Teaching and Evaluation Scheme from year 2023-24

Third Year B. Tech. Program in Electrical Engineering (Semester V)

Semester V Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	Category	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
1	PC-VII	EEPC3001	Control Systems- I	3	-	-	3	15	15	10	60	100
2	PC-VIII	EEPC3002	Digital Circuits	3	-	-	3	15	15	10	60	100
3	PC- IX	EEPC3003	Power System-II	3	-	-	3	15	15	10	60	100
4	PE- I			3	-	-	3	15	15	10	60	100
5	HSMC-II			3	-	-	3	15	15	10	60	100
6	OE-III			3	-	-	3	15	15	10	60	100
7	PC-VII	EEPC3004	Lab Control Systems -I	-	-	2	1	25	-	-	25	50
8	PC-VIII	EEPC3005	Lab Digital Circuits	-	-	2	1	25	-	-	25	50
9	PC- IX	EEPC3006	Lab Power System-II	-	-	2	1	25	-	-	25	50
			Total	**18**	**-**	**06**	**21**	**165**	**90**	**60**	**335**	**750**

Semester VI

Semester VI Course				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	Category	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
1	PC-X	EEPC3020	Microcontroller & Applications	3	-	-	3	15	15	10	60	100
2	PC-XI	EEPC3021	Control Systems -II	3	-	-	3	15	15	10	60	100
3	PC XII	EEPC3022	Power Electronics	3	-	-	3	15	15	10	60	100
4	OE-IV			3	-	-	3	15	15	10	60	100
5	HSMC-III			3	-	-	3	15	15	10	60	100
6	ESC	EEES3023	Machine Learning	3	-	-	3	15	15	10	60	100
7	PE- II(Lab)			-	-	2	1	25	-	-	25	50
8	PC-X	EEPC3024	Lab Microcontroller & Applications	-	-	2	1	25	-	-	25	50
9	PC XII	EEPC3025	Lab Power Electronics	-	-	2	1	25	-	-	25	50
10	ESC	EEES3026	Lab Machine Learning	-	-	2	1	25	-	-	25	50
			Total	**18**	**-**	**08**	**22**	**190**	**90**	**60**	**460**	**800**

#Industrial Training will be done after IV, VI semester for which credit will be awarded in VII semester.

ISE I, II are compulsory test. ISE III will be based on any one of the following components - Surprise Test, Declared Test, MCQ Test, Assignments, PPT presentation, Quiz, Fabrication of working model, etc. However, the course coordinator shall declare the method of evaluation at the beginning of the course.

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Program Outcomes (Graduates Attributes (GAs) as per NBA)

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design systems components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, social and environmental consideration. To use modern engineering IT tools to solve and model electrical engineering problems.

4. Conduct investigations of complex problems: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of the limitations

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and consequent responsibility relevant to the professional engineering practice.

7. Environment and sustainability: Understands the impact of professional engineering solutions in societal and environmental contexts, and demonstrates the knowledge of and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and multidisciplinary settings.

10. Communications: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentations, make effective presentations and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.

12. Life-long learning: Recognize the need for and have preparation and ability to engage in independent and life-long learning in the broadest context of technological changes.

Program Specific outcomes of EED of GECA (From institute website)

PSO1. Identify, formulate problems in power system domain and apply subject knowledge to provide solutions

PSO2. Classify, make use of various electrical machines, power electronics circuits and electrical drives for engineering applications and investigate for suitability and troubleshooting

PSO3. Analyze and apply concepts of electronics, control systems and instrumentation for engineering applications

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EEPC3001: Control Systems - I	
Teaching Scheme Lectures : 3 Hrs./Week Tutorial : Nil Total Credits : 3	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End Semester Exam : 60 Marks

Course Description: This is the course in Electrical Engineering which introduces the basic concepts of transfer function, signal flow graph, block diagram reduction & basic control system components and specify control System performance in Frequency domain and time domain analysis.

Course Objectives:

The objectives of the course are to

1. Understand the modeling of linear time variant/ invariant systems using transfer function
2. Explain operation of various control system components
3. Describe and analyze performance of system in Time domain
4. Define the concept of stability and its assessment for linear-time invariant systems and design simple feedback controllers
5. Distinguish the stability and its assessment for linear-time invariant systems in Frequency domain

Course Outcomes: After completing the course, students will able to:

CO1	Compute transfer function of linear time invariant systems
CO2	Describe operation of various control system components
CO3	Analyze and evaluate linear systems in time domain
CO4	Explain and evaluate stability of linear systems in time domain and describe various industrial controllers
CO5	Evaluate stability of linear systems in frequency domain

UNIT- I	**Transfer Functions and Block Diagrams:** Basic components and classifications of general control systems, physical –non physical, Linear/Nonlinear, Continuous/ On-off, Analog/ Digital, Open loop and closed-loop systems. Mathematical models of physical systems, Electrical analogy of non-electrical systems, Force-current and force voltages analogies. Definition of transfer function, Block diagram representation of physical systems, Block diagram reduction techniques, Signal flow graphs and Mason's gain formula, Transfer function of electrical, Mechanical and electromechanical systems
UNIT- II	**Control System Components:** Error detectors: Potentiometers, Synchros, Optical rotary encoders, DC and AC servomotors, AC and DC Tacho-generators

UNIT-III	**Time-Domain Analysis:** Standard test signals, Type and order of a system, Time- domain specifications, Steady state error and definition of error time constant, Dynamic-error-coefficients, Transient response of second order systems, Performance indices
UNIT-IV	**Stability** Nature of system response from the location of roots in the s-plane of characteristic equation, Absolute and relative stability, Routh's-Hurwitz criterion and its applications in special cases. **Stability in Time domain:** Definition of root-locus, Rules for plotting root-loci, Root contours, Stability analysis using root locus, effect of addition of poles and zeros, Root locus for systems with transportation lag, Computer aided root locus. **Industrial Controllers:** PD, PI, PID controllers, tuning methods, pneumatic and hydraulic controllers, ISE, IATE
UNIT- V	**Frequency-Domain Analysis** Frequency-domain specifications, Correlation between time-and frequency-domain responses, Polar plot, Bode plot, Determination of gain- and phase- margin from Bode plot, Effect of gain variation and addition of poles and zeros on Bode plot, Determination of transfer function from the given Bode plot, Bode plot for all-pass, minimum-phase, non-minimum phase systems. Computer aided Bode plot, Nyquist stability criterion, Determination of absolute and relative stability by the application of Nyquist Criterion, Effect of addition of poles & zeros on the shape of the Nyquist plot, Stability of linear control systems with time delay.

Detailed Syllabus:

Text Books:

1. I. J. Nagrath & M. Gopal, "Control System Engineering" New Age International.
2. Xavier," Control system Engineering", S. Chand Publication.
3. Norman Nice," Control System Engineering", John Wiley and Sons.

Reference Books:

1. Katsuhiko Ogata, " Modern Control Engineering", Prentice Hall.
2. Benjamin Kuo, "Automatic Control System", Prentice Hall.
3. John J. D'Azzo, C.H. Houpis, "Linear Control System Analysis and Design", McGraw Hill.

Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1		1	1	1	1	1	1	1		1	3
CO2	3	2	-			1		1	1	1	2	1		1	3
CO3	3	2	1	1		1	1	1	1	1	1	1		1	3
CO4	3	2	1	1		1		1		1	1	1		1	3
CO5	3	2	1	1		1	1	1	1	1	1	1		1	3

1 – Low 2 – Medium 3 – High

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ISE I, II compulsory Tests

ISE III Assessment: It is of 10 marks is based on anyone / or combination of few of following,

1. Mini Project/ Model Assessment
2. Finding solutions of various problems on control systems using MATLAB
3. PPT Presentation on various applications of control systems in Industries etc
4. MCQ

Sample Assessment Pattern:

Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember	5	5	4	5
K2	Understand	5	5	2	10
K3	Apply	5	5	4	25
K4	Analyze				15
K5	Evaluate				5
Total Marks 100		15	15	10	60

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2	K1+K2+K3	K1+K2+k3	K1+K2
	C01	C02	C03	CO4	CO5
ISE I, II (30 Marks)	06	06	06	06	06
ISE III (10 Marks)	2	2	2	2	2
	12	12	12	12	12

Designed by
Dr. SandhyaKulkarni

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EEPC3002: Digital Circuits	
Teaching Scheme Lectures : 3 Hrs./Week Total Credits : 3	**Examination Scheme** ISE 1 : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Description: Digital Circuits is a one-semester course compulsory to all third year engineering students of the department.

Course Objectives:

The objectives of the course are to-

1. Provide the knowledge to understand common forms of number representation, logic gates and families, binary codes and Boolean algebra and to enable student to understand the logical operation of simple digital circuits
2. Enable student to construct combinational logic circuits
3. Design and implement counter circuits
4. Design and implement shift registers, multiplexers and de-multiplexers
5. Explain A/D converters and D/A converters

Course Outcomes: After completion of this course students will be able to

CO1.	Explain digital codes, logical operations and number systems
CO2.	Design combinational logic circuits and also to perform lab work
CO3.	Facilitate the construction of sequential logic circuits like flip-flops, registers, counters
CO4.	Explain architecture of microprocessor and write assembly language programs
CO5.	Describe various types of memory devices

Detailed Syllabus

UNIT-I	**Fundamentals of Digital Systems and logic families** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL.

