K.K.Wagh Institute of Engineering Education and Research, Nasik (Autonomous w.e.f. A.Y.2022-23)
Details of Course Structure: S.Y. B.Tech Electrical Engineering

● **Summary of Credits and Total Marks for U.G.Programme:**

Semester	**S.Y. B.Tech**	
	Total Credits (TH+PR/OR/TU)	**Total Marks**
III	22	750
IV	20	700
Total	**42**	**1450**

● **Description of various Courses:**

Type of Course	**Description**	**Type of Course**	**Description**
ESC	Engineering Science Course - Workshop - Drawing- Fundamentals of different branches	DCC	Department Core Course
BSC	Basic Science Courses	DEC	Department Elective Course
LHSM	Liberal arts, Humanities, Social Sciences and Management courses	OEC	Open Elective Courses of other technical or emerging areas /Courses designed by Industry
PSI	Project work, Seminar, Internship, PBL	IMC	Induction and Mandatory Courses
NC/AC	Non Credit Courses /Audit Courses	ASM	Additional Specialized / MOOCs

SEM-III																
Course Code	**Course Type**	**Title of the Course**	**Teaching Scheme Hrs./Week**			**Evaluation Scheme and Marks**							**Credits**			
			TH	**TU**	**PR**	**INSEM**	**ENDSEM**	**CCE**	**TU/TW**	**PR**	**OR**	**Total**	**TH**	**TU**	**PR/OR**	**Total**
SMH222001	BSC	Applied Mathematics-III	3	1	--	20	60	20	25	--	--	125	3	1	--	4
ELE222002	DCC	Analog and Digital Circuits	3	--	--	20	60	20	--	--	--	100	3	--	--	3
ELE222003	DCC	Measurement and Instrumentation	3	--	--	20	60	20	--	--	--	100	3	--	--	3
ELE222004	ESC	Electrical Engineering Materials	3	--	--	20	60	20	--	--	--	100	3	--	--	3
ELE222005	DCC	Transformer and Induction Machines	3	--	--	20	60	20	--	--	--	100	3	--	--	3
ELE222006	LHSM	Engineering Ethics	1	--		--	--	--	25	--	--	25	1			1
ELE222007	DCC	Measurement and Machines Lab	--	--	4	--	--	--	25	50	--	75	--	--	2	2
ELE222008	DCC	Analog and Digital Circuits Lab	--	--	2	--	--	--	25	25	--	50	--	--	1	1
ELE222009	ESC	Electrical Engineering Materials Lab	--	--	2	--	--	--	25	--	25	50	--	--	1	1
ELE222010	PSI	Python for Numerical Methods	--	--	2	--	--	--	25	--	--	25	--	--	1	1
		Total	**16**	**1**	**10**	**100**	**300**	**100**	**150**	**75**	**25**	**750**	**16**	**1**	**5**	**22**

SEM-IV																
Course Code	**Course Type**	**Title of the Course**	**Teaching Scheme Hrs./Week**			**Evaluation Scheme and Marks**							**Credits**			
			TH	**TU**	**PR**	**INSEM**	**ENDSEM**	**CCE**	**TU/TW**	**PR**	**OR**	**Total**	**TH**	**TU**	**PR/OR**	**Total**
ELE222011	DCC	Electrical Network Analysis	3	--	--	20	60	20	--	--	--	100	3	--	--	3
ELE222012	DCC	Microcontroller and Embedded Systems	3	--	--	20	60	20	--	--	--	100	3	--	--	3
ELE222013	DCC	Power Electronics	3	--	--	20	60	20	--	--	--	100	3	--	--	3
ELE222014	DCC	Power System Engineering	3	--	--	20	60	20	--	--	--	100	3	--	--	3
ELE222015	LHSM	Design Thinking for Academic Project	3	--	--	20	60	20	--	--	--	100	3	--	--	3
ELE222016	AC	Solar PV System	1	--		--	--	--	--	--	--	--	--	--	--	--
ELE222017	DCC	Power Electronics Lab	--	--	4	--	--	--	25	50	--	75	--	--	2	2
ELE222018	DCC	Electrical Network Analysis Lab	--	--	2	--	--	--	25	--	25	50	--	--	1	1
ELE222019	DCC	Microcontroller and Embedded Systems Lab	--	--	2	--	--	--	25	--	25	50	--	--	1	1
ELE222020	PSI	Project Based Learning	--	--	2	--	--	--	25	--	--	25	--	--	1	1
		Total	**16**	**0**	**10**	**100**	**300**	**100**	**100**	**50**	**50**	**700**	**15**	**0**	**5**	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: III (Electrical Engineering)
SMH222601: Applied Mathematics-III

