distinguish various renewable energy sources like biogas, geothermal and MHD
23ELEU5E09.4	Explain need and operation of various energy storage technologies.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
23ELEU5E09.1	1	-	-	-	-	-	3	-	-	-	-	-	-	-
23ELEU5E09.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU5E09.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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School of Engineering & Management

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Department of Electrical Engineering

23ELEU5E09.4	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Unit	Course Contents	Hours
1	**Unit-I Introduction to Renewable Energy Sources** Energy sources: classification of energy sources, introduction to renewable energy, renewable energy trends, and key factors affecting renewable energy supply, global and Indian scenario of renewable energy sources. challenges, advantages and disadvantages of renewable energy sources and their uses.	9
2	**Unit-II Solar Energy** solar earth geometry, solar radiations and measurement, fundamentals of semi-conductors, absorption of light, solar thermal power generation, heat transfer, solar thermal conversion: basics, solar concentrator and tracking system, flat plate and concentrating collectors, single axis and two axes axis tracking collectors, selective coatings.	8
3	**Unit-III PV System Design** PV power generation, basic principle of power generation in PV cell, solar cell and its parameters, module and array, efficiency of PV cell, characteristics curves of PV cell, effects of different electrical parameters on I-V & P-V curves, configuration of PV power generation system - off-grid system & grid-connected PV system, design methodology, stand-alone PV system, grid-connected PV systems.	8
4	**Unit:IV Wind Energy** Power available in wind, wind turbine power & torque characteristics, types of rotors, characteristics of wind rotor, components of wind turbine, local effects, wind shear, turbulence & acceleration effects, measurement of wind, wind speed statistics, wind power calculations and Betz limit, capacity factor, speed ratio characteristics, electrical generator machines in wind energy systems	9
5	**Unit-V Biomass Energy and other renewable energy systems** Overview of biomass as energy source, physicochemical and thermal characteristics of biomass as fuel, biochemical conversion of biomass for energy production, gasification, bio-refinery and bio-diesel, geothermal energy different components, advantages, limitations	9
6	**Unit-VI Energy Storage Technologies** Introduction, need for storage for renewable energy sources, basic thermodynamic and electrochemical principles, classification, traditional energy storage system- battery, fuel cell, principle of operation, types, applications for power generation, battery management system.	9

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Department of Electrical Engineering

Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Non-Conventional Resources of Energy Systems .	G.S.Sawhney,	PHI Publication	4th	2012
2	Solar Energy- Principles of Thermal Collection and Storage	S. P. Sukhatme, J. K. Nayak,	Tata McGraw-Hill Publication.	3rd	-

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
01	Renewable Energy	Boyle, Godfrey	Oxford University Press	2nd	2004
02	Renewable and efficient electric power systems	Masters, Gilbert M	John Wiley & Sons,	-	2013.
03	Solar Photovoltaics: fundamentals, technologies and applications	Solanki, Chetan Singh.	PHI Learning Pvt. Ltd.,	-	2015

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Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5E10,** Analog and Digital Circuits
Prerequisite/s			Network Analysis
Teaching Scheme: Lecture/Tutorial/Practical			**04**/00/00
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: This course introduces the fundamentals of analog and digital circuits, covering topics such as operational amplifiers, filters, logic gates, combinational and sequential circuits. It focuses on circuit analysis, design, and real-world applications essential for modern electronic systems.

Course Objectives:

1	This course aims to introduce students the basic features of operational amplifier.
2	It intends to provide knowledge and experience for implementing simple electronic circuits to meet or exceed design specifications.
3	It is aimed to enable students for implementing combinational logic circuits for various applications.
4	It intends to provide knowledge for implementation of sequential circuits using flip-flops

Course Outcomes (COs): At the end of the course the student will be able to:

23ELEU5E10.1	Summarize various analog and digital circuits
23ELEU5E10.2	Implement analog and digital circuits to meet stated applications
23ELEU5E10.3	Construct basic analog filters, combinational and sequential circuits
23ELEU5E10.4	Analyze the performance of electronic circuits

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
23ELEU5E10.1	3	-	-	3	-	-	-	-	-	-	-	-	-	-
23ELEU5E10.2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
23ELEU5E10.3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
23ELEU5E10.4	-	3		-	-	-	-	-	-	-	-	-	-	-

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Department of Electrical Engineering

Content	Hrs.
Unit I:Fundamentals of Op-Amps Differential Amplifier(1st stage of OP-AMP), Ideal Operational Amplifiers, Block Diagram, Characteristics, op-amp powering, feedback in op-amp circuits, inverting, non-inverting amplifiers, adder, subtractor, voltage comparator, difference amplifier	7
Unit II:Applications of Opamps Instrumentation amplifier, Integrator, Differentiator, Schmitt trigger, Active filters-Low pass, high pass, band pass, all pass, band reject (notch) filters, Current to voltage convertor, voltage to current convertor, Logarithmic Amplifier	8
Unit III:Transistor Amplifiers and Voltage Regulators Introduction, Types of Configuration: common base, common emitter and common collector configurations, operating point, stability and biasing circuits, fixed voltage regulators (± 5 V, ± 12 V).	7
Unit IV: Combinational Circuits and Sequential Circuits Multiplexer, de-multiplexer, priority encoder, comparator, half & full adders, tri-state buffers. Latches – S-R latch, D latch, flip-flops- D F/F, J-K F/F,T F/F, master slave J-K F/F, conversion of one F/F to another F/F	7
Unit V: Applications of Sequential circuits Counters:Modulus of Counter, Synchronous and Asynchronous counters, Ripple counters, drawbacks of ripple counters, Ring counters, Shift registers, types of shift registers,	7
Unit VI: Digital to Analog and Analog to Digital Converters Binary weighted DAC, R-2R ladder DAC, Ramp ADC, dual slope ADC, successive approximation technique, flash ADC,	8

Text Books:

1	Sergio Franco, "Design with Op-Amps and analog Integrated Circuits", Tata McGraw-Hill Publication, Third Edition, 2001
2	Allen Mottershead, "Electronic Devices &Circuits: An Introduction", Prentice Hall India, 2010
3	A. Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, Fourth Edition, 2014

Reference Books:

1	R.A. Gayakwad, "Op-Amps & Linear Integrated Circuits", Prentice Hall India, Fourth Edition, 2012.
2	R. L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", Pearson Publications, Tenth Edition, 2009.
3	M. Moris Mano and Michael Ciletti, "Digital Design", Pearson Publications, Fifth Editic 2013

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Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU5E11, Electrical Distribution Systems**
Prerequisite/s			Electrical Circuit Analysis.
Teaching Scheme: Lecture/Tutorial/Practical			**04/--/--**
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**--/--/--**
		Total	**100**

Course Description: This course provides foundational knowledge of electric power distribution systems, focusing on load modeling, system classification, voltage drop analysis, economic design, substation components, protection devices, and power factor compensation techniques. It emphasizes practical approaches for planning and analyzing modern distribution networks.

Course Objectives:

1	Understand various types and components of electric distribution systems.
2	Analyze load characteristics and perform voltage drop calculations.
3	Design distribution systems considering economic and technical aspects.
4	Apply protection and compensation methods for efficient system operation.

Course Outcomes (COs):
At the end of the course the student will be able to:

23ELEU5E11.1	Classify loads and analyze their characteristics using load factors.
23ELEU5E11.2	Compare types of distribution systems and calculate voltage drops in DC distributors.
23ELEU5E11.3	Design distribution feeders and apply Kelvin's law for economic conductor selection.
23ELEU5E11.4	Identify substation components and design earthing systems.
23ELEU5E11.5	Identify faults and select suitable protective devices in distribution systems.
23ELEU5E11.6	Apply capacitor compensation methods for power factor improvement.

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Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
23ELEU5E11.1	3	3	-	2	2	1	-	-	2	2	-	-	3	3
23ELEU5E11.2	3	3	-	-	2	1	-	-	2	2	-	2	3	3
23ELEU5E11.3	3	3	-	3	2	-	2	-	1	-	-	-	3	3
23ELEU5E11.4	3	3	3	-	3	1	-	-	2	2	-	-	3	3
23ELEU5E11.5	3	3	-	2	-	1	3	-	2	-	-	1	3	3
23ELEU5E11.6	-	-	2	3	3	-	-	-	2	2	-	1	-	-

Content	Hrs.
UNIT-I LOAD MODELING AND CHARACTERISTICS Introduction to Distribution Systems, Load Modeling and Characteristics, Coincidence Factor, Contribution Factor, Loss Factor -Relationship between Load Factor and Loss Factor.Classification of Loads (Residential, Commercial, Agricultural and Industrial) and Their Characteristics.	9
UNIT II: CLASSIFICATION OF DISTRIBUTION SYSTEMS Classification of Distribution Systems Comparison of DC Vs AC, Under-Ground Vs Over Head Distribution Systems, Requirements and Design Features of Distribution Systems .Classification of supply systems Voltage Drop Calculations (Numerical Problems) in D.C Distributors for Radial D.C Distributor fed one end and at the both the ends (equal/unequal Voltages) and Ring Main Distributor.	8
UNIT III: ECONOMICS AND DESIGN OF DISTRIBUTION SYSTEMS Types of primary and secondary distribution systems, Voltage drop in AC distributors under uniform loading, Voltage drop in AC distributors under non-uniform loading, Economic choice of conductor (Kelvin's law) – derivation and numericals, Design considerations of distribution feeders, Energy losses in feeders, Economic comparison between AC and DC distribution systems, Economic comparison between overhead and underground systems.	9
UNIT IV: SUBSTATION AND EARTHING Substation: Classification of substations, Various equipment used in substation with their specifications, Bus bar arrangements in the substation Earthing: Necessity of Earthing, Types of Earthing system (Equipment and Neutral),	9

Head of Department
Department of Electrical Engg.
School of Engineering & Management

and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode),	
UNIT V: PROTECTION Objectives of distribution system protection- Types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Reclosures, Line sectionalizer, and circuit breakers.	8
UNIT VI : COMPENSATION FOR POWER FACTOR IMPROVEMENT Capacitive compensation for power factor control - Different types of power capacitors, shunt and series capacitors, Effect of shunt capacitors (Fixed and switched) - Power factor correction, capacitor allocation. Economic justification - Procedure to determine the best capacitor location.	9

Text Books:

1	TuranGonen, Electric Power Distribution system Engineering, CRC Press, 3rd Edition 2014.
2	V. Kamaraju, Electrical Power Distribution Systems, Tata Mc Graw Hill Publishing Company, 2nd edition, 2010.
3	B. R. Gupta- Power System Analysis and Design, 3 rd edition, Wheelers publication.