UNIT-II	**Combinational Logic Circuits** Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, SOP and POS form Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder IC 7483, excess-3 adder, BCD to seven segment decoder, IC 7447., ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization
UNIT-III	**Sequential circuits and systems** A one-bit memory, the circuit properties of bi-stable latch, the clocked SR flip flop, J- K,T and D-types flip-flops, applications of flip-flops, shift-registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters
UNIT-IV	**Evolution of Microprocessors** Intel 8085 Microprocessor Architecture, Addressing modes, Timing diagrams, Classification of Instructions, Instruction Set. Programming 8085: Assembly Language Programs Based on Arithmetic (8/16/32 Bit) Logical, Branch and Machine Control Group of Instructions, Programs for Counting Time Delays, Stack operation, Programs Illustrating the use of Stacks and Subroutines
UNIT-V	**Interrupts and Memory Organization** Interrupt Structure of 8085, Programs Illustrating the use of Hardware interrupts, Various Hardware and Software Interrupts, Types of data Transfer, Synchronous and Asynchronous Data Transfer, Interrupt Driven Data Transfer, Data Transfer by polling, Parallel Data Transfer. Types of Memory, Static/Dynamic.ROM/ RAM,PLD,CPLD,FPGA, Memory design

Text/References:

1. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
2. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
3. R. A. Gaonkar, "Microprocessor Architecture Programming and Applications with 8085",Penram Publishers
4. B Ram, "Fundamentals of Microprocessors and Microcomputers", Dhanpat Rai and Sons, New Delhi, IV Edition.
5. Malvino and Leach, "Digital Principles and Applications", McGraw Hill Publications

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Mapping Of Course Outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3		1	2	1		1		1				1	1
CO2	3	1			2	1		1		1				1	1
CO3	3	2			2	1	1	1		1				1	1
CO4	3	3		1	1	1	1	1		1				1	1
CO5	3	3	1	1	2	1	1	1		1				1	1

1 – Low 2 – Medium 3 – High

Sample Assessment Table:

Assessment Tool	K1+ K3+K4	K1+K2+K3	K1+K3+K4+K5	K1+K3+K4	K1+K2
Unit wise Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I, II(30 Marks)	10	10	10		
ISE III 10 Marks	2	3	5	5	5
End Semester Exam 60 Marks	12	12	12	12	12

Teaching Strategies: The teaching strategy is planed through the lectures, tutorials, NPTEL lectures and home Assignments

ISE I, II are compulsory tests.

ISE III Assessment: It is based on attendance of the student and any one component of the following. However, the course coordinator has to announce assessment components at the beginning of the course. 1) Multiple Choice Question Test,2) PPT presentation,3) Quiz 4) Surprise test, 5) Design and fabrication of working model, 6) Home assignments

Sample Assessment Pattern:

Level No.	**Knowledge Level**	**ISE I 1**	**ISE II**	**ISE III Assessment**	**End Semester Examination**
K1	Remember	5	5	5	30
K2	Understand			5	
K3	Apply	5	5		12
K4	Analyze	5	5		6
K5	Evaluate				12
Total		15	15	10	60

Designed by Dr. Sandhya Kulkarni

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EEPC3003: Power System-II	
Teaching Scheme Lectures: : 03 Hrs./Week Tutorial : 00 Total Credits : 03	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End Semester Exam : 60 Marks

Course Description: Electrical Power System is growing at a faster pace. An Electrical Engineer should be able to solve the power system network under normal & abnormal conditions. This course is aimed to cover from the fundamentals of Power System such as line constants, performance of transmission lines to the analysis part such as symmetrical & unsymmetrical fault analysis & different power flow methods.

Course Objectives:

The objectives of the course are to

1. Provide the knowledge to understand line constants.
2. Analyze sending end voltage, receiving end voltage, transmission efficiency and regulation in case of transmission line.
3. Develop and solve the positive, negative and zero sequence network for a given system.
4. Formulate the power flow problems using load flow methods.
5. Recognize the common cause of faults in the power system.

Course Outcomes :

After completing the course, students will able to:

CO1	Estimate the parameters of the transmission line, understand its operation, role and select the model for various studies.
CO2	Be able to model and analyze different power system components like generators, transformers etc.
CO3	Power flow studies and interpret the results using commonly available Perform techniques.
CO4	Analyze symmetrical and unsymmetrical faults on power system, compute fault currents
CO5	Analyze the concept of steady state and transient stability, its evaluation and its importance

Detailed Syllabus:

UNIT- I	**Performance of Transmission Lines:** Representation and performance of short, medium line- nominal T and nominal π method; long transmission line–rigorous solution, Voltage, current waves, evaluation of ABCD constants interpretation of long line equations, equivalent T and π representation, Ferranti effect, power flow through transmission line, surge impedance loading of transmission line, methods of voltage control.

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UNIT- II	**Representation of Power System Components:** Representation of Power System Components: Power in single-phase and 3 phase a. c. circuits. complex power flow through transmission line, balanced three phase circuits, balanced three phase power, one line diagram, impedance and reactance diagrams of a power system, per unit system, Synchronous generators: generator model, steady state characteristics, power transformer: Three phase power transformer, synchronous machine transients, determination of transient constants, DC component of stator currents. per unit representation of transformers, synchronous machines, representation of loads
UNIT- III	**Power Flow Studies:** Introduction, network model formulation, formation of bus admittance matrix, Power flow problem, Iterative methods of power flow such as Gauss, Gauss-Seidel, Newton-Raphson method, decoupled and fast decoupled methods, comparison of power flow methods, power flow simulation software
UNIT- IV	**Symmetrical & Unsymmetrical Fault Analysis:** Fundamentals of symmetrical components, sequence impedance and sequence networks of star connected loads, transmission lines, synchronous machines and transformer, sequence networks of a loaded generator, single line to ground (L-G), Line to line (L-L), double line to ground (L-L- G) faults, unbalanced fault analysis of above faults using bus impedance matrix, bus voltages and line currents during fault
UNIT- V	**Power system stability:** Steady-state and transient stability concepts, rotor dynamics and swing equation, equal area criterion, step by step solution of swing curve, multi-machine stability, factors affecting transient stability. Control of voltage and reactive power: Necessity, Various Methods, Load Frequency Control: Load frequency problem, speed governing system, automatic voltage control

Text and Reference Books:

1. C. L. Wadhawa , “Electrical Power System”, John Wiley & Sons
2. Hadi Saadat, “ Power System Analysis”, Tata McGraw-Hill
3. I. J. Nagrath & D. P. Kothari, “Modern Power System Analysis”, Tata McGraw-Hill
4. W.D. Stevenson and J.J. Grainger, “Power System Analysis”, McGraw-Hill
5. W.D. Stevenson, “Elements of Power System Analysis”, McGraw-Hill
6. W.D. Stagg & A.H. El-Abiad, “Computer Methods in Power System Analysis”, McGraw-Hill
7. Elgerd O. I., “Electrical Energy System Theory”, McGraw-Hill

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Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS1 3	PS1 4	PS1 5
CO1	3	2	1	1	1				1	1		1	3		
CO2	3	2	1	1	1	1			1	1		1	3		
CO3	3	2	1	1	1				1	1		1	3		
CO4	3	2	1	1	1	1			1	1		1	3		
CO5	3	2	1	1	1	1			1	1		1	3		

1 – Low 2 – Medium 3 – High

ISE I, II Compulsory are tests

ISE III Assessment: Teachers Assessment of 10 marks is based on attendance of the student and any one / or combination of few of following. However, the course coordinator has to announce assessment components at the beginning of the course. Presentation on latest topics/Real life problems related with the subject-1. Problems based on GATE questions, 2.Simulations problems, 3.Quiz,4. Surprise test

Sample Assessment Pattern:

Sample Assessment Pattern Level No.	**Knowledge Level**	**Class Test I**	**Class Test II**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	05	00	10
K2	Understand	05	05	05	20
K3	Apply	05	05	05	30
K4	Analyze	00	00	00	00
Total Marks 100		15	15	10	60

Sample Assessment Table:

Assessment Tool	K1,K2, K3	K1,K2,K 3	K1,K2,K 3	K1,K2,K3	K1,K2,K3
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	07	08	00	00	00
ISE II (15 Marks)	00	00	15	00	00
ISE IIIAssessment (10 Marks)	02	02	02	02	02
ESE Assessment (60 Marks)	12	12	12	12	12

Teaching Strategies:

The teaching strategy is planned through the lectures, tutorials and team based home Assignments.

Designed by Dr. S. P. Ghanegaonkar & Dr. V. A. Kulkarni

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EEPC3004: Lab Control Systems-I	
Teaching Scheme Practical : 2 hrs/Week Tutorial : Nil Total Credits : 01	**Examination Scheme** ISE I : 25 marks ESE : 25 marks

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Differentiate various control systems
CO2	Describe various control system components
CO3	Analyze performance of linear second order system in Time domain
CO4	Analyze and evaluate performance of linear second order system in Frequency domain
CO5	Explain operation of industrial controllers

List of Experiments:

Term-work shall consist of minimum 10 experiments from the following:

Sr. No.	Details
1	Perform an experiment to study potentiometers as an error detector for dc and ac signals.
2	Perform an experiment to study synchros as an error detector.
3	To study the speed torque characteristics of a DC servo motor
4	To study the speed torque characteristics of a AC servo motor
5	To study the performance characteristics of a DC speed motor control system.
6	Perform an experiment to study torque speed characteristic of AC servo motor
7	Perform an experiment to study computer aided design of a linear control system.
8	Perform an experiment to study time domain analysis of a second order system for mechanical or electrical circuits.
9	To study responses(Step and Impulse) of system for Type zero, Type one and Type two systems
10	Computer aided study of responses of PI,PD and PID controller
11	Perform an experiment to study a continuous- time and/or digital position control system.
12	Computer aided plotting of root-locus and verify analytically.

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13	Computer aided plotting of Bode- plots and verify analytically
14	To study the time response of a variety of simulated linear systems and to correlate the studies with theoretical results.
15	Computer aided plotting of Nyquist plots and verify analytically

Mapping Of Course Outcome with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	3	1				1		1		1		1		1	3
CO2	3	2		1		1	1	1	1	1		1		1	3
CO3	3	2		1		1	1	1	1	1		1		1	3
CO4	3	1		1		1		1	1	1		1		1	3
CO5	3			1		1	1	1	1	1		1		1	3

1 -Low 2 – Medium 3 - High

Sample Assessment Table:

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination 25 Marks					

Sample Assessment Pattern:

Preparation (S1)	05	
Conduct of Experiment (S2)	10	
Observation and Analysis of Results (S3)	05	
Record (S2)	05	
Mini-Project / Presentation/ Viva-Voce (S3)		
Total	25	

Designed by
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EEPC3005: Lab- Digital Circuits	
Teaching Scheme Practical : 2Hrs./Week Total Credits : 01	**Examination Scheme** ISE I : 25 Marks Practical Examination & Viva Voce :25 Marks

Course Objectives:

The objectives of the course are to-

1. To expose the students to a variety of practical circuits using various digital ICs.
2. To provide hand-on experience in designing and implementing digital/logic circuits.