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3hrs/week **Tutorial: 1hr/week**	**TH: 3** **TU: 1**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks** **Tutorial / Termwork: 25 Marks**

Prerequisite Courses: - Higher Secondary Mathematics

Course Objectives: The objectives of the course are to
1. Make the students familiarized with concepts and techniques in Ordinary differential equations, Laplace transform, Fourier transform and Z-transform, Vector Calculus, and Optimization
2. Introduce the techniques to understand advanced-level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Define L.T, F.T, Z.T, L.D.E, and Vector calculus, and prove their Properties.	1-Remember
CO2	Identify methods or techniques to solve particular types of mathematical problems.	2-Understand
CO3	Solve electrical engineering problems using appropriate transforms and techniques	3- Apply
CO4	Analyze the Real life problem using different mathematical transforms.	4- Analyze

COURSE CONTENTS

Unit I	**Linear Differential Equations with Constant Coefficient**	**(8hrs+2hrs Tutorial)**	**CO1, CO2, CO3,CO4**

LDE of nth order with constant coefficients, Method of Variation of Parameters, Cauchy's and Legendre's DE, Simultaneous DE.

Unit II	**Laplace Transform**	**(8hrs+2hrs Tutorial)**	**CO1, CO2, CO3,CO4**

Laplace Transform: Definition of LT, Inverse LT, Properties and theorems, LT of standard functions, LT of some special functions viz. Periodic, Unit Step, Unit Impulse. Applications of LT for Solving Linear differential equations and Electric circuits by Laplace transform.

Unit III	**Fourier Transform**	**(8hrs+2hrs Tutorial)**	**CO1, CO2, CO3,CO4**

Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine and Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses, Application to square, triangular, saw tooth wave.

Unit IV	Z Transform	(8hrs+2hrs Tutorial)	CO1, CO2, CO3,CO4
Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses using long division, residual, and partial fraction methods. Introduction to FIR and IIR system, Solution of difference equations			
Unit V	**Vector Calculus**	**(8hrs+2hrs Tutorial)**	**CO1, CO2, CO3,CO4**
Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrigational, and Conservative fields, Scalar potential, and Vector identities. Line, Surface, and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem, Applications to problems in Electromagnetic fields.			

Text Books

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Eastern Ltd.
2. P. N. Wartikar and J. N. Wartikar, "Applied Mathematics" (Volumes I and II), Pune Vidyarthi Griha Prakashan, Pune.
3. M. D. Greenberg, "Advanced Engineering Mathematics", 2nd Edition, Pearson Education

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignment 1 (Based on Units I and II) (Deadline: before Insem)	5
2	Assignment 2 (Based on Units III and IV) (Deadline: before Endsem)	5
3	LearniCo (Best 5 sessions out of Minimum 10 sessions)	5
4	Class Test (Before Endsem on Units III, IV, V)	5