Reference Books:

1	G. Ram Murthy, Electrical Power Distribution hand book, 2nd edition, University press 2004.
2	A.S. Pabla, Electric Power Distribution, Tata McGraw Hill Publishing company, 6th edition, 2013
3	M.V. Deshpande, Elements of Power Station design and practice, Wheelers Publication.
4	S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Publication
5	Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi

Useful Links	
1	8 week NPTL Course on Electrical Distribution System Analysis, By Prof. N P Padhy and Late Prof. G. B. Kumbhar ,IIT Roorkee Link: https://nptel.ac.in/courses/108107112

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Department of Electrical Engineering
T.Y. B. Tech. Semester-VI
Structure and Curriculum

Scheme 2023-2027

Academic Year 2025-26

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Course Code Draft Formats

Format: {YY}{DDD}{U/P/D}{S}{T}{NN}

Abbr	: Meaning
YY	: Year -> Last 2 digits of Year
DDD	: Dept Abbr.
L	: Level -> UG/PG/Doctoral
S	: Semester Number
T	: Type -> NEP bucket (*list)
NN	: Serial Number
A	: Assessment -> Theory / Lab / Tutorial

eg. 24DSEU3A01

NEP Bucket List

NEP Course Category	Abbr.	Code
Ability Enhancement Courses	AEC	A
Basic Science Courses	BSC	B
Co-Curricular Activities	CCA	C
Audit Course	AC	D
Program Elective Courses	PEC	E
Community Engagement Project /. Field Project	CEP/FP	F
Humanities/Social Science, Management	HSSM	H
Internship	INT	I
Project	PR	J
Indian Knowledge System	IKS	K
Multi-Disciplinary Minor	MDM	M
Vocation Skill Enhancement Courses	VSEC	N
Open Elective Courses	OEC	O
Program Core Courses	PCC	P
Research Methodology	RM	R
Engineering Science Courses	ESC	S
Value Education Courses	VEC	V
Honors Courses	HON	Z

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Teaching and Evaluation Scheme from Year 2023-24 (as per NEP-2020)

Department of Electrical Engineering

T.Y B.Tech SEMESTER VI

Course Code	Course Category	Course Type	Course Name	Teaching Scheme				Theory			Practical		Total Marks
				Credits	L	P	T	ISE	MSE	ESE	INT	OE/PoE	
23ELEU6P01	Program Core Courses	PCC	High Voltage Engineering	3	3	-	-	20	30	50	-	-	100
23ELEU6P02			Power System Analysis	3	3	-	-	20	30	50	-	-	100
23ELEU6P03			Electromagnetic Engineering	2	2	-	-	-	-	50	-	-	50
23ELEU6P04			High Voltage Engineering Lab	1	-	2	-	-	-	-	25	25	50
23ELEU6P05			Power System Analysis Lab.	1	-	2	-	-	-	-	25	25	50
23ELEU6M06	Multidisciplinary Minor	MDM-4	Plug in Electric Vehicles in Smartgrid	2	2	-	-	-	-	50	-	-	50
23ELEU6E07	Professional Elective	PEC-2	Power System Economics And Control Techniques	3	3	-	-	20	30	50	-	-	100
23ELEU6E08			Microcontroller & Application										
23ELEU6E09			Industrial Automation										
23ELEU6E10		PEC-2	Power System Economics And Control Techniques Lab	1	-	2	-	-	-	-	25	-	25
23ELEU6E11			Microcontroller & Application Lab										
23ELEU6E12			Industrial Automation Lab										
23ELEU6E13		PEC-3	Illumination Engineering	4	4	-	-	20	30	50	-	-	100
23ELEU6E14			Automotive Electrical and Electronics System										
23ELEU6E15			Smart Grid Technology										
23ELEU6N16	Vocational Skills Enhancement Course	VSEC	Data Structures & Algorithms using C++	2	1	2	-	-	-	-	25	25	50
23ELEU6D17	Mandatory Course	MC	Finishing School Training VI	Audit	3*	-	-	50	-	-	-	-	Grade
23ELEU6C18	Co-Curricular Activities	CCA	Liberal Learning-I	Audit	2#	-	-	50	-		-	-	Grade
23ELEU6C19			Liberal Learning-II										
Total				**22**	**18**	**8**	**-**	**180**	**120**	**300**	**100**	**75**	**675**
23ELEU6Z03	Honors Courses/Double (Minor)	HC (Optional)	Honors Paper-III (ODL) Process Control Engineering	4	4	-	-	20	30	50	-	-	100

*Values not included in total, #-2 contact hrs per club, Min Marks for passing: 40% of total marks of individual course

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Department of Electrical Engineering

T.Y. B. Tech. Curriculum

(As Per National Education Policy 2020)

Semester-VI

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**23ELEU6P01,High Voltage Engineering**
Prerequisite/s			DCMT, AC Machines
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**20/30/50**	**ISE / MSE / ESE**	**20/30/50**
	00/00/00	**INT / OE/POE**	00/00/00
	100	**Total**	**100**

Course Description: This course provides a comprehensive understanding of high voltage engineering, focusing on breakdown mechanisms in different insulating media, generation and measurement of high voltages and currents, and testing techniques for electrical power apparatus. It equips students with analytical and practical skills required for insulation design and high voltage testing.

Course Objectives:

1	Understand the physical processes leading to electrical breakdown in gases, liquids, solids, and vacuum.
2	Learn the methods for generation of high DC, AC, and impulse voltages and currents.
3	Understand and analyze circuits used for generating high voltages such as voltage multipliers, Tesla coils, and impulse generators.
4	Explore various techniques and instruments used for accurate measurement of high voltages and currents.
5	Study testing procedures and standards for high voltage equipment like insulators, transformers, and surge arresters.
6	Develop an understanding of insulation coordination and its role in power system reliability and safety

Course Outcomes (COs):

23ELEU6P01.1	Choose the appropriate circuit for generation of high DC/AC impulse voltage and currents.
23ELEU6P01.2	Apply suitable techniques used in the measurement of high voltage DC/AC

Head of Department
Department of Electrical Engg.
School of Engineering & Management
Kasaba Bawada, Kolhapur 416006

	impulse voltage and current.
23ELEU6P01.3	Illustrate the mechanisms of breakdown processes in gases and vacuum.
23ELEU6P01.4	Summarize the breakdown mechanisms in liquid and solid insulating material.
23ELEU6P01.5	Solve the numerical on impulse generator, electrostatic voltmeter, Rogowski coil & breakdown voltages.
23ELEU6P01.6	Analyze testing methods of high voltage electrical power apparatus.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
23ELEU6P01.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU6P01.2	3	2	-	-	1	-	-	-	1	1	-	-	-	-
23ELEU6P01.3	3	-	-	-	1	-	-	-	1	1	-	-	-	-
23ELEU6P01.4	3	-	-	-	1	-	-	-	1	1	-	-	-	-
23ELEU6P01.5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
23ELEU6P01.6	3	-	-	-	-	-	-	-	-	-	-	-	2	

Content	Hrs.
Unit I: Electric Breakdown in Gases and Vacuum Ionization and Decay Processes: Ionization by Collision, Photo-ionization and Secondary Ionization Processes.Electric Breakdown in Gases: Townsends Breakdown Mechanism, Breakdown in Electronegative Gases, Time Lags for Breakdown, Streamer Mechanism of Spark, Paschen's Law, Gaseous Breakdown in Non-uniform Fields, Corona Discharges, Practical Considerations using Gases for Insulation Purposes, Mechanisms for Breakdown in Vacuum Insulation.	8
Unit II: Electric Breakdown in Liquids and Solids Conduction and Breakdown in Pure Liquids, Conduction and Breakdown in Commercial Liquids: Suspended Particle Mechanism, Cavitation and Bubble Mechanism, Stressed Oil Volume Mechanism. Breakdown in Solids: Electromechanical Breakdown, Thermal Breakdown, Electrochemical Breakdown, Breakdown due to Treeing and Tracking, Breakdown due to Internal Discharges, Breakdown in Composite Insulation.	8
Unit III: Generation of High DC Voltages Voltage Doubler Circuit, Cockcroft Walton Voltage Multiplier Circuit, Van de Graff Generator. Generation of High Alternating Voltages: Cascade	6

Head of Department
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School of Engineering & Management

Transformers, Resonant Transformers Generation of High Frequency AC High Voltages: Tesla Coils	
Unit IV: Generation of Impulse Voltages: Standard Lightning & amp; Switching Impulse, Wave shape, Single Stage and Multistage Impulse Voltage Generation, Switching Impulse Voltage Generation Circuits Generation of Impulse Current: Wave shape – Analysis of Impulse Current Generator.	7
Unit V: Measurement of High Voltages and High Currents Resistance Potential Dividers, Electrostatic Voltmeters, Chubb Fortescue Method, Surge Recorder, Sphere Gaps for Measurement of High DC, AC and Impulse Voltage Measurements, Hall Generator, Rogowski Coils.	6
Unit VI: High Voltage Testing and Insulation Co-Ordination Testing of Insulators, Testing of Bushings, Testing of Isolators and Circuit Breakers, Testing of Cables, Testing of Transformers, Testing of Surge Arresters, Insulation Coordination	7