Course Outcomes:

After completion of this course students will be able to

CO1	To verify truth-table of various logic gates, Boolean algebra
CO2	Design and implement basic combinational and sequential logic circuits
CO3	Develop technical writing skills important for effective communication
CO4	Write assembly language programs and implement on 8085 microprocessor
CO5	Write assembly language programs and implement on 8085 processor

List of the Experiments:

The student shall perform minimum eight experiments of the following:

Sr. No.	Name of the Experiments
	Any 5 experiments from 1-8
1	To verify truth table and identify IC numbers of basic logic gates
2	To build basic logic gates using universal gates
3	Verification of De Morgan's theorems
4	Design and implementation of **any two** combinational logic circuits based on examples such as to find majority of one's, to find numbers exactly divisible by 3 or 4 etc.
5	To design arithmetic circuits such as half and full adder, half and full subtractor
6	To verify truth table of different flip-flop ICs
7	Design of mod-2, mod-5, mod-7/mod- 8/mod-9, mod-10 and reverse mod-10 counter using IC 7490
8	Design of mod n synchronous counter
	Any 5 experiments from 9--16
9	Study of 8085 Trainer kit.

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10	Execution of simple programs based on data transfer instructions/ on arithmetic and logical instructions
11	Execution of programs based on 8 bit data.
12	Execution of programs based on 16 bit data.
13	Execution of programs using any software interrupts of 8085.
14	Execution of programs using any hardware interrupts of 8085.
15	Execution of programs using SID/SOD.
16	Design of application based on 8085

Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2			2	1		1		1		1		1	1
CO2	3	2		1	2	1		1	1	1		1		1	1
CO3	3	2		1	2	1		1	1	1		1		1	1
CO4	3	2		1	2	1		1	1	1		1		1	1
CO5	3			1	2	1		1	1	1		1		1	1

1 -Low 2 – Medium 3 - High

Sample Assessment Table:

Assessment Tool	S1	S2	S3	S4	S5
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce					

Sample Assessment Pattern:

Preparation (S1)	05	
Conduct of Experiment (S2)	10	
Observation and Analysis of Results (S3)	05	
Record (S2)	05	
Total	25	

Designed by
Dr. Sandhya Kulkarni

Approved in XXVth Academic Council
Dated: 18th April 2023

EEPC3006: Lab Power System-II	
Teaching Scheme Practical : 2Hrs/Week Total Credits : 01	**Examination Scheme** ISE I : 25 Marks ESE :25 Marks

Course Objectives:

The objectives of the course are to-

1. Learn the power system software's such as MATLAB /MIPOWER/PSCAD
2. Acquire the skills of programming/modeling power system components.

Course Outcomes:

After completion of this course students will be able to:

CO1. Simulate and analyze power system studies by MATLAB /MIPOWER/PSCAD
CO2. Develop the Y-bus matrix
CO3. Identify fault current under the symmetrical and unsymmetrical faults conditions
CO4. Perform load flow and interpret the results.

List of the Experiments:

The student shall perform minimum eight experiments of the following using MATLAB/ MIPOWER/PSCAD

Sr. No.	Name of the Experiments
1	Simulation of the effect of line parameters on performance of transmission lines.
2	Determination of ABCD constants of a given transmission line.
3	Formulation of Y-bus matrix using computer program.
4	Computer aided solution of power flow problem by Gauss Seidel.
5	Computer aided solution of power flow problem by Newton-Raphson method.
6	Computer aided solution of power flow problem fast decoupled method.
7	Simulation and analysis for a symmetrical three phase fault.
8	Simulation and analysis of unsymmetrical LL fault.
9	Simulation and analysis of unsymmetrical LG fault.
10	Simulation and analysis of an unsymmetrical LLG fault.
11	Determination of steady state power limit of a transmission line.
12	Visit to HV/EHV substation, power generating station.

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Dated: 18th April 2023

Term Work:

The term work shall consist of submitting a file for minimum eight experiments performed with neatly written records of the study, programs & observations with results.

The term work will be assessed by the course coordinator.

Mapping Of Course Outcome with Program Outcomes:

Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 13	PSO 14	PSO 15
CO1	3				3				2	2		1	2		
CO2	3				3				2	2		1	2		
CO3	3				3				2	2		1	2		
CO4	3				3				2	2		1	2		

1 – Low 2 – Medium 3 – High

Details	**Term Work**
Preparation (S1)	05
Conduct of Experiment l (S2)	05
Observation and Analysis of Results (S3)	05
Record (S2)	05
Presentation/ Viva-Voce (S3)	05
Total	**25**

Sample Assessment Table:

Assessment Tool	**S1,S2,S3**	**S1,S2,S3**	**S1,S2,S3**	**S1,S2,S3**
	C01	C02	CO3	CO4
Term Work (25 Marks)	10	05	05	05

Designed by

Prof. W. A. Gavhane, Dr. S. P. Ghanegaonkar

Approved in XXVth Academic Council

Dated: 18th April 2023

Program Elective I (EEPE3010-EEPE 3015)

EEPE3010: Electrical Machine Design (Professional Elective I)	
Teaching Scheme Lectures : 03 Hrs/Week Tutorial : 00 Total Credits : 03	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Description:

EE3010 Design of Electrical machines is a selective subject for all students of the Electrical Engineering Department. Course is aimed to introduce fundamental concepts regarding machine design with electrical aspects of all types of machines to undergraduate students. The goal of this course is to understand and apply fundamentals knowledge of design to design all machines including transformers.

Course Objectives:

- The objectives of the course are to learn
- To study Selection proper commercial materials, their properties and selection criterions, IS standards used in electrical machine design.
- To study design of commercial induction motor and transformer

Course Outcomes:

After completing the course, students will able to

CO1	Explain basic considerations required for electrical machine design
CO2	Explain design stator and rotor of induction machines as per the specifications
CO3	Identify and solve problems on performance parameters the Induction motor
CO4	Demonstrate the design core, yoke, windings and cooling systems of transformers
CO5	Solve design problems related to performance of transformer

Detailed Syllabus:

UNIT-I	**Major considerations in Electrical Machine Design** Electrical Engineering Materials- Space factor- Choice of Specific Electrical and Magnetic loadings- Thermal considerations- Heat flow, Temperature rise and Insulating Materials, Rating of machines, Standard specifications
UNIT-II	**Design of Induction Motors -I** Constructional features, types of ac windings, Output equation of Induction motor , Main dimensions, specific electrical and magnetic loadings, ranges of specific loadings, turns per phase, number of stator slots. Length of air gap- Rules for selecting rotor slots of squirrel cage machines, Design of rotor bars & slots , Design of end rings, Harmonic field effect on the performance of three phase induction motor, Specifications of Induction motor

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Dated: 18th April 2023

UNIT-III	**Design of Induction Motors -II** Magnetic leakage calculations – Leakage flux and leakage reactance: Slot leakage, tooth top leakage, zig-zag leakage, overhang leakage, leakage reactance calculation for three phase machines.MMF Calculation for air gap, stator teeth, stator core, rotor teeth and rotor core, effect of saturation, effects of ducts on calculations of magnetizing current, calculations of no-load current. Calculations of losses and efficiency
UNIT-IV	**Design of Transformers - I** Types and constructional features of core and windings used in transformers. Transformer auxiliaries such as tap changer, pressure release valve, breather and conservator. Specifications of transformer. Output Equations, Design of Main Dimensions – KVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions, Design of Tank, Methods of cooling of Transformers
UNIT-V	**Design of Transformers -II** Estimation of resistance and leakage reactance of transformer, No load current, losses, efficiency and regulation of transformers. Calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. Temperature rise in Transformers, Design of IVT, CVT,& Current Transformer

Text Books:

1. M.G. Say, Theory and Performance and Design of A.C. Machines, 3rd Edition, ELBS London
2. Sawhney A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.

Reference Books:

1..Indrajit Dasgupta,Design of Transformers, TMH
2. M.V.Deshpande "Design and Testing of Electrical Machine Design" Wheeler Publications, 2010.
3.A.Shanmuga Sundaram, G. Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
4.R.K.Agarwal" Principles of Electrical Machine Design" Esskay Publications, Delhi, 2002.
5. K. G. Upadhyay, Design of Electrical Machines, New age publication.
6.Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programs, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.
7. Vishnu Murti, "Computer Aided Design for Electrical Machines", B.S. Publications.

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Dated: 18th April 2023

Mapping of Course Outcome with Program Outcomes:

Course outcome	PO 01	PO 02	PO 03	PO 04	PO 05	PO0 6	PO 07	PO0 8	PO0 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2													
CO2	3	2	3		1	1						1		3	
CO3	3	2	3		1	1						1		3	
CO4	3	2	3		1	1						1		3	
CO5	3	3	3		1	1						1		3	

1- Low 2- Medium 3-High

Sample Assessment Table:

Assessment Tool	K1,K2,K3	K2,K3,K4	K2,K3, K4	K1,K2,K3 K4	K2,K3,K4
Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I & II 30 Marks	7	8	15		
ISE III 10 Marks	02	02	02	02	02
ESE 60 Marks	12	12	12	12	12

Teaching Strategies: It is planned through the lectures and team based home works. Exercises are assigned weekly to stimulate the students to actively use and revise the learned concepts which also help the students to express their way of solving the problems fluently in written form. Most critical concepts and mistakes are emphasized.

ISE I, II are compulsory tests

ISE III Assessment:It is based on one of the /or combinations of the few of the following.

1. Home Assignments, 2. Powerpoint presentation on new concepts in design in any type of machine ,3. Develop working models using software, 4. Surprise written Test with multiple choice questions, 5. Quiz

Sample Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment /Assignment**	**End Semester Examination**
K1	Remember	10	03	10
K2	Understand	10	04	20
K3	Apply	10	03	20
K4	Analyze	00	00	10
Total		30	10	60

Designed by
Prof. Dr. S. M. Shinde

Approved in XXVth Academic Council
Dated: 18th April 2023

EEPE 3011:High Voltage Engineering (Professional Elective I)	
Teaching Scheme Lectures : 03 Hrs/Week Tutorial : 00 Total Credits : 03	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III Assessment : 10 Marks End -Semester Exam : 60 Marks

Course Description: This course introduces the concepts of High Voltage Engineering The course comprises the basic breakdown theories related to various insulating materials and covers the various aspects of over voltage generation and insulation coordination.