List of Tutorial Assignments		
Sr. No.	**Title of Assignment**	**COs Mapped**
1.	Solution of first and second-order ODE for electrical networks using different techniques.	**CO1, CO2, CO3,CO4**
2.	Representation and solution of O.D.E obtained in tutorial 1 in Laplace domain and verification of result using MATLAB.	**CO1, CO2, CO3,CO4**
3.	Obtain the FT of the following waveforms. 1) Distorted sine wave 2) Square wave 3) Triangular wave	**CO1, CO2, CO3,CO4**
4.	Calculation of power using Fourier transform, voltage, and current using MATLAB.	**CO1, CO2, CO3,CO4**
5.	Representation of difference equation in Z-transform and impulse/step response of the same.	**CO1, CO2, CO3,CO4**
6.	Apply Curl and Divergence of vector in an electromagnetic field.	**CO1, CO2, CO3,CO4**

Guidelines for Tutorial / Termwork Assessment		
Sr. No.	**Components for Tutorial / Termwork Assessment**	**Marks Allotted**
1	Assignment on Computational software	5
2	Tutorial (Each tutorial carries 15 marks)	15
3	Attendance (Above 95 %: 5 Marks, below 75% : 0 Marks)	5

Strength of CO-PO-PSO Mapping														
	PO												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	--	--	--	--	--	--	--	--	--	--	--	--
CO2	3	3	3	--	--	--	--	--	3	3	--	--	--	--
CO3	3	3	3	2	--	--	--	--	3	3	--	--	--	2
CO4	3	3	3	2	1	--	--	--	3	3	--	1	--	2

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S. Y. B. Tech.
Pattern 2022-Semester: III (Electrical Engineering)
ELE222002: Analog and Digital Circuits

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3 hrs/week	**Th-3**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: Fundamentals of Electronics Engineering

Course Objectives: The objectives of the course are to
1. Introduce the applications of analog and digital IC circuits to the students
2. Explain the concepts of Linear and nonlinear applications of OPAMP.
3. Empower students to design the digital circuits for the given problem statement.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	understand different digital memories and programmable logic families	2. Understand
CO2	Describe linear and nonlinear applications of OPAMP with derivations and related graphs	2. Understand 3. Apply
CO3	Design different combinational and sequential digital circuits using K-Map.	6-Create
CO4	Design analog circuits based on OPAMP for a given problem.	6-Create

COURSE CONTENTS			**COs mapped**
Unit I	**Linear Applications of OPAMP**	**8 hrs.**	**CO2,CO4**
Ideal and Practical characteristics of OPAMP, Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, differentiator, active filter, voltage regulator, V-I and I-V converters.			
Unit II	**Nonlinear applications of OPAMP**	**8 hrs.**	**CO2,CO4**
Zero crossing detector, Design of First Order Filters, Peak Detector, Instrumentation Amplifier, Oscillators (Wein bridge and Phase shift), Square, Triangular, and Saw Tooth Waveform Generator			
Unit III	**D/A and A/D converters**	**8 hrs.**	**CO2,CO4**
Digital to Analog converters: Weighted resistor/converter, R-2R Ladder D/A converter, examples of D/A converter, sample and hold circuit **Analog to Digital converter**: Dual slope A/D Conversion, Successive Approximation A/D Conversion, V to F, and F to V converter.			
Unit IV	**Design of combinational logic circuit**	**8 hrs.**	**CO3**
The standard representation of logic functions, Karnaugh map: structure for two, three, and four, SOP and POS form reduction of Boolean expressions by K-map. Design of combinational circuits using Boolean expressions and K-maps, encoders, decoders, and a digital comparator.			
Unit V	**Design of sequential circuit**	**8 hrs.**	**CO1,CO3**
Shift registers, Introduction to sequential circuit Design of asynchronous counters Up and down synchronous counters using K-map, N modulo counters,			

Digital memories: RAM, ROM, EPROM; digital logic families: PAL, PLA, FPGA
Text Books
1. Jaico and Charles H. Roth, "Fundamentals of Logic Design," Jr. Fourth Edition, Jaico Publishing House. 2. James, "Operational Amplifier and Linear Integrated Circuits Theory and Application," Jaico Publishing House.
Reference Books
1. Thomas Floyd and R.P. Jain, "Digital Fundamentals", 8th edition, Pearson Education. 2. P. Jain, "Modern Digital Electronics", 5th edition, Tata McGraw Hill, New Delhi. 3. Gaikwad R., "Operational Amplifier", 4th Edition, PHI New Delhi.