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1.	High Voltage Engineering	M.S.Naidu and V.Kamaraju	Tata McGraw Hill Education (India) Pvt. Ltd.	Fifth	2013
2.	High Voltage Engineering	C.L.Wadhwa	New Age International Pvt. Ltd.	Third	2012
3.	High Voltage Engineering Fundamentals	E. Kuffel, W. S. Zaengl, J. Kuffel	Elsevier	Second	2012
4.	Fundamentals of High-Voltage Engineering	Ravindra Arora and Bharat Singh Rajpurohit	Wiley	First	2019

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1.	An Introduction To High Voltage Engineering	Subir Ray	Prentice Hall India Learning Private Limited	Second	2013
2.	High Voltage Technology	L.L. Alston	Oxford University Press,	First	2011
3.	High Voltage Engineering	E.Kuffel and M. Abdullah,	Pergamon Press	First	2013
4.	High-Voltage Engineering: Theory and Practice	Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy, RoshdyRadwan	Marcel Dekeer, New York	Second	2000

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Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU6P02, Power System Analysis**
Prerequisite/s			Power System
Teaching Scheme: Lecture/Tutorial/Practical			**03/--/--**
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**--/--/--**
		Total	**100**

Course Description: This course offers a foundational overview of power system analysis, covering component modeling, per-unit systems, transmission lines, and power flow analysis. Students ill learn to calculate real/reactive power, assess stability, and apply Gauss-Seidel and Newton-Raphson methods, preparing them for careers in power generation, transmission, and distribution.

Course Objectives:

1	Understand fundamental power system components and their equivalent circuits.
2	Apply the per-unit system for simplified power system analysis.
3	Analyze power flow including real/reactive power and stability in transmission lines.
4	Solve power flow problems using iterative methods like Gauss-Seidel, Newton-Raphson, and Fast Decoupled.

Course Outcomes (COs):
At the end of the course the student will be able to:

23ELEU6P02.1	Understand power system structure and component modeling using equivalent circuits.
23ELEU6P02.2	Apply per-unit system for simplifying power system calculations.
23ELEU6P02.3	Compute transmission line parameters using GMD for various configurations.
23ELEU6P02.4	Analyze power flow and determine maximum power transfer using complex power equations.
23ELEU6P02.5	Solve power flow problems using Gauss-Seidel, Newton-Raphson, and Fast Decoupled methods.
23ELEU6P02.6	Evaluate system stability and explain voltage and frequency control methods.

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
23ELEU6P02.1	3	3	-	2	2	1	-	-	2	2	-	-	3	3
23ELEU6P02.2	3	3	-	-	2	1	-	-	2	2	-	2	3	3
23ELEU6P02.3	3	3	-	3	2	-	2	-	1	-	-	-	3	3
23ELEU6P02.4	3	3	3	-	3	1	-	-	2	2	-	-	3	3
23ELEU6P02.5	3	3	-	2	-	1	3	-	2	-	-	1	3	3
23ELEU6P02.6	-	-	2	3	3	-	-	-	2	2	-	1	-	-

Content	Hrs.
UNIT I: POWER SYSTEM OVERVIEW Aspects of power system analysis, Power system components ,Equivalent Circuit representation of the System components-Alternator, Transformer, Load, Transmission line: Short, Medium and long.,Representation of power system by single line diagram, impedance diagram and reactance diagram,	6
UNIT II: PER UNIT SYSTEM Concept and significance of the per unit system in power system analysis, Selection of base values: base power (MVA) and base voltage (kV), Derivation of base current and base impedance from selected base values, Per unit representation of power system components: Generator, Transformer, Transmission Line, Load, numerical examples on per unit calculations and system modeling.	6
UNIT III: TRANSMISSION LINE POWER ANALYSIS Transmission line parameters – Resistance, Inductance, Capacitance, and Conductance and their significance, Effect of Transmission Line Length on Parameters, Inductance of single-phase line composed of solid and bundled conductors,Concept of Self GMD (Geometric Mean Radius) and Mutual GMD for inductance Effect of earth's electric field on transmission line capacitance.	7
UNIT IV: POWER FLOW ANALYSIS Concept of Complex Power ($S = VI^*$) – definition and components (Real Power P and Reactive Power Q), Derivation of complex power, real power, and reactive power at the receiving end of a transmission line using General Circuit Equation (GCE), Condition for maximum power transfer at the receiving end of the transmission line,Condition for maximum power transfer at the sending end of the transmission line,Real-time Power Flow:Grid management, with applications like dynamic load flow	8
UNIT V: POWER FLOW ANALYSIS TECHNIQUES Introduction to the Gauss-Seidel method for solving power flow problems,Handling voltage-controlled buses in the Gauss-Seidel method, Introduction to the Newton-Raphson method for power flow	7

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869 'F' Kasaba Bawada, Kolhapur 416006

analysis,Introduction to the Fast Decoupled Power Flow method, , Numerical examples for each method, Applications of power flow methods in real-world power system analysis.	
UNIT VI: POWER SYSTEM STABILITY AND CONTROL Introduction to power system stability and its importance in ensuring a reliable power supply, Classification of stability: Transient stability, Steady-state stability, and Dynamic stability, Power system control: Concepts of frequency control and voltage control, Application of power flow methods in stability analysis, Numerical examples related to power system stability	7

Text Books:

1	Hadi Saadat, 'Power System Analysis', 3 rd Edition (revised), Tata McGraw Hill Publishing Company, 2011.
2	I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', 4th Edition, Tata McGraw-Hill Publishing Company, 2011.

Reference Books:

1	Olle I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, Second Edition, 2003.
2	P. Kundur, 'Power System Stability and Control', 1st Edition, Tata McGraw Hill Publications, 2006.
3	K.Nagasarkar and M.S. Sukhija, 'Power System Analysis', 1st Edition, Oxford University Press, 2007.
4	John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', 1st Edition, McGraw Hill International Book Company, July 2017.
5	E. Mariani, S.S. Murthy, "Control of Modern Integrated Power Systems", Springer, 1997.

Useful Links	
1	Prof. A.K. Sinha, "NPTEL – Power System Analysis", Department of Electrical Engineering, IIT Kharagpur. Link: https://nptel.ac.in/courses/108105067/#.

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School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**23ELEU6PO3, Electromagnetic Engineering**
Prerequisite/s			A strong foundation in basic calculus (differential and integral) and vector algebra is essential.
Teaching Scheme: Lecture/Tutorial/Practical			**02/00/00**
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**--/--/50**
	P	**INT / OE/POE**	00/00/00
		Total	**50**

Course Description: This course introduces the fundamental mathematical and physical concepts of static and time-varying electromagnetic fields, culminating in the study of Maxwell's equations, wave propagation, and transmission lines. Students will learn to analyse electromagnetic phenomena and apply these principles to practical engineering problems.

Course Objectives:

1	This course develops foundational concepts in electrostatic and electromagnetic fields.
2	It familiarizes the students with electrical field and scalar potential, magnetic field and vector potential, Maxwell's equations, Biot-Savart Law, electrostatic boundary conditions, time varying potential.
3	This course will help students in preparing for competitive examinations.

Course Outcomes (COs): At the end of the course the student will be able to:

23ELEU6PO3.1	Catch the concepts of electrostatic and electromagnetic fields.
23ELEU6PO3.2	Apply various laws in electromagnetics to identify the nature and strength of electric and magnetic fields.
23ELEU6PO3.3	Test the boundary value conditions in electromagnetic fields.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
23ELEU6PO3.1	3	2	1	-	-	-	-	-	-	-	-	-	-	-
23ELEU6PO3.2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
23ELEU6PO3.3	3	3	2	-	-	-	-	-	-	-	-	-	-	-

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

Content	Hrs.
Unit I: Vector Analysis Vector Algebra, Rectangular Coordinate System, Vector Component, Vector Field, Dot Product, Cross Product, Circular and Cylindrical Coordinate System, Vector Calculus, Del Operator, Gradient of Scalar, Divergence of Vector and Divergence Theorem, Curl of a Vector and Stroke's Theorem, Classification of Vector Fields	6
Unit II: Electrostatic Fields Coulombs Law and Field Intensity, Electric Fields due to Continuous Charge Distributions, Electric Flux Density, Gauss's Law- Maxwell's Equation, Electric Potential, Relationship between E and V-Maxwell's Equation, Electric Dipole and Flux Lines, Energy Density in Electrostatic Fields.	7
Unit III: Magneto Static Fields and Magnetic Forces Biot- Savart's Law, Ampere's Circuital Law-Maxwell's Equation, Application of Ampere's Law, Magnetic Flux Density-Maxwell's Equation, Maxwell's Equation for Static Fields, Magnetic Scalar and Vector Potentials. Introduction, Forces due to Magnetic Torque and Moment, Magnetic Dipole.	7
Unit IV: Maxwell's Equations Introduction, Faraday's Law, Transformer and Motional Electromotive Forces, Displacement Current, Maxwell's equations in Final Forms, Time-Varying Potentials, Time Harmonic Fields.	6

Text Books:

1	William Hayt, "Engineering Electromagnetics", Mc Graw Hill.
2	R.K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill India,
3	Matthew. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press

Reference Books:

1	E.C. Jordan & K.G. Balmain, "Electromagnetic waves & Radiating Systems", Prentice Hall, India
2	K.D. Prasad, "Antenna & Wave Propagation" Satya Prakashan
3	N. Narayana Rao, "Elements of Engineering Electromagnetics", Prentice Hall

	Useful Links
1	https://archive.nptel.ac.in/courses/108/106/108106073/
2	https://archive.nptel.ac.in/courses/108/104/108104099/

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Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

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School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**23ELEU6P04, High Voltage Engineering Lab**
Prerequisite/s			DCMT Lab, AC Machine Lab
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/**25**
		Total	**50**

Course Description: This laboratory course offers hands-on experience in the generation and measurement of high voltages and currents, as well as testing the dielectric strength of various insulating materials. It emphasizes practical understanding, safety, communication skills, and professional ethics in high voltage experiments.