Course Objectives:

The objectives of the course are to

1. develop an understanding of breakdown phenomenon in case of solid, liquid and gaseous insulating medium
2. develop familiarity with various methods of generation of high voltages
3. develop familiarity with various methods of measurement of high voltages
4. develop an understanding of over voltage phenomenon & concepts of insulation coordination
5. develop an understanding of importance of testing of power apparatus

Course Outcomes:

After completing the course, students will able to:

CO1	Calculate breakdown strength of various insulating materials for power system applications
CO2	Describe the breakdown phenomenon in case of various insulating materials
CO3	Explain the concepts of generation of high voltages & currents
CO4	Explain the causes and protection from over voltages and of insulation coordination
CO5	Explain the direct and indirect testing methods

Detailed Syllabus:

UNIT-1	**Conduction & Breakdown in Gases:** Ionization Process & Current Growth, Townsend's Criterion for Breakdown, Determination of Alpha & Gamma, Streamer Theory of Break Down in Gases, Paschen's Law, Breakdown in Non-Uniform Field & Corona Discharge. Conduction & Break Down in Pure Liquid & Commercial Liquid--cavitations mechanism, suspended particle mechanism etc.Breakdown in Solid Dielectrics-intrinsic, electromechanical, thermal breakdown etc

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Dated: 18th April 2023

UNIT-2	**Generation of High Voltage & Currents:** Generation of High D. C. Voltages: voltage doubler, voltage multiplier, electrostatic machines etc.; Generation of High Alternating Voltages: cascade circuits, resonating circuits etc. Generation of transient voltages: Single stage and multistage impulse generator circuits, tripping and synchronization of impulse generator; Generation of switching surge voltages; Generation of Impulse Currents
UNIT-3	**Measurement of High Voltages & Currents:** Measurement of High Direct Current Voltages, High Alternating Voltages & Impulse Voltages- use of potential dividers, gaps and other methods of measurement; Measurement of High Direct Currents, High Alternating Currents & High Impulse Currents
UNIT-4	**Over Voltage Phenomenon & Insulation Coordination:** Natural Causes for Over Voltages, Lightning Phenomenon, Over Voltages Due to Switching Surges, System Faults & Other Abnormal Conditions, Principles of Insulation Coordination on High Voltage & Extra High Voltage Power Systems, concept of statistical factor of safety, risk of failure
UNIT-5	**High Voltage Testing of Power Apparatus:** High voltage testing of bushings, transformers, cables etc. Non-destructive insulation test techniques: High voltage dielectric loss measurements, discharge measurements

Text and Reference Books:

1. M. S. Naidu , V. Kamaraju, "High Voltage Engineering" , Tata McGraw –Hill publications
2. E. Kuffel, W.S. Zaengl, J. Kuffel, "High Voltage Engineering fundamentals", Butterworth – Heinemann publishers
3. D. Kind, K. Feser, "High Voltage Test Techniques", Vieweg/ SBA publications
4. M. Khalifa, "High Voltage Engineering- Theory & Practices", Dekker publications

Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1				1						1	3	1	2
CO2	3	1				1	1					1	3	3	2
CO3	3	1	1			1	1					1	3	3	2
CO4	3	1				1						1	3	1	2
CO5	3	1				1						1	3	1	3

1- Low 2- Medium 3- High

ISE I,II are compulsory tests

ISE III Assessment: Teachers Assessment of 10 marks is based on attendance of the student and one of the / or combination of few of following.

1. Assignments,2 MCQ, 3 Quiz

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Sample Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	10		25
K2	Understand	10	3	25
K3	Apply	10	2	10
K4	Analyze		3	
K5	Evaluate		2	
Total Marks 100		30	10	60

Sample Assessment table

Assessment Tool	K1+K2+ K3	K1+K2	K1+K2	K1+K2	K1+K2
	C01	C02	C03	CO4	CO5
Class Test (30 Marks)	10	10	10		
Teachers Assessment (10 Marks)	02	02	02	02	02
ESE Assessment (60 Marks)	12	12	12	12	12

Special Instructions if any: Nil

Designed by
Dr. V. A. Kulkarni (Deodhar)

Approved in XXVth Academic Council
Dated: 18th April 2023

EEPE3012 : Energy Storage Systems (Professional Elective I)	
Teaching Scheme Lectures : 03 Hrs/Week Tutorial : 00 Total Credits : 3	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End-Semester Exam : 60 Marks

Course Description: Coverage of energy storage techniques involving electrochemical, mechanical and emerging options. Integration of the energy storage media, its effects on the bulk power system, and design tradeoffs to understand environmental impacts, cost, reliabilities, and efficiencies for commercialization of bulk energy storage.

Course Objectives: The objectives of the course are to

1. Understand energy storage needs
2. Study and compare different methods of Electro-chemical energy storages
3. Understand superconducting magnetic energy storage systems
4. Get knowledge of mechanical and thermal energy storage systems
5. Study various energy storage applications and management of storage systems

Course Outcomes: After completing the course, students will able to

CO1.	Describe the need of energy storage systems - present and future
CO2	Demonstrate working/ operational principles of various Electrochemical Energy Storage systems
CO3	Explain superconducting magnetic energy storage systems
CO4	Explain mechanical energy storage and Thermal energy storage systems
CO5	Select appropriate energy storage systems for various applications and demonstrate management of energy storage systems

Detailed Syllabus:

UNIT-I	**Necessity of Energy Storage:** Storage Needs - Variations in Energy Demand - Variations in Energy Supply - Interruptions in Energy Supply - Transmission Congestion - Demand for Portable Energy - Demand and scale requirements - Environmental and sustainability issues, future prospect of storage
UNIT-II	**Electrochemical Energy Storage:** Electrochemical storage system (11 Hours) (a) Batteries-Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and their voltages- Li-ion battery & Metal hydride battery vs lead-acid battery. (b) Supercapacitors- Working principle of supercapacitor, types of supercapacitors, cycling and performance characteristics, difference between battery and supercapacitors, Introduction to Hybrid electrochemical supercapacitors (c) Fuel cell: Operational principle of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems, hybrid fuel cell-supercapacitor systems

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Dated: 18th April 2023

UNIT-III	**Superconducting Magnetic Energy Storage:** Introduction to Superconducting Magnetic Energy Storage (SMES) operation, theory of usage and emergent research. Focus will primarily be on large utility scale energy storage facilities
UNIT-IV	**Mechanical Energy Storage and Thermal Energy Storage:** Flywheel, Pumped hydro storage, compressed gas storage technologies, models for compressed gas capacity, efficiency and availability Thermal Energy Storage- Phase Change Materials (PCMs); Selection criteria of PCMs; Stefan problem; Solar thermal LHTES systems; Energy conservation through LHTES systems; LHTES systems in refrigeration and air-conditioning systems
UNIT-V	**Applications:** Present status of applications, Utility use (Conventional power generation, Grid operation & Service), Consumer use (Uninterruptible power supply for large consumers), New trends in application, Renewable energy generation, Smart grid, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems

Text and Reference Books:

1. Ter-Gazarian, A.G. (2011) *Energy Storage for Power Systems, 2nd Edition*, IET Publications (ISBN: 978-1849192194)
2. Huggins, R.A. (2010) *Energy Storage*, Springer, (ISBN: ISBN 978-1441910240)
3. R. P. Deshpande, "Ultracapacitors", McGraw Hill Education Publication.
4. Robert A. Huggins, "Energy Storage", Springer Publication.
5. Fransisco Diaz," Energy storage in power systems", published by Wiley.

Mapping of Course outcome with program outcomes:

Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	1	1	1	1	1	1		1	1	1	1
CO2	3	2	2	1	1	1	1	1	1	1		1	1	1	1
CO3	3	2	1	1		1	1	1	1	1		1	1	1	1
CO4	3	2	1	1		1		1	1	1		1	1		
CO5	3	2	1	1		1	1	1	1	1		1	1	1	1

1- Low 2- Medium 3- High

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K2+K3	K1 to K6	K1 to K6
Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I, II 30 Marks	8	7	8	7	
ISE III Assessment 10 Marks	2	2	2	2	2
ESE Assessment 60 Marks	12	12	12	12	12

ISE I , II are compulsory tests

ISE III Assessment: Teacher's Assessment is based on one of the following.

1. Assignments, 2. Models/ Presentations, 3. multiple choice questions test, 4. Quiz

Sample Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	Test		Teachers Assessment /Assignment	End Semester Examination
K1	Remember	5	5	2	10
K2	Understand	5	5	2	20
K3	Apply	5	5	3	20
K4	Analyze			3	10
Total		15	15	10	60

Designed by
Dr. Sunanda Ghanegaonkar

Approved in XXVth Academic Council
Dated: 18th April 2023

EEPE 3013 :Utilization of Electrical Energy (Professional Elective I)	
Teaching Scheme Lectures : 03 Hrs/Week Tutorial : 00 Total Credits : 03	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE IIIent : 10 Marks End -Semester Exam : 60 Marks

Course Objectives:

The objectives of the course are to

1. Understand laws of illumination and different lighting schemes
2. Understand different heating methods employed in various industries such as steel, wood and plastic, different types welding methods used in industries, at construction sites and domestic purposes as well
3. Define Electrolytic processes
4. Understand existing traction systems in India
5. Understand different services such as urban, sub-urban and mainline rail traffic

Course Outcomes:

After completing the course, students will able to

CO1	Explain laws of illumination and different lighting schemes
CO2	Explain different heating methods employed in various industries such as steel, wood and plastic, different types welding methods used in industries, at construction sites and domestic purposes as well
CO3	Explain Electrolytic processes
CO4	Explain existing traction systems in India
CO5	Explain different services such as urban, sub-urban and mainline rail traffic

UNIT-I	**Illumination:** Introduction, Definition, Laws of illumination, coefficient of utilization and depreciation, Polar curves, Photometry, Artificial sources of light ,Incandescent lamps, Arc lamps, Discharge lamps, filament lamps, fluorescent tubes, comparison between filament lamps and fluorescent tube, Compact fluorescent lamps, LED lamps, Principles of light control, Types and design of lighting schemes, lighting calculations, factory lighting, street lighting and flood lighting.

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UNIT-II	**Electrical Heating & Welding:** Electrical Heating**:** Introduction, Advantages, Modes of transfer of heat, Methods of electrical heating, Resistance heating, Induction heating, Dielectric heating, High frequency heating, Causes of feeler of heating elements. Electric Welding: Introduction, Advantages, Disadvantages of welding, Resistance welding, Electric arc welding, Choice of welding time, Submerged arc welding, Electron beam welding, Laser beam welding, Types of welding electrodes, Comparison between resistance & arc welding, Electrical welding equipment, comparison between AC & DC welding. Problems on heating and welding
UNIT-III	**Electrolytic Process and Air conditioning and refrigeration:** Electrolytic Process: Introduction, Principle of electrolysis, Laws of electrolysis, Application of electrolytic process- electroplating, metal extraction and metal processing, electromagnetic stirs, Power supply for electrolysis process. Air conditioning and refrigeration: function of complete air conditioning system -Types of compressor motor. Cool storage - estimation of tonnage capacity and motor power. Water Coolers- Control of temperature. simple heat load calculations
UNIT-IV	**Electrical Traction I :** Introduction, Heavy of existing electrical traction system in India, System of traction, System of track electrification, Comparison between DC & AC traction, Special features of traction motors, Different type of traction motor, Braking, Overhead & auxiliary equipment
UNIT-V	**Electrical Traction II :** Introduction, Types of services, Speed time & speed distance curves for different services, Definition crest speed, Average speed, Schedule time, Dead weight, Accelerating weight, Adhesive weight, Coefficient of adhesion. Factors affecting schedule speed of train, Traction efforts, and specific energy conservation.

