D Y PATIL
DEEMED TO BE
UNIVERSITY

SCHOOL *of* ENGINEERING
& MANAGEMENT
KOLHAPUR

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

Scheme 2023-2027

Academic Year 2025-26

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

D.Y. PATIL EDUCATION SOCIETY
Deemed to be University
Kasba Bawada, Kolhapur
School of Engineering & Management
KOLHAPUR

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

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

D.Y. PATIL EDUCATION SOCIETY
Deemed to be University
Kasba Bawada, Kolhapur
School of Engineering & Management
KOLHAPUR

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

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**

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

D.Y. PATIL EDUCATION SOCIETY * Deemed to be University * Kasba Bawada, Kolhapur * School of Engineering & Management * KOLHAPUR *

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

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

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

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
KasabaBawada, 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
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

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

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

Head of Department
Department of Electrical Engg.
School of Engineering & Management
[illegible], Kasaba Bawada, Kolhapur-416006

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

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

Head of Department
Department of Electrical Engg.
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**

Head of Department
Department of Electrical Engg.
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

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
KasabaBawada, Kolhapur
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.

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
KasabaBawada, 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
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
Department of Electrical Engg.
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

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

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

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

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

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

(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

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

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
KasabaBawada, Kolhapur
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

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
KasabaBawada, Kolhapur
Department of Electrical Engineering

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

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
KasabaBawada, 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
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.

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
KasabaBawada, Kolhapur
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

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
KasabaBawada, Kolhapur
Department of Electrical Engineering

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.

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
KasabaBawada, 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
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

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

	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

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
KasabaBawada, Kolhapur
Department of Electrical Engineering

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.

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
KasabaBawada, 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
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.

Head of Department
Department of Electrical Engg.
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

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
KasabaBawada, Kolhapur
Department of Electrical Engineering

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.

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
KasabaBawada, 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
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

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
KasabaBawada, Kolhapur
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	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
KasabaBawada, Kolhapur
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

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
KasabaBawada, Kolhapur
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

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
KasabaBawada, Kolhapur
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		-	-	-	-	-	-	-	-	-	-	-

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

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

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- 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.

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
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
869 'E' Kasaba Bawada, Kolhapur

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

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

D Y PATIL
DEEMED TO BE
UNIVERSITY

SCHOOL *of* ENGINEERING & MANAGEMENT
KOLHAPUR

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

Scheme 2023-2027

Academic Year 2025-26

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

D.Y. PATIL EDUCATION SOCIETY
Deemed to be University
Kasba Bawada, Kolhapur
School of Engineering & Management
KOLHAPUR

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

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

D. Y. PATIL EDUCATION SOCIETY ★ Deemed to be University ★ Kasba Bawada, Kolhapur ★ School of Engineering & Management ★ KOLHAPUR ★

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

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

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

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

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

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- 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/#.

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			**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.

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

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/

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			**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.

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
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.

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

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
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			**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

Head of Department
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

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			**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	-	-	-	-	-	-	-	-	-	-	-

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

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

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

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

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- 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.

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	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

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

	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

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

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			**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.

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
KasabaBawada, 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	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

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

	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

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
KasabaBawada, Kolhapur
Department of Electrical Engineering

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**

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.

C

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	-	-	-	-	-	-	-	-	-

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

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

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
KasabaBawada, Kolhapur
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	-	-	-

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

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
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.

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
KasabaBawada, Kolhapur
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	-	-	-	-	-	-	-

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

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
KasabaBawada, Kolhapur
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)

Head of Department
Department of Electrical Engg.
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	-	-	-	-	-	-	-

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

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
KasabaBawada, Kolhapur
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

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

D.Y. Patil Education Society, Kolhapur
(Deemed to be University)
School of Engineering &Management
KasabaBawada, Kolhapur
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	-	-

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

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

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.

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
KasabaBawada, 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
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

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

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

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			**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.

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	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

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