Course Objectives:

1	Understand and operate high voltage generation and measurement setups.
2	Examine and test the breakdown strength of air and insulating oils.
3	Perform field distribution studies using the electrolyte tank method.
4	Evaluate the insulation properties of solid dielectrics and power cables.
5	Develop skills in technical reporting and effective communication.
6	Adhere to safety, professional, and ethical standards during laboratory practices.

Course Outcomes (COs):

23ELEU6P04.1	Illustrate generation and measurement of high voltage and current
23ELEU6P04.2	Demonstrate electrical breakdown voltage of air & transformer oil
23ELEU6P04.3	Implement field mapping using Electrolyte Tank
23ELEU6P04.4	Demonstrate insulation strength of any solid dielectric material, cables
23ELEU6P04.5	Communicate effectively, both orally and in writing journals
23ELEU6P04.6	Follow professional and ethical principles during laboratory work

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
23ELEU6P04.1	3	-	-	2	-	-	-	-	-	-	-	-	-	-
23ELEU6P04.2	3	2	2	3	-	-	-	-	-	-	-	-	-	-
23ELEU6P04.3	3	-	-	3	2	-	-	-	-	-	-	-	-	-
23ELEU6P04.4	3	2	-	3	-	-	-	-	-	-	-	-	-	-
23ELEU6P04.5	-	-	-	-	-	-	-	-	-	2	-	-	-	-
23ELEU6P04.6	-	-	-	-	-	-	-	2	2	-	-	-	-	-

List of Experiments	
Expt. No.	**Name of Experiment**
1	To study & draw of impulse wave shape of sample impulse wave
2	To study of 5-stage, 150kV, and 225J impulse generator and to measure wave shape of impulse wave
3	Measurement of DC breakdown voltage of air, using sphere gap assembly
4	Measurement of AC breakdown voltage of air, using sphere gap assembly
5	To study & draw of impulse wave shape of sample impulse wave
6	To determine breakdown voltage of transformer oil
7	5 kV AC Insulation Test
8	To Measurement of Insulation Resistance by Megger
9	Simulation of impulse voltage generation
10	Simulation of impulse voltage generation

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

Text Books:

Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1.	High Voltage Engineering	M.S.Naidu and V.Kamaraju	Tata McGraw Hill Education (India) Pvt. Ltd.	Fifth	2013
2.	High Voltage Engineering	C.L.Wadhwa	New Age International Pvt. Ltd.	Third	2012
3.	High Voltage Engineering Fundamentals	E. Kuffel, W. S. Zaengl, J. Kuffel	Elsevier	Second	2012
4.	Fundamentals of High-Voltage Engineering	Ravindra Arora and Bharat Singh Rajpurohit	Wiley	First	2019

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
5.	An Introduction To High Voltage Engineering	Subir Ray	Prentice Hall India Learning Private Limited	Second	2013
6.	High Voltage Technology	L.L. Alston	Oxford University Press,	First	2011
7.	High Voltage Engineering	E.Kuffel and M. Abdullah,	Pergamon Press	First	2013
8.	High-Voltage Engineering: Theory and Practice	Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy, RoshdyRadwan	Marcel Dekeer, New York	Second	2000

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- IV
Course Code and Course Title			**23ELEU6P05, Power System Analysis Lab.**
Prerequisite/s			Power System Analysis
Teaching Scheme: Lecture/Tutorial/Practical			--/--/02
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	--/--/--
	P	**INT / OE/POE**	**25/--/50**
		Total	**75**

Course Description: This course offers a foundational overview of power system analysis, covering component modeling, per-unit systems, transmission lines, and power flow analysis. Students will learn to calculate real/reactive power, assess stability, and apply Gauss-Seidel and Newton-Raphson methods, preparing them for careers in power generation, transmission, and distribution.

Course Objectives:

1	Understand fundamental power system components and their equivalent circuits.
2	Apply the per-unit system for simplified power system analysis.
3	Analyze power flow including real/reactive power and stability in transmission lines.
4	Solve power flow problems using iterative methods like Gauss-Seidel, Newton-Raphson, and Fast Decoupled.

Course Outcomes (COs):At the end of the course the student will be able to:

1	Understand power system structure and component modeling using equivalent circuits.
2	Apply per-unit system for simplifying power system calculations.
3	Compute transmission line parameters using GMD for various configurations.
4	Analyze power flow and determine maximum power transfer using complex power equations.
5	Solve power flow problems using Gauss-Seidel, Newton-Raphson, and Fast Decoupled methods.
6	Evaluate system stability and explain voltage and frequency control methods.

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	-	2	2	1	-	-	2	2	-	-	3	3
CO2	3	3	-	-	2	1	-	-	2	2	-	2	3	3
CO3	3	3	-	3	2	-	2	-	1	-	-	-	3	3
CO4	3	3	3	-	3	1	-	-	2	2	-	-	3	3
CO5	3	3	-	2	-	1	3	-	2	-	-	1	3	3
CO6	-	-	2	3	3	-	-	-	2	2	-	1	-	-

List of Experiments

Expt. No.	Name of Experiment	Unit	CO
1	Calculate per unit values of parameters of power system components using Scilab.	II	2
2	Identify conductor types from given samples and calculate Self GMD and Mutual GMD.	III	3
3	Calculate inductance of single-phase and three-phase lines with given spacing using GMD method.	III	3
4	Calculate capacitance of single-phase and three-phase lines including effect of earth.	III	3
5	Determine real and reactive power at receiving end for a given transmission line using Scilab.	IV	4
6	Determine real and reactive power at sending end for a given transmission line using Scilab.	IV	4
7	Perform load test on model transmission line and determine efficiency.	IV	4
8	Implement Gauss-Seidel method for 3-bus power flow analysis using Scilab.	V	5
9	Implement Newton-Raphson method for 3-bus power flow analysis using Scilab.	V	5
10	Implement Fast Decoupled method for power flow using Scilab and compare	V	5

Head of Department
Department of Electrical Engg.
School of Engineering & Management

	results.		
11	Simulate the change in system stability due to variation in load and reactive power using Scilab.	VI	6
12	Watch and document working of reactive power compensation equipment (like SVC, STATCOM) – Report Preparation.	VI	6

Text Books:

1	Hadi Saadat, 'Power System Analysis', 3 rd Edition (revised), Tata McGraw Hill Publishing Company, 2011.
2	I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', 4th Edition, Tata McGraw-Hill Publishing Company, 2011.

Reference Books:

1	Olle I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, Second Edition, 2003.
2	P. Kundur, 'Power System Stability and Control', 1st Edition, Tata McGraw Hill Publications, 2006.
3	K.Nagasarkar and M.S. Sukhija, 'Power System Analysis', 1st Edition, Oxford University Press, 2007.
4	John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', 1st Edition, McGraw Hill International Book Company, July 2017.
5	E. Mariani, S.S. Murthy, "Control of Modern Integrated Power Systems", Springer, 1997.

Useful Links	
1	Prof. A.K. Sinha, "NPTEL – Power System Analysis", Department of Electrical Engineering, IIT Kharagpur. Link: https://nptel.ac.in/courses/108105067/#.

Head of Department
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School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			**T.Y. B. Tech, Semester- VI**
Course Code and Course Title			**23ELEU6M06, Plugin Electric Vehicles in Smart grid**
Prerequisite/s			Basic Electrical Engineering,Power Electronics ,Storage Systems
Teaching Scheme: Lecture/Tutorial/Practical			**02/--/--**
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**--/--/50**
	P	**INT / OE/POE**	**--/--/--**
		Total	**50**

Course Description: This course offers an overview of Plug-in Electric Vehicles (PEVs), focusing on EV architecture, batteries, charging systems, and Grid-to-Vehicle (G2V) integration. It emphasizes energy management, electric propulsion, and smart grid communication to enhance energy efficiency and grid reliability..

Course Objectives:

1	To acquire knowledge on energy exchange between storage element and power grid. □ □
2	To provide knowledge on the benefits of V2G
3	To learn the challenges in V2G integrated power system
4	To learn the impacts of EV and V2G on the power grid

Course Outcomes (COs)

1	Understand the architecture, components, and classifications of plug-in electric vehicles (PEVs).
2	Analyze battery technologies, charging methods, and battery management systems used in EVs
3	Describe electric propulsion systems and powertrain configurations used in modern electric vehicles
4	Explain the principles and infrastructure of Grid-to-Vehicle (G2V) technology and its impact on the power grid.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	-	-	-	1	-	-	-	-	-	-	-	3	3
CO2	3	2	2	1	2	-	-	-	-	-	-	-	3	3
CO3	3	2	2	2	3	1	-	-	-	-	-	-	3	3

Head of Department
Department of Electrical Engg

CO4	3	2	2	-	3	-	-	-	-	-	-	1	3	3

Content	Hrs.
Unit-I Introduction to Plug-in Electric Vehicles (PEVs) Classification: BEV, HEV, PHEV; Components of electric vehicles – battery, motor, inverter, controller; EV drive-train configurations; Advantages and challenges of PEVs; Overview of energy consumption and efficiency in electric vehicles.	6
Unit II: Battery Technologies and Charging Infrastructure Battery types for PEVs – Li-ion, NiMH, solid-state; Battery management systems (BMS); Charging levels – Level 1, Level 2, and DC fast charging; Battery performance parameters – energy density, cycle life, charging/discharging rates; Thermal management in EV batteries; Advances in battery recycling and second-life applications.	7
Unit III: Electric Propulsion and Powertrain Systems Types of electric propulsion – series, parallel, and hybrid; EV powertrain components – motor, controller, gearbox; Motor types – BLDC, PMSM, induction; Basics of regenerative braking and power electronics used in propulsion.	7
Unit-IV Grid-to-Vehicle (G2V) Technology Concept of G2V – unidirectional power flow from the grid to electric vehicles; Comparison of G2V and V2G; Communication and safety standards – IEC 61851, ISO 15118, SAE J1772; Smart charging strategies – time-of-use pricing, demand-side response, and peak load management;	6

Head of Department
Department of Electrical Engg.
School of Engineering & Management
Kasaba Bawada, Kolhapur-416006.