Text and Reference Books:

1. Jack L. Lindsey, "Applied Illumination Engineering", Second Edition, The Fairmont Press Publishers
2. C. L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", 10th Edition, New Academic Science Publishers
3. S.V.Suryanarayana, "Utilization of Electric Power Electric Traction", New Age International
4. R. K. Rajput,"Utilization of Electrical Power", Laxmi Publications
5. E. O. Taylor, "Utilization of Electric Energy", SI Edition, Orient Longman PVT Ltd,2006

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Dated: 18th April 2023

Mapping of Course Outcome with Program Outcomes :

Course outcome	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O 1	PS O2	PS O3
CO1	3	2				1						1	1		
CO2	3	2				2						1	1	1	
CO3	3	2				2						1	1	1	
CO4	3	2				2						1	1	1	
CO5	3	2				2						1	1	1	

1- Low 2- Medium 3- High

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K2+K3	K1 to K6	K1 to K6
Course outcomes	CO1	CO2	CO3	CO4	CO5
Class Test 30 Marks	8	7	8	7	
Teachers Assessment 10 Marks	2	2	2	2	2
ESE Assessment 60 Marks	12	12	12	12	12

ISE I, II are compulsory tests

ISE III **Assessment:** It is based on one of the following.

1. Assignments, 2 Models/ Presentations, 3. Multiple choice questions test, 4. Quiz

Sample Assessment Pattern :

Assessment Pattern Level No.	**Knowledge Level**	**Test**		**Teachers Assessment /Assignment**	**End Semester Examination**
K1	Remember	5	5	2	10
K2	Understand	5	5	2	20
K3	Apply	5	5	3	20
K4	Analyze			3	10
Total		15	15	10	60

Designed by
Dr. Sunanda Ghanegaonkar

Approved in XXVth Academic Council
Dated: 18th April 2023

EEPE 3014 :Optimization Techniques (Professional Elective I)	
Teaching Scheme Lectures : 03 Hrs/Week Tutorial : 00 Total Credits : 03	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Description: Electrical Power Systems is growing at a faster pace. An Electrical Engineer should be able to solve the optimization problems in electrical engineering. This course is aimed to cover the fundamentals of LPP and NLPP optimization techniques for solving engineering problems.

Course Objectives: The objectives of the course are to

1. Introduce the fundamental concepts of Optimization Techniques;
2. Make the learners aware of the importance of optimizations in real scenarios;
3. Provide the concepts of various classical and modern methods for constrained and unconstrained problems in both single and multivariable.

Course Outcomes : After completing the course, students will able to:

CO1	Formulate optimization problems as mathematical programming problems
CO2	Solve various constrained and unconstrained problems in single variable as well as multivariable
CO3	Choose a suitable technique to solve a particular type of optimization problem.
CO4	Analyze and apply Evolutionary algorithms to find global optimum of linear and nonlinear optimization problems in real life situation
CO5	Analyze and apply the suitable optimization techniques for solving problems in Electrical engineering

Detailed Syllabus:

Unit 1	**Introduction:** Concept of optimization and classification of optimization techniques, formation of optimization problems Linear Programming : Standard form of LPP Simplex Method of solving LPP, duality, decomposition principle, transportation problem and application of LPP to Electrical Engineering

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Dated: 18th April 2023

Unit 2	**Non-Linear Problem (NLP):** One dimensional methods, Elimination methods, Interpolation methods, Unconstrained optimization techniques-Direct search and Descent methods, constrained optimization techniques, direct and indirect methods
Unit 3	**Dynamic Programming** Multistage decision processes, concept of sub-optimization and principle of optimality, conversion of final value problem into an initial value problem.
Unit 4	**Introduction to Multi objective Optimization** Evolutionary algorithms for optimization and search such as Genetic Algorithm, Swarm based Optimization techniques
Unit 5	**Applications in Electrical Engineering** Economic Load Dispatch in thermal and Hydro-thermal systems Unit commitment problem, reactive power optimization. Optimal power flow, applications in control systems etc

Text and Reference Books

1. S.S.Rao, "Optimization - Theory and Applications", Wiley-Eastern Limited.
2. David G. Luenberger, "Introduction of Linear and Nonlinear Programming ", Wesley Publishing Company
1. Polak, "Computational methods in Optimization", Academic Press. Pierre D.A, "Optimization Theory with Applications", Wiley Publications.
4 .Kalyanmoy deb, "Optimization for Engineering Design: Algorithms and Examples", Kalyanmoy deb, PHI Publication.
5. .D.E. Goldberg & Addision, "Genetic Algorithm in Search Optimization and Machine Learning ", Wesley Publication, 1989
6. L.P. Singh, "Advanced Power System Analysis and Dynamics", Wiley Eastern Limited.
7. Hadi Saadat "Power System Analysis ", TMH Publication.
8. Olle I.Elewgerd " Electrical Energy System : An Introduction", TMH Publication, New Delhi.

ISE I, II are compulsory tests

ISE III Assessment: It is based on attendance of the student and one of the / or combination of few of following. However, the course coordinator has to announce assessment components at the beginning of the course.

1. Presentation on latest topics/Real life problems related with the subject
2. Problems based on GATE questions, 3. Simulation problems, 4. Quiz

Approved in XXVth Academic Council
Dated: 18th April 2023

Sample Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	5	10	10
K2	Understand	10	10	20
K3	Apply	5		30
Total Marks 100		20	20	60

Sample Assessment table :

Assessment Tool	K1+K2+ K3	K1+K2+ K3	K1+ K2	K2	K1+K3
	CO1	CO2	CO3	CO4	CO5
ISE I, II (30 Marks)	10	5	5		
ISE III Assessment (10 Marks)				10	10
ESE Assessment (60 Marks)	10	20	10	10	10

Teaching Strategies: The teaching strategy is planned through the lectures, tutorials and team based home Assignments.

Designed by
Dr. Sunanda Ghanegaonkar

Approved in XXVth Academic Council
Dated: 18th April 2023

Semester II

EEPC3020: Microcontroller and Applications	
Teaching Scheme Lectures : 3 Hrs./Week Tutorial : NIL Total Credits : 03	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End Semester Exam : 60 Marks

Course Description: The purpose of this course is to teach students the fundamentals of microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where automatic control can be achieved via a microprocessor/controller implementation.

Course Objectives:

The objectives of the course is to give exposure to

1. Fundamental concepts of Microcontrollers and differentiate them
2. Understand the architecture of microcontrollers
3. Write assembly language programs using microcontrollers
4. Interface peripherals like I/O, A/D, D/A, timer etc to microcontrollers
5. Develop small real world interfacing applications using microcontrollers

Course Outcomes:

After completing the course, students will able to:

CO1	understanding the architecture of microcontrollers and differentiate them from microprocessors.
CO2	describe various addressing modes of microcontroller and memory organization of microcontroller
CO3	write assembly language programs for various modes of 8051/PIC
CO4	interface memory and I/O devices to microcontroller
CO5	interface real world input/ output devices to 8051/PIC microcontroller

Detailed syllabus

Unit I	**Fundamentals of Microcontrollers** Comparison of fundamentals of Microprocessor and Microcontrollers. Overview of the 8051 family. Selection of Microcontroller, 8051 Architecture Microcontroller architecture, Comparison of 8-bit/16-bit/31-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems

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Unit II	**Architecture of 8051 microcontroller** Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory. Addressing modes: Introduction, Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing PIC Microcontroller: Architecture, memory organization
Unit III	**Instruction Set and Programming** 8051 Instruction set, I/O Ports and Memory Organization, Instruction Set, programming. Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.
Unit IV	**Memory and I/O Interfacing and Communication** RAM memory organization Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose IO, ADC, DAC, timers, counters, memory devices. I/O port programming, Various modes of timer operations, Interrupts, priority, Serial mode communication, Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.
Unit V	**Applications of Microcontrollers** Interfacing of 8051 to Real world applications such as 8255,LED interfacing, stepper motor, Relays, heater coil, LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing . Projects based on real time systems using microcontrollers, Raspberry or suitable controllers like PIC/ ATMEGA etc

Text / References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.
2. K. J. Ayala, “ 8051 Microcontroller” , Delmar Cengage Learning,2004.
3. R. Kamal, “Embedded System”, McGraw Hill Education,2009.
4. Ajay Deshmukh, “Microcontrollers”, Tata McGraw Hill, New Delhi.
5. Kenneth Ayala, 8051 Microcontroller, Pen ram international, II edition

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Dated: 18th April 2023

Mapping Of Course Outcome With Program Outcomes:

Course Outcome	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PSO 3
CO1	3	3		1	2	1		1		1	1	1		1	1
CO2	3	1			2	1		1		1	1	1	1	1	1
CO3	3	2			2	1	1	1		1	1	1		1	1
CO4	3	3		1	1	1	1	1		1	1	1	1	1	1
CO5	3	3	1	1	2	1	1	1		1	1	1	1	1	1

1 – Low 2 – Medium 3 – High

ISE I, II are compulsory tests

ISE III Assessment: It is of 10 marks is based on one of the / or combination of few of following, 1. Mini projects, 2. PPT presentation, 3. Assignment based on programming of microprocessors for different applications.

Sample Assessment Pattern:

Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember		5	4	5
K2	Understand				15
K3	Apply	5	5	2	20
K4	Analyze	5			20
K5	Evaluate	5	5	4	
Total Marks 100		15	15	10	60

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K2+K3	K2+K3+K4	K2+K3+K4	K2+K3+K4
	C01	C02	C03	CO4	CO5
ISE I, II (30 Marks)	06	06	06	06	06
ISE III (10 Marks)	2	-	3	3	2
ESE Assessment (60 Marks)	14	08	14	12	12

Special Instructions If Any: NIL

Designed by
Dr. Sandhya Kulkarni

Approved in XXVth Academic Council
Dated: 18th April 2023

EEPC3021: Control Systems II	
Teaching Scheme Lectures : 3 Hrs./Week Tutorial : 00 Total Credits : 03	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End Semester Exam : 60 Marks

Course Description: This is the course in Electrical Engineering which introduces the basic concepts and techniques for processing signals on a computer and being familiar with filter design, transform-domain processing and importance of Signal Processors.