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignment 1 (Based on Units I and II) (Deadline: before Insem)	5
2	Assignment 2 (Based on Units III and IV) (Deadline: before Endsem)	5
3.	LearniCo (Best 5 sessions out of Minimum 10 sessions)	5
4.	Mini project	5

Strength of CO-PO-PSO Mapping														
CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	--	--	--	--	--	--	--	--	--	--	--
CO2	3	3	3	--	3	--	--	--	--	--	--	--	3	--
CO3	3	3	3	2	3	--	--	--	2	2	--	2	3	--
CO4	3	3	3	2	3	--	--	--	2	2	--	2	3	--

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S. Y. B. Tech.
Pattern 2022 Semester: III (Electrical Engineering)
ELE222003: Measurement and Instrumentation

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3 hrs/week	**TH-3**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses:- Fundamentals of Electrical Engineering, Fundamentals of Electronics Engineering, Applied Physics

Course Objectives: The objectives of the course are to

1. Impart knowledge of the principle of measurement of electrical and physical quantities, construction, and operating principles of electrical instruments.
2. Select the proper instrument and methods for measurement.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Describe the working principles of various measuring instruments.	1-Remember
CO2	Explain the construction and working of measuring instruments and transducers with calibration.	2-Understand
CO3	Calculate power, energy, and circuit parameters using various measurement techniques.	3-Apply
CO4	Select appropriate measuring methods and transducers for the measurement of electrical and physical quantities.	3-Apply

COURSE CONTENTS

Unit I	**Measuring Instruments and Instrument Transformer**	**(8hrs)**	**COs Mapped - CO1**

Introduction, classification, static and dynamic characteristics of measuring instruments, deflecting, controlling and damping system, errors.
Measuring Instruments: Principle and construction of moving coil, moving iron, and dynamo meter-type instruments.
Instrument Transformer: Use of instrument transformers, ratios, basic constructional features of C.T. and P.T., ratio and phase angle errors, reduction of errors, and applications in measurement.

Unit II	**Measurement of Power and Energy**	**(8hrs)**	**COs Mapped - CO1, CO3**

Measurement of Power: Torque equation, errors and their compensation, advantages, and disadvantages of dynamometer type wattmeter, low power factor wattmeter, poly-phase wattmeter. Measurement of power by one, two & three-wattmeter methods.
Measurement of Energy: Construction, working principle, torque equation of single phase conventional (induction type) energy meter. TOD meter.

Unit III	**Measurement of Resistance, Inductance, and Capacitance**	**(8hrs)**	**COs Mapped - CO2, CO4**

Measurement of resistance: Wheatstone Bridge, Kelvin's Double Bridge, Ammeter-Voltmeter method, Earth Tester and Megger.

Measurement of inductance, Capacitance: Maxwell's Bridge, Anderson Bridge, Schering Bridge, Wien Bridge, Applications and Limitations.

Unit IV	**Electronic Instruments**	**(8hrs)**	**COs Mapped - CO1, CO3**

Signal Conditioning and Data Acquisition: Amplification, ADC and DAC, S/H Circuits, Data Acquisition: Single and Multi Chanel, Data Logging,
Electronic Instruments: Block diagram and operation of digital ammeter and voltmeter, Digital multimeters, Block diagram and operation of single phase and three phase static energy meter, Calibration of static energy meter. Digital Storage Oscilloscope

Unit V	**Instrumentation**	**(8hrs)**	**COs Mapped - CO3, CO4**

Instrumentation: Introduction, classification, types: resistive, inductive, capacitive transducers, basic requirements for transducers. Measurement of Temperature, Linear and Angular Displacement, Pressure, Flow, and Level Measurement.
Intelligent Sensors: General Structure of smart sensors and their components, Characteristics of smart sensors and applications.