Text Books:

1	Advanced Electric Drive Vehicles, Ali Emadi, CRC Press 2017
2	Plug In Electric Vehicles in Smart Grids, Charging Strategies, Sumedha Rajakaruna , Farhad Shahnia and Arindam Ghosh,Springer,2015
3	ICT for Electric Vehicle Integration with the Smart Grid, Nand Kishor; Jesus Fraile-Ardanuy, IET 2020

Reference Books:

1	Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid, Junwei Lu and Jahangir Hossain, IET 2015
2	Lance Noel · Gerardo Zarazua de Rubens Johannes Kester · Benjamin K. Sovacool, Vehicle-to-Grid A Sociotechnical Transition Beyond Electric Mobility, 2019
3	https://www.iec.ch/technical-committees-and-subcommittees#tclist

	Useful Links
1	https://www.sciencedirect.com/topics/engineering/plug-in-electric-vehicle

Head of Department
Department of Electrical Engg.
School of Engineering & Management
869, 'E', Kasaba Bawada, Kolhapur-416006.

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**23ELEU5E07, Power System Economics And Control Techniques**
Prerequisite/s			Fundamental of Power system
Teaching Scheme: Lecture/Tutorial/Practical			**03/--/--**
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	--/--/--
		Total	**100**

Course Description: This course covers the economic planning, operation, and control of power systems, including load analysis, generation cost, grid operations, reserve management, and smart grid trends, with a focus on efficiency and reliability.

Course Objectives:

1	To understand the economic and operational aspects of power system generation and planning.
2	To analyze the load characteristics and apply factors affecting the cost of electricity generation.
3	To study grid interconnection, load-frequency control, and reserve management.
4	To explore emerging technologies like smart grids, demand response, and renewable integration from an economic perspective.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Analyze load curves and compute key load factors.
2	Evaluate cost components in power generation.
3	Explain generator selection and reserve planning.
4	Describe grid interconnection and frequency control.
5	Identify grid faults and assess reliability impacts.
6	Discuss smart grid economics and emerging trends.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	1	-	-	3	3
CO2	3	2	3	1	1	1	1	-	-	1	-	-	3	3
CO3	3	2	3	2	1	1	1	-	-	1	-	-	3	3

Head of Department
Department of Electrical Engg.
School of Engineering & Management
Kasaba Bawada, Kolhapur-416006

CO4	3	2	2	2	2	1	1	1	-	1	-	-	3	3
CO5	3	3	2	3	3	2	2	1	1	1	-	-	3	3
CO6	3	2	3	2	3	2	3	1	1	1	-	-	-	-

Content	Hrs.
Unit I: Fundamentals of Power System Operation and Load Analysis Load curve and load duration curve; Integrated load duration curve; Base load and peak load plants; Classification of power plants; Concepts of connected load, maximum demand, average demand, demand factor, and load factor.	7
Unit II: Power Plant Economics and Cost Introduction to power generation costs; Cost components – fixed, variable, capital, and operational costs; Plant capacity factor, plant use factor, diversity factor, and plant load factor; Choice of size and number of generating units for economic operation.	8
Unit III: Reserves and Power Station Operation Types of reserves – cold reserve, hot reserve, and spinning reserve; Firm power and standby supply; Economic load sharing among different power plants; Principles of combined operation of power stations; Role of hydro-thermal coordination.	7
Unit IV: Interconnected Power Systems and Grid Management Introduction to interconnected systems; Advantages of grid interconnection; Structure of State and National Grids; Grid frequency and voltage control; Tie-line power flow and area control error (ACE); Load frequency control (LFC) in interconnected systems.	7
Unit V: Grid Faults, Reliability, and Case Studies Causes and types of grid faults – equipment failure, natural disasters, operator error; Impact of grid faults – brownouts, blackouts, voltage collapse; Reliability indices; Major national and international blackout case studies (e.g., India 2012 blackout); Prevention and restoration strategies.	7
Unit VI: Small Power Plants and Their Economics Types of small power plants – solar PV, micro-hydro, biomass, wind, and diesel-based systems; Cost components – capital investment, fuel cost, and life cycle cost; Economic analysis – Levelized Cost of Electricity (LCOE), Net Present Value (NPV), Internal Rate of Return (IRR), and payback period; Tariff design for small-	8

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Department of Electrical Engg.
School of Engineering & Management

scale generation; Grid-connected vs. standalone systems; Case studies – techno-economic analysis of grid-tied and off-grid solar PV systems	

Text Books:

1	Mehta V.K., Rohit Mehta Principles of Power System S.Chand & Co. New Delhi, 2005, ISBN: 9788121924962
2	Gupta J.B. A course in Electrical Power. S. K Kataria and sons, New
3	Sivanagaraju S.; Satyanarayana S. Electrical Power Transmission and Distribution Pearson ISBN : 8131707911, 9788131707913

Reference Books:

1	Gupta B.R. Power System Analysis and Design S.Chand and Co. New Delhi ISBN :9788121922388
2	Kamraju V. Electrical Power Distribution System Tata Mc.GrawHill, New

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School of Engineering &Management
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Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**23ELEU6E08, Microcontroller and Applications**
Prerequisite/s			Analog and Digital Circuits
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description:
This course introduces the architecture, programming, and interfacing of microcontrollers with a focus on real-time applications. It covers instruction sets, peripheral interfacing, and system design using microcontrollers for automation, control, and embedded systems.

Course Objectives:

1	To develop basic knowledge of microcontrollers and their features
2	To provide skills for programming microcontroller for applications in Electrical Engineering.
3	To enable students to interface and program different peripherals to microcontrollers.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Explain the architecture and features of microcontrollers
2	Apply programming techniques to implement counters, timers, interrupts and other peripherals.
3	Implement the applications related to interface microcontroller with electrical and electronics systems.
4	Construct a microcontroller based application.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	-

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Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Unit	Course Contents	Hours
1	**Unit I: Microcontroller Basics** Overview of 8051/Arduino, features, Architecture, Pin out and pin functions, program memory, data memory, SFR area, PSW, Code memory space, (Internal/External), Port structure, clock circuit.	6
2	**Unit II: Programming ports and timers** Introduction to Embedded C programming, ,I/O programming, Development tools for 8051 programs, Programming Timers and counters Timer block diagram and function, Timer modes 0, 1, 2 and their Applications, Timer and Counter Programming	7
3	**Unit III: Interrupts and Serial Communication** Interrupt structure, Writing ISR, interrupt, Interrupt priorities, Programming for external interrupt. Programming timer interrupts. Serial Communication :Serial communication modes, RS232 signals of PC, Programming through Serial communication	8
4	**Unit IV: Peripheral Interfacing- I** Interfacing of microcontrollers to external peripherals and programming, LCD interfacing, Interfacing of Analog to Digital Converters and Digital to Analog Converters, Stepper motor interfacing	7
5	**Unit V: Peripheral Interfacing- II** Peripheral Interfacing- II DC motor interfacing, PWM programming using microcontrollers, Use of Arduino in Power Electronics Applications, Interfacing Temperature Sensors, Introduction to CAN protocol and its interfacing.	7
6	**Unit VI: Introduction to PIC microcontrollers** Introduction to PIC microcontrollers PIC microcontrollers, overview, Features, concepts of brown out reset, watch dog timers, configurations registers, concept of hardware-in-loop simulation, programming examples	7

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Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	"The 8051 Microcontroller and Embedded systems using Assembly and C	Muhammad Mazidi, Janice Mazidi and Rolin McKinlay,	Pearson Education	2nd	2007
2	8051 Architecture, Programming and Applications"	Kenneth Ayala ,	-	3rd	2007
3	Getting Started With Arduino - The Open Source Electronics Prototyping Platform,	Massimo Banzi and Michael Shiloh,	Maker Media	3rd	2014

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Embedded Systems and Robots-Projects using the 8051 Microcontroller	Subrata Ghoshal,	Cengage Learning,	1st	2009
2	Arduino Cookbook	Michael Margolis,	Shroff/ O'Reilly,	2nd	2012
3	PIC Microcontroller and Embedded Systems using Assembly and C for PIC18	azidi, RolinMc Kinlay and Danny Causey,	Pearson Education.	2nd	2011

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School of Engineering &Management
Kasaba Bawada, Kolhapur
Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU6E09, Industrial Automation**
Prerequisite/s			Basics of Electronics and Electrical
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description:
This course introduces students to the fundamentals of industrial automation, focusing on the application of PLCs, SCADA, and DCS in automated control systems. It emphasizes system architecture, programming, and integration of industrial communication protocols in process industries.