Course Objectives: The objectives of the course are to give exposure to-

1. describe compensator design in frequency domain
2. represent mathematical modeling of systems using state space
3. evaluate stability of digital systems, and explain digital PID controller
4. explain different methods to analyze nonlinear control systems.
5. describe advanced intelligent Controllers

Course Outcomes:

After completing the course, students will able to:

CO1	Analyze and design compensators in frequency domain
CO2	Represent physical systems using state space, find Observability and controllability
CO3	Explain sample data control and evaluate stability of digital systems
CO4	Differentiate and explain various methods of analysis of nonlinear control systems.
CO5	Describe various advanced controllers

Detailed Syllabus:

UNIT I	**Design of Classical Control System in frequency domain** Introduction to compensator. Design of Lag, lead, lag-lead compensator. Compensator design in frequency domain: lead, Lag and lag-lead compensator design using Bode diagram.
UNIT II	**State Variable Analysis** State space representation of continuous systems solving the time-invariant state equation, State transition matrix, Eigen values and Eigenvectors, Controllability and Observability criteria for time invariant systems, Pole placement using state variable feedback, Design of state observers
UNIT III	**Digital control and Stability** Introduction to digital control, concepts of sampling, reconstruction of signals, sample data control, Z and inverse Z transform. Stability using Jury criteria, Bilinear transformation

UNIT IV	**Nonlinear Control Systems** Common physical nonlinearities, characteristics of nonlinear systems, Linearizing techniques, construction of phase trajectory, Non-linear control system using describing function concept, phase plane techniques and Liapunov's stability criterion
UNIT V	**Advanced Controllers** Feed forward, Ratio, Cascade and Direct digital control (DDC). Programmable Logic Controllers**:** Introduction to PLC, Constructional features, Fuzzy logic controller and its applications.

Text Books

1. I.J. Nagrath & M. Gopal, "Control Systems Engineering",New Age Publishers 4th edition.
2. M. Gopal. , "Digital Control Systems", New Age Publishers 4th Edition.

Reference Books

1. Benjamin Kuo, "Digital Control system", Oxford.
2. K. Ogata, "Modern Control System", Prentice Hall.
3. Lee Stoline, "Applied Nonlinear System", Prentice Hall.
4. Norman Nice, "Control System Engineering", New Age Publishers

Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1	3				1	1			1					1	2
CO2	3	2			1	1			1					1	2
CO3	3	2			1	1			1					1	2
CO4	3	2	1		1	1			1					1	2
CO5	3	2		2	1				1					1	2

1 –Low 2 – Medium 3 –High

ISE I, II are compulsory tests

ISE III Assessment: It is of 10 marks based on one of the / or combination of few of following,

1. Assignment , 2. MCQ

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Sample Assessment Pattern:

Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	5	5	4	14
K2	Understand	5	5	2	12
K3	Apply	5	5	4	14
K4	Analyze				
Total Marks 100		15	15	10	60

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K2+K3	K2+k3+K4	K2+k3+K4
	C01	C02	C03	CO4	CO5
ISE I, ISE II (30 Marks)	06	06	06	06	06
ISE III (10 Marks)	2	2	2	2	2
ESE (60 Marks)	12	12	12	12	12

Special Instructions If Any: NIL

Designed by
Dr. Sandhya Kulkarni

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Dated: 18th April 2023

EEPC 3022: Power Electronics	
Teaching Scheme: Lectures : 3 Hrs./Week Total Credits : 03	**Examination Scheme:** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End Semester Exam : 60 Marks

Course Description:

The objective of this course is to give exposure to the students of various semiconductor devices of the switching devices. It also covers applications in the different types of power converter configurations and their control techniques.

Course Objectives:

The objective of the course is to give exposure to the students of

1. Power semiconductor devices
2. Triggering methods, commutation methods and various characteristics of switching devices
3. Operations and analysis of AC-DC converters and dual converters
4. Operations and analysis of DC-DC converters and their control techniques
5. Operations of DC-AC converters and its various control techniques

Course Outcomes:

After completing the course, students will able to:

CO1	Describe structure, characteristics, and applications of power semiconductor devices
CO2	Describe different triggering methods, commutation methods and various characteristics of switching devices
CO3	Explain and analyze single and three phase AC-DC converters with different types of load and their control techniques
CO4	Explain and analyze types, operation and control techniques of DC-DC converters
CO5	Explain and analyze DC-AC converters and various control techniques

Detailed Syllabus:

Unit I	**Characteristics of Switching Devices** Structure, Two transistor analogy of SCR, Principle of operation, V/I characteristics of power semiconductor devices such as SCR,TRIAC, DIAC, GTO, SiC, Power Transistor, Power MOSFET, IGBT.
Unit II	**Performance of switching Devices** Gate triggering methods, Turn on-Turn off characteristics of SCR, Design of gate driving circuits, Types of commutation, Ratings, protection, Series & parallel operation
Unit III	**AC-DC Converters** Principle & operation of single phase half wave and full wave converters with different types of load, Three phase half and full wave converters, Performance parameters, Use of freewheeling diode, Effect of source inductance, Single phase and Three phase dual converters with circulating and non-circulating mode of operations.

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Unit IV	**DC-DC Converters** Principle of operation of chopper, Basic principles of step-down and step-up operation, various control techniques, chopper classification, Various commutation methods, voltage, current, load commutated chopper, Buck, Boost, Buck-Boost converters.
Unit V	**DC-AC Converters** Principle of operation of series and parallel inverters, Single phase center tapped and bridge inverter with R, RL load, Three-phase bridge inverters-180 and 120 degrees mode of operation, PWM techniques, Voltage Source Inverter, Current source inverters, Concepts of multilevel inverters and their types.

Text and Reference Books:

1. M.H. Rashid, “Power Electronics”, Third Edition, Prentice-Hall of India Pvt. Ltd. 2005
2. Mohan, Undel and, Robbins, "Power Electronics”, Second Edition, John Willey & Sons, 1995
3. B. K. Bose, “Modern Power Electronics and AC Drives”, Prentice-Hall of India Pvt. Ltd. 2006
4. C. W. Lander, “Power Electronics”, Tata McGraw-Hill Publications India 1993
5. P.C. Sen, “Power Electronics", Tata McGraw-Hill Publications India
6. G. K. Dubey, S. R. Doradla, A. Joshi, M. K. Sinha, “Thyristorised Power Controllers", Wiley Eastern Ltd.1987
7. M. Ramamoorthy, ”An Introduction to Thyristor & Their Applications”, East-West Press Pvt. Ltd., New Delhi

Mapping of Course outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	-		-	2		3	-	-		2		3	1
CO2	3	2	-		3	2		3	3	3		2		3	1
CO3	3	1	3		3	2		3	3	3		2		3	1
CO4	3	1	3		3	2		3	3	3		2		3	1
CO5	3	1	3		3	2		3	3	3		2		3	1

1 – High 2 – Medium 3 – Low

ISE I, II are compulsory tests

ISE III Assessment is will be based on **any ONE** of the following:

1. Multiple Choice Objective Test, 2. Assignments/PPT presentation on allotted topics
3.Written Test on numerical,4. Quiz

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Sample Assessment Pattern:

Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	05	05	02	15
K2	Understand	05	05	02	15
K3	Apply	05	05	04	20
K4	Analyze			02	10
Total Marks: 100		**15**	**15**	**10**	**60**

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K1+K2+K3	K1+K2+K3	K1+K2+K3+K4
	C01	C02	C03	CO4	CO5
ISE I (15 Marks)	7.5	7.5	-	-	-
ISE II (15 Marks)	-	-	7.5	7.5	-
ISE III (10 Marks)	02	02	02	02	02
ESE Assessment (60 Marks)	12	12	12	12	12

Designed by
Prof. S.S. Mopari

Approved in XXVth Academic Council
Dated: 18th April 2023

EEES 3023: Machine Learning	
Teaching Scheme Lectures : 3 Hrs./Week Tutorial : Nil Total Credits : 3	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End Semester Exam : 60 Marks

Course Description: The students will understand the basics of Machine Learning. They will also learn and will be able to apply different machine learning models to various datasets.

Prerequisites: Engineering Mathematics(Probability and statistics, linear algebra)

Course Objectives:

The objectives of the course are to give exposure of

1. Understand basic applications and issues of Machine Learning
2. Understand the different types of datasets
3. Analyze and work with different datasets
4. Analyze various Machine Learning techniques and algorithms
5. Apply various algorithms to different datasets.

Course Outcomes: After completing the course, students will able to:

CO1	Identify the application areas of ML
CO2	Classify and apply different Learning methods
CO3	Apply Supervised learning techniques.
CO4	Apply Unsupervised learning techniques.
CO5	Apply Deep learning techniques.

Detailed Syllabus:

Unit 1	**Introduction: Machine Learning** Definition of learning, Network, datasets and handling of data, Feature sets, Dataset division: test, train and validation sets, cross validation.
Unit 2	**Basics of machine learning** Applications of Machine Learning, processes involved in Machine Learning, Introduction to Machine Learning Techniques: Supervised Learning, Unsupervised Learning and Reinforcement Learning, Real life examples of Machine Learning.
Unit 3	**Supervised learning:** Classification and Regression, K-Nearest Neighbor, Linear Regression, Logistic Regression, Support Vector Machine (SVM), Evaluation Measures: SSE, MME, R^2, confusion matrix, precision, recall, F-Score, ROC-Curve.

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Unit 4	**Unsupervised learning** Introduction to clustering, Types of Clustering: Hierarchical, Agglomerative Clustering and Divisive clustering; Partitional Clustering- K-means clustering.
Unit 5	**Miscellaneous:** Dimensionality reduction techniques, PCA, LDA, ICA. Introduction to Deep Learning, Gaussian Mixture Models, Natural Language Processing, Computer Vision.