Text Books

1. A. K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", 17th Edition, Dhanpat Rai & Co.
2. B. C. Nakra and K. K. Chaudhari, "Instrumentation Measurement and Analysis", 4th Edition, McGraw Hill Education India Private Limited
3. Melville Bigham Stout, "Basic Electrical Measurements", 3rd Edition, Literary Licensing, LLC
4. D. Patranabhis, "Sensors and Transducers", 2nd Edition, PHI Publications

Reference Books

1. E. W. Golding and F. C. Widdies, "Electrical Measurements and Measuring Instruments", 5th Edition, Reem Publications.
2. Rajendra Prasad, "Electronic Measurements and Instrumentation", 2nd Edition, Khanna Publishers.
3. Arun K. Ghosh, "Introduction to Measurements and Instrumentation", 4th Edition, PHI Publication.
4. M. M. S. Anand, "Electronics Instruments and Instrumentation Technology", 3rd Edition, PHI
5. D. A. Bell, "Electronic Instrumentation and Measurements", 3rd Edition, Oxford University Press
6. S. Gupta, J. P. Gupta, "PC Interfacing for Data Acquisition and Process Control", 2nd Edition, Instrument Society of America

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignment 1 (Based on Units I and II) (Deadline: before Insem)	5
2	Assignment 2 (Based on Units III and IV) (Deadline: before Endsem)	5
3.	LearniCo (Best 5 sessions out of Minimum 10 sessions)	5
4.	Class test (Before Endsem)	5

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	1	-	-	-	-	-	-	-	1	3	-
CO4	3	3	3	1	-	-	-	-	-	-	-	1	3	-

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S. Y. B. Tech.
Pattern 2022 Semester: III (Electrical Engineering)
ELE222004: Electrical Engineering Materials

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3hrs/week	**TH- 3**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: Fundamentals of Electrical Engineering, Applied Physics, Applied Chemistry

Course Objectives: The objectives of the course are to
1. Impart knowledge of physical properties of Electrical Engineering Materials.
2. Explain materials used for various electrical components with appropriate applications.

Course Outcomes: On completion of the course, students will be able to

	Course Outcomes	**Bloom's Level**
CO1	Define various terminologies used in engineering materials	1-Remember
CO2	Understand the significance of different materials for various components and applications	2-Understand
CO3	Comment on the behavior of the material under various operating conditions	3- Apply
CO4	Analyze the properties of electrical engineering material used in different electrical equipment and appliances.	4- Analyze

COURSE CONTENTS

Unit I	**Introduction to Electrical Materials**	**8 hrs.**	**CO1**

Importance of materials, Classification of electrical materials, Scope of electrical materials, Requirement of Electrical Engineering materials, Operational requirements of electrical materials, Types of engineering materials, Levels of material structure. Ferromagnetic semiconductors, Introduction to Thermoplastics, Rubbers, and Thermosets.

Unit II	**Dielectric Properties of Insulating Materials**	**8 hrs.**	**CO1, CO3**

Parameters of Dielectric material [Dielectric constant, Dipole moment, Polarization, Polarizability], Introduction to Polar and Non-Polar dielectric materials. Mechanisms of Polarizations- Clausius Mossotti Equation, Piezo-Electric, Pyro-Electric and Ferro-Electric Materials, Dielectric loss and loss tangent, Concept of the negative tan delta, insulating materials for supercapacitor.

Unit III	**Dielectric Breakdown and Testing of Materials**	**8 hrs.**	**CO2**

A) Dielectric Breakdown:
Introduction, Concept of Primary and Secondary Ionization of Gases (descriptive treatment only), Breakdown Voltage, Breakdown Strength, Factors affecting Breakdown Strengths of Solid, Liquid, and Gaseous dielectric materials.

B) Testing of Materials: Explanation of following with objectives, equipment required, circuit diagrams, and observations to be taken.