Course Objectives:

1	To provide knowledge of basic concepts and principles of industrial automation systems.
2	To familiarize students with the fundamentals of logic development for automation processes.
3	To develop the ability to design and simulate ladder logic programs for real-time industrial applications using PLCs.
4	To impart hands-on skills in testing, debugging, and troubleshooting of digital and analog automation programs.
5	To explore SCADA and DCS architecture and their applications in monitoring and controlling large-scale industrial operations.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Summarize the fundamental principles of industrial automation
2	Apply the concepts of fundamentals of logic for various processes of automation.
3	Analyze and formulate the requirements of appropriate ladder programs to provide solutions using PLCs.
4	Construct, debug and test the programs developed for digital and analog operations.
5	Build architecture of SCADA and explain the importance of SCADA in critical infrastructure
6	Identify the knowledge of PLC, SCADA and DCS with industrial networking protocols for process industries.

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Department of Electrical Engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs)/Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	2	2	-	2	-	-	-	-	-	-	-	-	-

Unit	Course Contents	Hours
1	**Unit I : Introduction to Automation:** Fundamentals of industrial automation, Definition and Goals of Automation, need and role of automation, evolution of automation. Types of processes, comparison, evolution of PLC, Types of Automation	7
2	**Unit II : Fundamentals of Logic:** Number systems and codes, Boolean Algebra, Logic Gates, Karnaugh map, Combinational Logic circuits-code conversion, Combinational logic optimization and design-SOP and POS form, reduction techniques	7
3	**Unit III : Programmable logic Controller:** Hardware Components, Basic PLC structure, Types of PLC, Inputs and Outputs, Factors to consider in selecting PLC, General PLC Programming Procedure, PLC Programming Languages, Processor Memory Organization, Creating ladder diagram for real time task, Mnemonic Programming Code	8
4	**Unit IV : PLC Functions:** Programming Timers, Programming Counters, Program control instructions, Data Manipulation Instructions, Math Instructions, Sequence rand Shift Register Instructions, Creating ladder diagram from process control descriptions, program editing ,commissioning and monitoring, preventive maintenance and troubleshooting	7
5	**Unit V :Introduction to SCADA systems:** Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, Second generation - Distributed, Third generation –	8

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	Networked Architecture),	
6	**Unit VI : SCADA Protocols and SCADA systems in industries:** Open systems interconnection (OSI) Model, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), Device Net, Control Net, Ether Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus).Implementation of SCADA Systems and related various applications.	8

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Programmable Logic Controllers: Principles and Application	John Webb, Resis Ronald,	Prentice hall of India	Fifth	2007
2	Programmable Logic Controllers: Programming Methods and Applications	Hackworth	Pearson India	First	2008
3	Programmable Logic Controllers	Frank Fetruzella	Elsevier India	Third	2007
4	Concept of SCADA System and its Evolution	Mini S. Thomas, John Douglas, McDonald	CRC Press	First	2015
5	Handbook of SCADA Control-System Security	Robert Radvonovsky, Jacob Brodsky	CRC Press	First	2013

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Programmable Controllers	Batten G. L	McGraw Hill Inc	Second	2005
2	Real Time Computer Control	Bennett Stuart	Prentice Hall	First	1988
3	Measurement Systems	Doebelin E. O.	McGraw-Hill International Editions	Fourth	1990
4	Practical Modern SCADA Protocols	Gordan Clark, Deem Reynders	ELSEVIER	First	2004
5	Programmable Logic Controllers with Applications	P. K. Srivstava	BPB Publications	First	2004

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Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**23ELEU6E10, Power System Economics And Control Techniques Lab**
Prerequisite/s			Fundamental of Power System
Teaching Scheme: Lecture/Tutorial/Practical			--/--/02
Credits			1
Evaluation Scheme	T	ISE / MSE / ESE	--/--/--
	P	INT / OE/POE	25/--/--
		Total	25

Course Description: This course introduces the fundamentals of satellite communication, including satellite placement, earth and space segments, and modern telecommunication systems. Key topics cover orbital mechanics, constellations, link budgets, propagation, interference, and system design considerations.

Course Objectives:

1	To understand the economic and operational aspects of power system generation and planning.
2	To analyze the load characteristics and apply factors affecting the cost of electricity generation.
3	To study grid interconnection, load-frequency control, and reserve management.
4	To explore emerging technologies like smart grids, demand response, and renewable integration from an economic perspective.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Analyze load curves and compute key load factors.
2	Evaluate cost components in power generation.
3	Explain generator selection and reserve planning.
4	Describe grid interconnection and frequency control.
5	Identify grid faults and assess reliability impacts.
6	Discuss smart grid economics and emerging trends.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	1	-	-	3	3
CO2	3	2	3	1	1	1	1	-	-	1	-	-	3	3
CO3	3	2	3	2	1	1	1	-	-	1	-	-	3	3
CO4	3	2	2	2	2	1	1	1	-	1	-	-	3	3
CO5	3	3	2	3	3	2	2	1	1	1	-	-	3	3
CO6	3	2	3	2	3	2	3	1	1	1	-	-	-	-

Internal Assessment Instructions (25 Marks)

To complete the internal assessment of 25 marks for the subject Power System Economics and Control Techniques, students are required to complete the following components:

1. One Assignment Or One Survey
2. One Visit and its Report

Guidelines:

1. Students must select topics from the suggested list provided below .Each component (Assignment, Survey, and Visit Report) should be:
2. Individually completed.
3. The Survey should involve basic data collection and analysis on a relevant topic.
4. The Visit Report must include the purpose of the visit, observations, photos (if possible), and key learning outcomes.

List of Suggested Activity :

Sr.No	Experiment	CO
1	Assignment 1:Calculate various Economical factors from the given Load Curve.	CO1
2	Assignment 2:Calculation on Commercial and Residential Consumers Load Demand	CO1,
3	Assignment 3 :Calculation on Industrial Consumers Load Demand.	
4	Survey 1: Collect information and prepare a report on latest technology used in Transmission Line.	CO2
5	Survey 2:Collect information and prepare a report on latest technology used in Distribution Substation and Distribution lines.	CO2
6	Visit-1 Visit nearby Distribution Substation and observe the Layout and write the technical details about Main transformer, CT, PT, Lightning arrester, Earthing System etc.	CO3
7	Visit-2 Visit nearby Hydro Power station and observe the Layout and write the technical details of Generator, working cycles of Turbine, Reservoir, Penstock etc.	CO4
8	Visit-3 Visit nearby Transmission line and observe the Layout and write the technical details about Main transformer, CT, PT, Lightning arrester, Earthing	CO6

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	System etc.	

Text Books:

1	Mehta V.K., Rohit Mehta Principles of Power System S.Chand & Co. New Delhi, 2005, ISBN: 9788121924962
2	Gupta J.B. A course in Electrical Power. S. K Kataria and sons, New
3	Sivanagaraju S.; Satyanarayana S. Electrical Power Transmission and Distribution Pearson ISBN : 8131707911, 9788131707913

Reference Books:

1	Gupta B.R. Power System Analysis and Design S.Chand and Co. New Delhi ISBN :9788121922388
2	Kamraju V. Electrical Power Distribution System Tata Mc.GrawHill, New

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D.Y. Patil Education Society, Kolhapur
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Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**23ELEU6E12, Microcontroller & Application Lab**
Prerequisite/s			A foundational understanding of digital electronics and basic programming concepts
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/00
		Total	**25**

C

ourse Description: This course introduces the fundamentals of microcontrollers and their practical applications using 8051 and Arduino platforms. Students will learn programming, interfacing techniques, and real-time implementation of control systems for sensors, actuators, and communication using Keil and Arduino IDEs.

Course Objectives:

1	To develop the necessary skills required for programming 8051 and Arduino microcontroller implement real world applications.
2	To understand the practical problems in electrical systems and implement programs for same. .
3	To introduce various programming softwares and implement microcontroller based applications.

Course Outcomes (COs):

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

1	Use simulation tools to analyze microcontroller based systems
2	Apply programming techniques to implement counters, timers, interrupts and other peripherals.
3	Execute programs to interface microcontrollers with electrical and electronics systems
4	Construct programs for electrical applications using microcontrollers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-	-	-

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CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	-

List of Experiments	
Expt. No.	**Name of Experiment**
1	Introduction to different Development Boards, Keil/Arduino IDE, Using Keil/Arduino IDE to assemble a program, Hex file format, Downloading and running the program
2	Demonstrate the flashing of GPIO ports of using delay.
3	Implement a 8-bit up and down counter using microcontroller.
4	Devise a running light scheme using GPIO pins of microcontroller.
5	Demonstrate the process of serial communication using 8051 and Arduino microcontroller
6	Construct a C program using 8051 to generate pulses using various timer modes
7	Execute programs to demonstrate interrupts for 8051.
8	Construct a C program to interface LCD with Arduino.
9	Devise a Arduino based relay control for single phase ac loads.
10	Construct a C program to interface stepper motor with Arduino.
11	Construct a temperature control system using Arduino
12	Demonstration of Hardware-in-loop simulation using Arduino and Matlab /Simulink

Text Books:

1	"Muhammad Mazidi, Janice Mazidi and Rolin McKinlay, "The 8051 Microcontroller and Embedded systems using Assembly and C", Pearson Education, 2nd Edition, 2007
2	"Kenneth Ayala , "8051 Architecture, Programming and Applications", 3rd Edition, 2007
3	Massimo Banzi and Michael Shiloh, Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform, Shroff/Maker Media; 3rd edition, 2014

Reference Books:

1	Subrata Ghoshal, "Embedded Systems and Robots- Projects using the 8051 Microcontroller", Cengage Learning, 1st Edition, 2009
2	Michael Margolis, "Arduino Cookbook", Shroff/ O'Reilly,2nd Edition,2012
3	Mazidi, RolinMc Kinlay and Danny Causey, "PIC Microcontroller and Embedded Systems using Assembly and C for PIC18", Pearson Education.