NPTEL/SWAYAM Course:

1. NPTEL Course Name- Introduction to Machine Learning, Instructor-Prof. Balaraman Ravindran, Host Institute-IIT Madras
2. NPTEL Course Name- Machine Learning Instructor-Prof. Carl Gustaf Jansson, Host Institute-KTH, The Royal Institute of Technology

Text Books/Suggested References:

1. Introduction to Machine Learning, By Jeeva Jose, Khanna Book Publishing Co., 2020.
2. Machine Learning for Dummies, By John Paul Mueller and Luca Massaron, For Dummies, 2016.
3. Machine Learning, By Rajeev Chopra, Khanna Book Publishing Co., 2021.
4. Machine Learning: The New AI, By Ethem Alpaydin, The MIT Press, 2016.
5. Machine Learning, Tom M. Mitchell, McGraw Hill Education, 2017.
6. https://www.udacity.com/course/intro-to-machine-learning--ud120
7. https://www.coursera.org/learn/machine-learning-duke

Mapping Of Course Outcome with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3		1	2	1		1		1	1	1		1	1
CO2	3	1			2	1		1		1	1	1	1	1	1
CO3	3	2			2	1	1	1		1	1	1		1	1
CO4	3	3		1	1	1	1	1		1	1	1	1	1	1
CO5	3	3	1	1	2	1	1	1		1	1	1	1	1	1

1 – Low 2 – Medium 3 – High

Sample Assessment Table:

Assessment Tool	K1+ K3+K4	K1+K2+K3	K1+K3+K4+K5	K1+K3+K4	K1+K2
Unit wise Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I 15 Marks	10	5			
ISE II 15 Marks		5	10		
ISE III 10 Marks	2	3	5	5	5
End Semester Exam 60 Marks	12	12	12	12	12

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Dated: 18th April 2023

Teaching Strategies: The teaching strategy is planed through the lectures, tutorials, NPTEL lectures and home Assignments

ISE III Assessment: Is based on

Class Participation:25%

Class Attendance:25%

In-class Problems:25%

Class Test performance:25%

Sample Assessment Pattern:

Level No.	**Knowledge Level**	**ISE I1**	**ISE II**	**ISE III Assessment**	**End Semester Examination**
K1	Remember	5	5		15
K2	Understand	5	5		15
K3	Apply				9
K4	Analyze	5	5		9
K5	Evaluate				12
Total		15	15	Given above	60

Designed by Dr. N. J. Phadkule

Approved in XXVth Academic Council
Dated: 18th April 2023

EEPC3024 : Lab Microcontroller and Applications	
Teaching Scheme Practical : 2Hrs/Week Tutorial : NIL Total Credits : 01	**Examination Scheme** ISE III : 25 Marks ESE : 25 Marks

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Analyze and write, execute assembly language programs (8-bit) on 8051 microcontroller
CO2	Analyze and write, execute assembly language programs on 16 bit data on 8051
CO3	Analyze and write, execute assembly language programs using interrupts on 8051 microprocessor
CO4	Analyze and write, execute assembly language programs to interface peripherals on 8051 microprocessor
CO5	Analyze and write, execute assembly language programs and interface peripherals to 8051 microcontroller

List of Experiments:

Term-work shall consist of minimum ten experiments from the following:

Sr. No.	Details
1	Study of 8051/PIC Trainer kit.
2	Execution of simple programs based on data transfer (8 bit data) instructions for 8051/PIC etc
3	Execution of simple programs based on arithmetic and logical instructions(8 bit) for 8051/PIC etc
4	Execution of programs using bit addressable memory, for 8051/PIC etc
5	Execution of programs using any hardware/ software interrupts for 8051/PIC etc
6	Interfacing serial ports/communication to microcontroller
7	Interfacing of 8255 to 8051/PIC
8	Interfacing of LED, LCD display to microcontroller
9	Interfacing of dc motor/stepper motor to 8051/PIC
10	Interfacing of ADC to 8051/PIC
11	Interfacing of DAC to 8051 to generate various signals like square, triangular, saw tooth *etc*./PIC
12	Development of simple system based on microcontroller

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Dated: 18th April 2023

Mapping Of Course Outcome With Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO 13	PO 14	PO 15
CO1	3	3			2	1		1		1		1	1	1	1
CO2	3	2		1	3	1	1	1	1	1		1	1	1	2
CO3	3	2		1	3	1	1	1	1	1		1	1	1	1
CO4	3	1		1	2	1		1	1	1		1	1	2	2
CO5	3			1	3	1	1	1	1	1		1		1	1

1- Low 2 – Medium 3 - High

Sample Assessment Table:

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce					

Sample Assessment Pattern:

Preparation (S1)	05	
Conduct of Experiment (S2)	10	
Observation and Analysis of Results (S3)	05	
Record (S2)	05	
Mini-Project / Presentation/ Viva-Voce (S3)		
Total	25	

Designed by
Dr. Sandhya Kulkarni

Approved in XXVth Academic Council
Dated: 18th April 2023

EEPC3025: Lab Power Electronics	
Teaching Scheme Practical : 2Hrs/Week Tutorial : NIL Total Credits : 01	**Examination Scheme** ISE II :25 Marks ESE :25 Marks

Laboratory Course Outcomes:
As an outcome of completing the Laboratory course, students will able to:

CO1	Describe static and transient characteristics of SCR, IGBT, MOSFET
CO2	Explain various triggering method of SCR and measure the load voltages for varying firing angles
CO3	Explain forced commutation techniques and measure various parameters related to it
CO4	Explain single phase half wave, full wave/ three phase converters with various loads and measure the load voltages by changing firing angles
CO5	Explain the operations of Inverters/ Choppers and plot associated waveforms

List of Experiments: Term work shall consist of minimum eight experiments from the following:(Software based simulation can be used for some experiments)
Perform an experiment/simulate/study and

Sr. No.	Details
1	Plot Static V-I Characteristics of SCR, IGBT, MOSFET and measure I_L, I_H, V_{BO}
2	Plot Transient Characteristics of various switching devices
3	Construct SCR using two transistors.
4	Draw waveforms of load voltages by varying firing angles for R, R-C, UJT Triggering Methods of SCR.
5	Draw waveforms of load voltages using Forced Commutation methods of SCR.
6	Draw waveforms of load voltages for single phase half wave and full wave Converter with R, RL loads.
7	Draw waveforms of load voltages for single phase half and fully controlled converter with R, RL loads.
8	Draw waveforms of load voltages for three phase converters with different types of load.
9	Observe the operation of Series/ parallel Inverters and measure associated voltages
10	Observe the operation of SCR D.C. Choppers and measure output voltage by varying duty ratio
11	Study of D. C. Power Supplies/ A. C. Power Supplies
12	Study of SCR/IGBT based Industrial applications

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Dated: 18th April 2023

Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	1	2	3	2	1	2		2	2	2		2			
CO2	1	2	3	2	1	2		2	2	2		2			
CO3	1	2	3	2	1	2		2	2	2		2			
CO4	1	2	3	2	1	2		2	2	2		2			
CO5	1	2	3	2	1	2		2	2	2		2			

1 – High 2 – Medium 3 - Low

Sample Assessment Table:

Assessment Tool	**S1+S2+S3**	**S1+S2+S3**	**S1+S2+S3**	**S1+S2+S3**	**S1+S2+S3**
Course Outcomes	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce (25 marks)	05	05	05	05	05

Sample Assessment Pattern:

Preparation (S1)	05	-
Conduct of Experiment (S2)	05	05
Observation and Analysis of Results (S3)	10	05
Record (S2)	05	05
Mini-Project / Presentation/ Viva-Voce (S3)	-	10
Total :	**25**	**25**

Designed by
Prof. S. S. Mopari

Approved in XXVth Academic Council
Dated: 18th April 2023

EEES3026:Lab Machine Learning	
Teaching Scheme Practical : 2 hrs/Week Tutorial : Nil Total Credits : 01	**Examination Scheme** ISE I : 25 marks ESE : 25 marks

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Differentiate various control systems
CO2	Describe various control system components
CO3	Analyze performance of linear second order system in Time domain
CO4	Analyze and evaluate performance of linear second order system in Frequency domain
CO5	Explain operation of industrial controllers

List of Experiments:

Term-work shall consist of minimum eight experiments based on the following concept:

1. Python/MATLAB Introduction:
2. Loops and Conditions and other preliminary stuff,
3. Functions, Classes and Modules,
4. Exceptions, Database access,
5. Mathematical computing with Python packages like: numpy, Mat-plotLib, pandas Tensor Flow, Keras
6. Implement basic ML models like SVM, KNN, K-Means, Logistic Regression, Linear Regression

- ★ Students need to submit homework and projects via Google classroom.
- ★ Each submission must be an outcome of individual effort.

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Dated: 18th April 2023

Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1			2	1		1		1		1		1	1
CO2	3	2		1	3	1	1	1	1	1		1		1	1
CO3	3	2		1	3	1	1	1	1	1		1		1	1
CO4	3	1		1	2	1		1	1	1		1		1	1
CO5	3			1	3	1	1	1	1	1		1		1	1

1 -Low 2 – Medium 3 - High

Sample Assessment Table:

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce					

Sample Assessment Pattern:

Preparation (S1)	05	
Conduct of Experiment (S2)	10	
Observation and Analysis of Results (S3)	05	
Record (S2)	05	
Mini-Project / Presentation/ Viva-Voce (S3)		
Total	25	

Designed by

Dr. N. J. Phadkule

Approved in XXVth Academic Council
Dated: 18th April 2023

Program Elective II(EEPE3031-3036)

EEPE 3031: Lab Industrial Electrical Systems	
Teaching Scheme	**Examination Scheme**
Practical : 2 hrs/Week	ISE I : 25 marks
Tutorial : Nil	ESE : 25 marks
Total Credits : 01	

Laboratory Course Outcomes:
After completing the laboratory course students will able to:

CO1	Awareness of National Electric Code
CO2	Enable the students to design of electrical installation of residential & factory building
CO3	Acquire knowledge about testing and installation & maintenance of transformers , circuit breakers and induction machines
CO4	Ability to design various protective devices in power system for protecting equipment and personnel

List of Experiments: Term-work shall consist of minimum eight experiments of which at least minimum 2 from each of the following:

1. Study of National Electrical Code (NEC), 2011
2. Design electrical installation scheme for given 1 BHK residential unit/ electrical laboratory
3. Design electrical installation scheme of a given factory/ small industrial unit.
4. Design public lighting installation scheme of given premises
5. Design H. T./L.T. line installation scheme for given HT (11kV) or LT (415 V) line
6. Visit to Grid substation/ switchyard.
7. Maintenance and installation of Power transformer
8. Maintenance and installation of Vacuum or SF6 circuit Breaker
9. Study of PLC and SCADA for distribution automation
10. Study/Design of industry standard 3 phase induction motor control panel
11. Earthling Design
12. Lightning protection
13. Estimation and drawing layout of Industrial zones as per industrial requirements