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_ee12/preview

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Department of Electrical Engineering

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**23ELEU6E13,** Industrial Automation Lab
Prerequisite/s			A foundational understanding of digital electronics and basic programming concepts
Teaching Scheme: Lecture/Tutorial/Practical			00/00/**02**
Credits			**01**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	00/00/00
	P	**INT / OE/POE**	**25**/00/00
		Total	**25**

Course Description: This course covers the basics of PLC and SCADA systems, focusing on ladder logic programming, sensor interfacing, and industrial automation. Students will also learn to simulate and monitor processes using SCADA tools.

Course Objectives:

1	To familiarize students with the basic components and indicators of a PLC system.
2	To enable students to write and test ladder logic programs for industrial automation.
3	To develop basic skills in designing and simulating control applications using SCADA tools.

Course Outcomes (COs):

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

1	Identify hardware components and front panel indicators of a PLC.
2	Develop and test basic ladder logic programs using timers, counters, and logic instructions.
3	Interface PLCs with sensors, actuators, and control external devices.
4	Create and simulate simple industrial automation tasks using SCADA software

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	-	-	-	2	-	-	-	-	-	-	-	-	-
CO2	3	2	3	-	2	-	-	-	-	-	-	-	-	-
CO3	3	-	3	1	2	-	-	-	-	1	-	-	-	-
CO4	3	2	2	2	3	-	-	-	-	-	1	-	-	-

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Department of Electrical Engg.
School of Engineering & Management

D.Y. Patil Education Society, Kolhapur
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School of Engineering &Management
KasabaBawada, Kolhapur
Department of Electrical Engineering

List of Experiments	
Expt. No.	**Name of Experiment**
1	Assemble various modules and component of PLC to make a PLC system.
2	Examine INPUT-OUTPUT modules
3	Execute ladder diagram for basic and universal logic gates
4	Prepare ladder diagram for different Arithmetic operations.
5	Execute ladder diagram for logical operations along with truth table.
6	Develop Ladder program for timing applications
7	Develop Ladder program for counting applications
8	Execute/Prepare all over ladder diagram for industrial process and control.
9	Use of advanced instruction for application in PLC
10	Configuring Screens, Graphics and Creating a Project and tags in SCADA_1
11	Configuring Screens, Graphics and Creating a Project and tags in SCADA_2
12	HMI(Human Machine Interface) interfacing with PLC

Note: Out of 12 experiments minimum 10 experiments should be performed

Text Books:

1	John Webb and Ronald Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall of India, 2007.
2	Hackworth, "Programmable Logic Controllers: Programming Methods and Applications", 1st Edition, Pearson India, 2008.
3	Robert Radvanovsky and Jacob Brodsky, "Handbook of SCADA Control-System Security", 1st Edition, CRC Press, 2013

Reference Books:

1	Batten G. L., "Programmable Controllers", 2nd Edition, McGraw Hill Inc., 2005.
2	Frank Petruzella, "Programmable Logic Controllers", 3rd Edition, Elsevier India, 2007.
3	Mini S. Thomas and John Douglas McDonald, "Concept of SCADA System and Its Evolution", 1st Edition, CRC Press, 2015.

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Department of Electrical Engineering

Class			**T.Y. B. Tech, Semester- VI**
Course Code and Course Title			**23ELEU6E13,** Illumination Engineering
Prerequisite/s			Basic Electrical Engineering , Basic Electronics Engineering
Teaching Scheme: Lecture/Tutorial/Practical			**03/--/--**
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	**--/--/--**
		Total	**100**

Course Description: This course covers the basics of Illumination Engineering, including light properties, sources, measurement, and design practices. It focuses on efficient lighting system design for architectural, industrial, and commercial applications.

Course Objectives:

1	To introduce the fundamentals of Illumination Engineering
2	To provide lighting sources, standard practices for illumination levels & measurement calculations for designing a system.
3	To impart technology in the analysis & design of architectural lighting system.

Course Outcomes (COs): At the end of the course the student will be able to:

1	Describe basic terms and laws in illumination engineering.
2	Classify different types of lamps used for lighting.
3	Identify indoor and outdoor illumination system components, its controls & design aspects.
4	Evaluate different lighting designs and their applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO3	3	3	2	2	2	-	2	-	-	-	-	-	-	-

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Department of Electrical Engineering

CO4	2	3	3	2	2	-	2	-	-	-	-	-	-	-

Content	Hrs.
Unit-I: Illumination Engineering Basics Necessity of illumination, visible range of light, optical system of human eye, vision-visual acuity, contrast, sensitivity, visual perception, good & bad effects of lighting, perfect level of luminance, artificial lighting, colour temperature. Definition of luminous flux, luminous intensity, Lumen output, candela, laws of illumination, light distribution curve. Glare, Colour Rendering Index	6
Unit II : Light sources Lamp materials. Discharge Lamps: characteristics of low and high mercury and Sodium vapour lamps. Low Vapour Pressure discharge lamps – Mercury Vapour lamp, Fluorescent Lamp, Compact Fluorescent Lamp (CFL), High Vapour Pressure discharge lamps - Mercury Vapour lamp, Sodium Vapour lamp, Metal , Induction lamps.	6
Unit III: Components of illumination system Ballast, igniters and dimmers for different types of lamps, Luminaries: types, factors, Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures, luminary's standard (IEC-598- Part I).	7
Unit IV : Indoor lighting Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation and factors affecting it, Illumination required for various work planes, Space to mounting height ratio, Interior illumination: Types of fixtures, DLOR and ULOR, Selection of lamp and luminance, utilisation factor, reflection factor and maintenance factor , Determination of Lamp Lumen output, Calculation of wattage of each lamp and no of lamps needed, space to mounting height ratio. Layout of lamp luminaire. Indian standard recommendation and standard practices for illumination levels in various areas.	7
Unit V: Outdoor lighting Street Lighting : level of illumination required, Types of fixtures used and their suitable application, Various arrangements in street lighting, Selection of lamp and luminaire, Calculation of their wattage, Number and arrangement, space to mounting height ratio, illumination level available on road Flood Lighting : Terms related to flood lighting, Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, space to mounting height ratio, Recommended method for aiming of lamp	6
Unit VI : Modern trends in illumination LED luminary designs, Intelligent LED,OLED,QLED fixtures, Natural light conduiting, Organic lighting system, LASERS, characteristics, features and applications, non-lighting lamps, Optical fiber, its construction as a light guide, features and applications	7

Text Books:

1	Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher - York, PA: Visions Communications
2	H. S. Mamak, "Book on Lighting", Publisher International lighting Academy

Reference Books:

1	National Lighting code 2010(SP 72:2010)

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School of Engineering & Management

2	M. A. Cayless, A. M. Marsden, "Lamps and Lighting", Publisher-ButterworthHeinemann(ISBN978-0-415-50308-2)

Class			T.Y. B. Tech, Semester- VI
Course Code and Course Title			**23ELEU6E14, Automotive Electrical and Electronics Systems**
Prerequisite/s			Basic Electrical and Electronics Circuits
Teaching Scheme: Lecture/Tutorial/Practical			**03**/00/00
Credits			**03**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description:
This course introduces the fundamental concepts of automotive electrical and electronic systems. It covers wiring, batteries, charging systems, starting and ignition systems, lighting, dashboard instruments, chassis electronics, and components of electric and hybrid vehicles along with sensors. The course emphasizes system operation, diagnostics, and preventive maintenance.

Course Objectives:

1	To understand the basic components and wiring of automotive electrical systems.
2	To learn about batteries, charging systems, and their testing methods.
3	To explore lighting, dashboard instruments, and chassis electrical systems.
4	To study electric and hybrid vehicle components and related sensors.

Course Outcomes (COs):
At the end of the course the student will be able to:

1	Explain basic automotive electrical components, wiring, and starting systems.
2	Describe batteries, charging systems, and dashboard instruments.
3	Identify functions of chassis electrical and lighting systems.
4	Describe components of electric and hybrid vehicles and their sensors.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	3	2	-	-	2	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	2	-	-	-	-	-	-	-	-	-
CO3	2	3	2	-	2	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	3	-	1	-	-	-	-	-	-	-

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D.Y. Patil Education Society, Kolhapur
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School of Engineering &Management
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Department of Electrical Engineering

Unit	Course Contents	Hours
1	**Unit 1: Automobile Electrical Components and Wiring** Introduction to basic automotive electrical and electronic systems. Construction, working, and applications of electrical components such as switches (SPST, SPDT, ganged switch, mercury switch), relays, solenoids, buzzers, and resistors. Testing of circuit defects including open circuit, short circuit, shorts to ground, and voltage drop. Understanding of automotive wiring and lighting circuits Introduction to wiring diagrams for headlight, turn indicators, horn, windshield wiper, and stop light.	7
2	**Unit 2: Automotive Battery and Charging System** Study of battery types: lead-acid, maintenance-free, hybrid, dry cell, and lithium-ion. Overview of battery construction, working, ratings, and specifications. Battery testing methods: terminal test, leakage test, specific gravity test, open circuit test, and drain test. Factors affecting battery life: internal short circuit, overcharging, and sulphation.	6
3	**Unit 3: Starting and Ignition Systems** Study of starting system layout, components, and functions. Types of starter drives: bendix drive, overrunning clutch, and integrated starter generator. Basic starting system tests: quick test, current draw, and resistance tests. Overview of ignition systems: electronic ignition with transistor, magnetic pickup, optical, and Hall effect triggering. Basics of computer-controlled and distributor-less ignition systems with block diagrams.	7
4	**Unit 4: Chassis Electrical systems** Antilock brakes (ABS), Active suspension, Traction control, Electronic control of automatic transmission, other chassis electrical systems, Central locking, Air bags and seat belt tensioners, seat heaters.	7
5	**Unit 5: Lighting system and Dashboard Instruments** Principle of automobile illumination, head lamp mounting and construction, sealed beam auxiliary lightings, horn, windscreen-wipers, signaling devices, electrical fuel pump, fuel, oil and temperature gauge, speedometer, odometer, etc. (Dash board instruments)	6
6	**Unit 6: Electrical and hybrid vehicles Components of an EV** EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV. Transduces and sensors Definition and classification, principle of working and application of various light sensors,	8