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Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	1	1			1				1		1			
CO2	3	2	1	1		1			1	1		1			
CO3	3	1	1	1		1			1	1		1			
CO4	3	1	1	1		1			1	1		1			

1 -Low 2 – Medium 3 - High

Sample Assessment Table:

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO 1	CO 2	CO 3	CO 4	CO5
ISE I (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce					

Sample Assessment Pattern:

Preparation (S1)	05
Conduct of Experiment (S2)	10
Observation and Analysis of Results (S3)	05
Record (S2)	05
Mini-Project / Presentation/ Viva-Voce (S3)	
Total	25

Designed by
Dr. S. M. Shinde & Dr. S. P. Ghanegaonkar

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Dated: 18th April 2023

EEPE 3032: Lab High Voltage Engineering,	
Teaching Scheme Practical : 2Hrs/Week Tutorial : NIL Total Credits : 01	Examination Scheme ISE I : 25 Marks ESE : 25 Marks

The High Voltage Lab in Electrical Engineering Department is a facility that has been created with a view to not only provide real time experience to learners about working on High Voltage phenomena including dielectric puncture, HV measurement techniques, protection aspects but also serve as a powerful platform for academic, industry and society linkages through testing for mutual benefit

Laboratory Course Outcomes: As an outcome of completing the Laboratory course, students will able to:

CO1	Understand various ways of generation of high voltages
CO2	Compare the quality of solid insulating material
CO3	Measure the breakdown strength of liquid insulating material
CO4	Understand the importance of appropriate clearances around high voltage equipment
CO5	Understand the importance of calibration, detail specifications and various standards

List of Experiments: Term-work shall consist of record of *minimum eight* experiments of the following:

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Sr. No.	Details
1	Measurement of dielectric strength of transformer oil
2	Measurement of High A.C. Voltage using sphere gap
3	Measurement of breakdown strength of solid insulating material
4	Impulse voltage test on insulator
5	Power frequency test on insulator
6	Tan δ measurement of insulator
7	Study of Impulse Generator
8	Calibration of E. S. V. using sphere gap
9	Layout of High Voltage Laboratory
10	Study of voltage doubler principle
11	Measurement of insulation resistance of cable
12	Study of high voltage simulator
13,14	Record of-detailed specifications of *any two* with study of rating, manufacturing process (of any one of them) in case of following electrical equipment list- on the basis of survey conducted by the group of students List of the equipment: 1. Various types of circuit breakers ,2. Various lights/luminaries ,3. Distribution transformers ,4. Instrument transformers ,5. Solar water heater ,6. All types of industrial fans ,7. D-G sets ,8. All Pumps
15,16	Study of any one of the 'Indian Standard' related to following electrical apparatus on the basis of corresponding IS No., important provisions in that IS, amendments(how many, when, why, comparison with older version) Porcelain bushings for alternating voltages up to and including 1000V b) Bushings for alternating voltages above 1000 volts c) Control Transformer for switchgear and control gear for Voltages not exceeding 1000V AC d) Dry type Transformer e) Outdoor Three Phase Distribution Transformer upto including 100 kVA,11 kV f) Power Transformers g) Transformer oil h) Insulation Coordination of highest voltages for equipments i) High voltage alternating current circuit breakers j) Porcelain insulators overhead power lines with nominal voltage greater than 1000V k) Voltage transformer , Insulation Coordination Record of any one of the following Comparison of specifications for Voltage transformer IS 3156 and IEC 186 Comparison of specifications for Insulation Coordination IS 2165 and IEC-171

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Mapping of Course Outcome with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PS O2	PS O 3
CO1	3	1	1				1	3	2	1	1	2	3		
CO2	3	3	2	3		1	3	3	2	1	3	2	3		
CO3	3	3	2	2		3	3	3	2	1	3	2	3		
CO4	3	3	1	1		3	1	3	2	1	3		3		
CO5	3	2	3	1		3	3	3	3	1	3	1	3		

1- Low 2 – Medium 3 - High

Sample Assessment Table:

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce	05	05	05	05	05

Sample Assessment Pattern:

Preparation (S1)	05
Conduct of Experiment (S2)	
Observation and Analysis of Results (S3)	10
Record (S2)	10
Mini-Project / Presentation/ Viva-Voce (S3)	
Total	25

Designed by Prof. V A Kulkarni(Deodhar)

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EEPC3033 : Lab Renewable Energy Technology	
Teaching Scheme Practical : 2Hrs/Week Tutorial : NIL Total Credits : 01	**Examination Scheme** ISE III : 25 Marks Practical and Viva-Voce : 25 Marks

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to:

CO1	Elaborate different types of energy sources
CO2	Understand I-V and P-V Characteristics of Solar cell & Estimate the fill factor
CO3	Analyze wind resources and energy production from wind turbines
CO4	Plot electrical characteristics of fuel cell
CO5	Explain Biogas plant

List of Experiments: Term-work shall consist of minimum ten experiments from the following:

Sr. No.	Details
1	Plot I-V and P-V characteristics of single Solar PV Module with radiation and temperature changing effects
2	Plot I-V and P-V characteristics with series and parallel combination of Solar PV modules
3	Study effect of shading on output power of Solar PV Module
4	Measure output power of solar PV system with effect of tilt angle
5	Plot charging and discharging characteristics of battery
6	Measure performance parameters of DC load system with and without battery (with variable rated capacity system) in Solar PV stand-alone system
7	Measure performance parameters of AC load system with and without battery in Solar stand-alone PV system.
8	Measure performance parameters of Combine AC and DC load system with and without battery in Solar stand-alone PV system
9	Identify and measure the parameters of a solar PV Module at Specific location
10	Measure the spectral response of a solar cell and Calculate quantum efficiency
11	Study of biogas plant
12	Study solar resource assessment station and record associated parameters
13	Simulate characteristics of fuel cell using electrical software

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14	Simulate operation of wind turbine and measure associated parameters using electrical software
15	Study of Tri-brid system

Mapping of Course Outcome With Program Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO 13	PO 14	PO 15
CO1	3	3			2	1		1		1		1	1	1	1
CO2	3	2		1	3	1	1	1	1	1		1	1	1	2
CO3	3	2		1	3	1	1	1	1	1		1	1	1	1
CO4	3	1		1	2	1		1	1	1		1	1	2	2
CO5	3			1	3	1	1	1	1	1		1		1	1

1- Low 2 – Medium 3 - High

Sample Assessment Table:

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce					

Sample Assessment Pattern:

Preparation (S1)	05	
Conduct of Experiment (S2)	10	
Observation and Analysis of Results (S3)	05	
Record (S2)	03	
Mini-Project / Presentation/ Viva-Voce (S3)	02	
Total	25	

Designed by
Dr. S M Shinde

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EEPE3034: Lab Internet of Things	
Teaching Scheme Practical : 2 hrs/Week Total Credits : 01	Examination Scheme ISE I : 25 marks ESE : 25 marks

Laboratory Course Outcomes:

As an outcome of completing the Laboratory course, students will able to

CO1	develop arduino programming for problem solving
CO2	develop arduino programming with LED, button and switch
CO3	interpret analog and digital communications with arduino
CO4	develop arduino programming for connecting sensors and actuators to control the applications
CO5	develop IoT based application

List of Experiments

1. Introduction of Arduino IDE
2. Write an arduino program to demonstrate setup () and loop () functions
3. Write an arduino program to demonstrate serial and serial.begin() statements
4. Write an arduino program to demonstrate serial.print() statement
5. Write an arduino program to demonstrate serial.available() statement
6. Write an arduino program to demonstrate serial.read() and serial.write() statements
7. Write an arduino program to demonstrate serial.analogRead() function
8. Write an arduino program to demonstrate user defined functions
9. Write an arduino program to demonstrate data types.
10. Write an arduino program to demonstrate variables
11. Write an arduino program to demonstrate constants
12. Write an arduino program to demonstrate operators
13. Write an arduino program to demonstrate if statements
14. Write an arduino program to demonstrate switch case
15. Write an arduino program to demonstrate loops
16. Write an arduino program to demonstrate arrays
17. Write an arduino program to demonstrate strings
18. Write an arduino program to demonstrate string object

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19. Write an arduino program to demonstrate time based functions
20. Write an arduino program to demonstrate random numbers generation
21. Write an arduino program to demonstrate digital I/O functions
22. Write an arduino program to demonstrate analog I/O functions
23. Write an arduino program to demonstrate light an LED
24. Write an arduino program to demonstrate the 7-segment display.
25. Write an arduino program to demonstrate button
26. Write an arduino program to demonstrate switch
27. Write an arduino program to demonstrate interrupts
28. Write an arduino program to demonstrate UART communication protocol
29. Write an arduino program to demonstrate I2C communication protocol
30. Write an arduino program to demonstrate SPI communication protocol
31. Write an arduino program for interfacing with potentiometer.
32. Write an arduino program for interfacing with temperature sensor
33. Write an arduino program for interfacing with PIR sensor
34. Write an arduino program for interfacing with infrared and ultrasonic sensor
35. Write an arduino program for interfacing with accelerometer
36. Write an arduino program for interfacing with PWM
37. Write an arduino program for interfacing with servo motor
38. Write an arduino program for interfacing with stepper motor
39. Write an arduino program for interfacing with DC motor

Reference Books:

[1] Brian Evans, Beginning Arduino Programming, New York: Apress, 2011.
[2] Cornel Amariei, Arduino Development Cook Book, Birmingham: Packt Publishing Ltd., 2015.

Mapping of Course Outcome With Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3				1		1		1		1			1
CO2	3	2		1		1	1	1	1	1		1			1
CO3	3	2		1		1	1	1	1	1		1			1
CO4	3	1		1		1		1	1	1		1			1
CO5	3			1		1	1	1	1	1		1			1

1- Low 2 – Medium 3 - High

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Sample Assessment Table:

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO1	CO2	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce					

Sample Assessment Pattern:

Preparation (S1)	05	
Conduct of Experiment (S2)	10	
Observation and Analysis of Results (S3)	05	
Record (S2)	03	
Mini-Project / Presentation/ Viva-Voce (S3)	02	
Total	25	

Designed by
Dr. N. J. Phadkule

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