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Department of Electrical Engineering

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
01	Automobile Electrical and Electronic systems	Tom Denton	SAE publication	-	2000
02	Automotive Electrical Equipment	P.M. Kohli	Tata McGraw Hill, New Delhi.	2nd	-

Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Automotive Electronic Systems	Ulrich Adler, Robert Bosch	GMBH,	-	1995.
2	Automobile Electrical Equipment	A.P. Young & Griffith	ELBS &NewnesButterworths, London	-	-

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Class			T.Y. B. Tech, Semester- V
Course Code and Course Title			**23ELEU6E15, Smart Grid Technology**
Prerequisite/s			Network Analysis
Teaching Scheme: Lecture/Tutorial/Practical			**04**/00/00
Credits			**04**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**20/30/50**
	P	**INT / OE/POE**	00/00/00
		Total	**100**

Course Description: This course covers the fundamentals and advanced concepts of smart grids, including architecture, AMI, renewable integration, demand-side management, energy storage, and cybersecurity. It emphasizes the shift from traditional to intelligent, automated, and sustainable power systems..

Course Objectives:

1	Understand the evolution, need, and functions of smart grids and global and Indian developments.
2	Describe smart grid technologies and their roles in automation, electric vehicles, and energy storage.
3	Understand smart metering and AMI concepts and apply them in automation and energy monitoring.
4	Understand micro-grid architecture and its integration, control, and interaction with smart grids.

Course Outcomes (COs): At the end of the course the student will be able to:

1	Understand to Differentiate Conventional and Smart Grid.
2	Identify the need of Smart Grid, Micro Grid, Smart metering, Smart storage, Hybrid Vehicles,
3	Evaluate the design, operation, and integration challenges of Micro grids with renewable sources in smart energy systems.
4	Evaluate power quality issues, monitoring systems, and mitigation methods in smart grids with renewable energy integration.
5	Comparing and getting acquainted with emerging technologies and current professional issues in electric Grid
6	Compare various communication technologies and architectures used in Smart Grids and identify their role in ensuring grid security and efficiency.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	3	2	2	2	2	1	2	1	-	1	-	2	1	-
CO2	3	3	2	2	3	2	3	1	-	1	1	3	1	1
CO3	2	2	2	1	2	2	2	1	1	2	1	3	2	2
CO4	2	2	2	2	2	2	3	1	1	2	2	3	2	-
CO5	3	3	2	2	3	2	3	1	-	1	1	3	1	-
CO6	2	2	2	1	3	2	2	1	1	3	2	3	-	-

Content	Hrs.
Unit I: Introduction to Smart Grid Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Drivers of SG in India, Challenges for SG,Difference between conventional & smart grid, Smart Grid Vision & Roadmap for India, Concept of Resilient and Self Healing Grid, Present development & International policies in Smart Grid, Smart Cities, Pilot projects in India.	7
Unit II: Smart Grid Technologies Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Phase Measurement Unit(PMU).Smart Substations, Substation and Feeder Automation, application for monitoring, protection and control, Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid(V2G), Grid to vehicles(G2V), Smart storage technologies – Battery(flow and advanced), SMES, Super Capacitors, Pumped Hydro, Compressed Air Energy Storage(CAES) and its comparison, Optimal Location of PMUs for Complete Observability.	8
Unit III: Smart Meters and Advance Metering Infrastructure Introduction to Smart Meters, Advanced Metering Infrastructure (AMI), Real Time Prizing, Automatic Meter Reading (AMR), Outage Management System (OMS) Smart Sensors, Smart Appliances, Home & Building Automation, Geographic Information System (GIS).	7
Unit IV: Microgrids Concept of Microgrid, need & applications of Microgrid, Microgrid Architecture, DC Microgrid, Formation of Microgrid, Issues of interconnection, protection & control of Microgrid, Integration of renewable energy sources, Smart Microgrid, Microgrid and Smart Grid Comparison, Smart Microgrid Renewable Green Energy System, Cyber Controlled Smart Grid	7
Unit V: Power Management in Smart Grid Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web	7

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based Power Quality monitoring, Power Quality Audit.	
Unit VI: Communication Technology for Smart Grid Communication Architecture of SG, Wide Area Measurement System (WAMS), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN).Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line(BPL), IP based protocols	8

Text Books:

1	Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2	Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press
3	JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley

Reference Books:

1	Nikos Ziargyriour, "Micro grid, Architecture and Control", IEEE Press, Wiley
2	Yang Xiao, "Communication and Networking in Smart Grids", CRC Press, Taylor and Francis group
3	Lars T. Berger and Krzysztof Iniewski, "Smart Grid-Applications, Communications and Security", Wiley
4	Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert
5	"Substation Automation (Power Electronics and Power Systems)", Springer

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Class			**T.Y. B. Tech, Semester- VI**
Course Code and Course Title			**23ELEU6N16, Data Structures & Algorithms using C++**
Prerequisite/s			Basic programming knowledge and an understanding of fundamental data types
Teaching Scheme: Lecture/Tutorial/Practical			**01/00/02**
Credits			**02**
Evaluation Scheme	**T**	**ISE / MSE / ESE**	**50/--/--**
	P	**INT / OE/POE**	**--/--/--**
		Total	**50**

Course Description: This course introduces fundamental data structures like arrays, linked lists, stacks, queues, trees, and graphs, along with essential algorithms for searching and sorting. Students will learn to implement these structures and analyse the efficiency of these algorithms.

Course Objectives:

1	Inculcate basic principles and concepts of data structures in student.
2	Familiarize students with commonly used data structures and their associated algorithms used in industry.
3	Apply data structures and algorithms to solve programming problems efficiently.
4	Enhance problem-solving skills through practical implementation and programming assignments.

Course Outcomes (COs): At the end of the course the student will be able to:

1	Analyze the time and space complexity of fundamental sorting and searching algorithms.
2	Comprehend the fundamental concepts of linked lists and implement basic operations on them.
3	Apply linear data structures such as stacks and queues to solve various computational problems.
4	Utilize tree and graph data structures and their traversal techniques for efficient problem-solving.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	3	3	1	2	1	-	-	-	1	-	-	1	-	-
CO2	3	2	2	1	1	-	-	-	1	-	1	2	-	-
CO3	3	3	2	1	2	-	-	-	1	-	1	2	-	-
CO4	3	3	3	2	2	-	-	-	1	-	1	2	-	-

Content	Hrs.
Unit I: Introduction to Data Structures Data Structures, Types of data structure, Matrix representation using arrays: Row and column major, operations on matrices, Sparse Matrix, Sorting techniques with time complexity: Bubble sort, Insertion sort, Merge sort, Quick sort Searching techniques with time Complexity: Linear search, Binary search	4
Unit II: Linked List Introduction to linked list, Representation of Linked Lists in Memory, Singly Linked List, Doubly Linked List, Circular Linked List, Circular, Operations on linked list.	4
Unit III: Stack and Queue **Stack**: Introduction, Array Representation of Stack, Linked Representation of Stack, Applications of stack.**Queue**: Introduction, Array Representation of Queue, Linked list representation of Queue, Types of Queues: Circular Queue, Priority Queue, Applications of Queue.	4
Unit IV: Trees and Graphs asic trees concept, Binary tree representation, Binary tree operation, Binary tree traversal, Binary search tree implementation, Threaded Binary tree. Basic concepts, Graph Representation, Graph traversal. Applications of trees & graphs.	4

List of Experiments	
Expt. No.	**Name of Experiment**
1	Write a C++ program to perform insertion, deletion, traversal operations on an array.
2	Write a C++ program to implement Linear and Binary Search algorithms.
3	Implement the Bubble Sort algorithm in C++ to sort an array of integers.
4	Write a C++ program to implement the Insertion Sort algorithm for sorting an array of integers.
5	Implement the Merge Sort algorithm in C++ to sort an array of integers.
6	Write a C++ program to perform insertion, deletion and traversal operations on singly linked list.
7	Write a C++ program to perform insertion, deletion and traversal operations on doubly

Head of Department
Department of Electrical Engg.
School of Engineering & Management

	linked list.
8	Implement a stack data structure in C++ using an array. Include the push, pop, peek, and isEmpty operations.
9	Implement a queue data structure in C++ using a linked list. Include the enqueue, dequeue, peek, and isEmpty operations.
10	Write a C++ program for Binary tree traversal (Pre-order, Post-order, In-order traversal)
11	Write a C++ program to perform Insertion, traversal, search operations on Binary Search tree.

Text Books:

1	S. Lipschutz , 'Data Structures with C', Tata McGraw-Hill
2	Horowitz Ellis, Sahani –'Fundamentals of Data Structures in C++' -, Universities Press Publication
3	Richard F. Gilberg and Behrouz A. Forouzon, 'Data Structures- A Pseudocode Approach with C', Cengage Learning 2rd 2004 2 Data

Reference Books:

1	Michael T Goodrich –'Data Structures and Algorithms in C++' – 2nd Edition –Wiley Publication
2	Mark Allen Weiss -' Data Structures and Algorithm Analysis in C++ '-3rd Edition - Pearson Publication
3	R. Hubbard – 'SCHAUM'S OUTLINE OF DATA STRUCTURES WITH C++ '–. 1st Edition – McGraw Hill Education

	Useful Links
1	https://www.youtube.com/results?search_query=data+structure+nptel+course

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