1. Measurement of dielectric loss tangent (tan δ) by Schering Bridge-IS 13585-1994.
2. Measurement of dielectric strength of solid insulating material-IS 2584.
3. Measurement of dielectric strength of liquid insulating material -IS 6798.
4. Measurement of dielectric strength of gaseous insulating material.

Unit IV	**Magnetic Materials and Conducting Materials**	**8 hrs.**	**CO1, CO3**

Magnetic Materials: Introduction, Parameters of Magnetic material [Permeability, Magnetic Susceptibility, Magnetization], Classification of Magnetic Materials, Diamagnetism, Paramagnetism,

Ferromagnetism, Ferri-magnetism, Ferro-magnetic behavior below Critical Temperature, Spontaneous Magnetization, Anti-ferromagnetism, Ferrites, Applications of Ferromagnetic Materials, Magnetic materials for Electric Devices such as Transformer Core, Core of Rotating Machines, Soft Magnetic Materials, Hard Magnetic Materials, materials used for Superconducting magnetic energy storage (SMES). High-density Magnetic materials.

Conducting Materials: Copper, Aluminum and its applications, Materials of High and Low Resistivity-Constantan, Nickel-Chromium Alloy, Tungsten, Kanthal, Silver and Silver alloys, characteristics of Copper Alloys (Brass & Bronze), Electrical Carbon Materials. Materials used for Lamp Filaments, Solders, Metals, and Alloys for different types of Thermal Bimetal and thermocouples. Introduction of High density conducting materials.

Unit V	**Advances and Application of Materials in Electrical Engineering**	**8 hrs.**	**CO3, CO4**

Superconductivity and Superconducting Materials, Semiconductor materials used for Solar PV (Types, Efficiency of Solar PV), Materials used in Batteries, Optical Communications (Optical Fibre), Composite Material, and Fuel Cells.

Text Books

1. S.P. Seth, "A Course in Electrical Engineering Materials", Dhanpat Rai and Sons publication.
2. R. K. Rajput, "A Textbook of Electrical Engineering Materials" Laxmi Publications (P) Ltd.
3. K. B. Raina and S. K. Bhattacharya, "Electrical Engineering Materials", S. K. Kataria Sons.
4. P.K. Palanisamy, "Material Science for Electrical Engineering", Scitech Pub. Pvt. Ltd., Chennai (India).

Reference Books

1. D. M. Tagare, "Electrical Power Capacitors-Design & Manufacture", Tata McGraw Hill Publication.
2. S. P. Chalotra and B. K. Bhattacharya, "Electrical Engineering Materials", Khanna Publishers, Nath Market.
3. C. S. Indulkar and S. Thiruvengadam, "Electrical Engineering Materials", S. Chand and Company Ltd.
4. Kamraju and Naidu, "High Voltage Engineering", Tata McGraw Hill Publication.
5. James F. Shackelford & M. K. Muralidhara, "Introduction to Material Science for Engineering", Sixth Edition, Pearson Education.
6. IEEMA Ratner, "Insulation Technology Course Material", Pearson Education.
7. Traugott Fischer, "Materials Science for Engineering Students", Elsevier Publications.
8. Rakesh Das Begamudre, "Energy Conversion Systems", New Age International Publishers.

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignment 1 (Based on Units I and II) (Deadline: before Insem)	5
2	Assignment 2 (Based on Units III and IV) (Deadline: before Endsem)	5
3.	LearniCo (Best 5 sessions out of Minimum 10 sessions)	5
4.	Group Presentations	5

	Strength of CO-PO-PSO Mapping													
Strength of	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	--	--	--	--	--	--	--	--	--	--	--	--	--
CO 2	3	2	--	--	--	--	--	--	--	--	--	--	--	--
CO 3	3	2	--	2	--	--	--	--	2	2	--	2	--	--
CO 4	3	2	--	2	--	--	--	--	2	2	--	2	--	--

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2020 Semester: III (Electrical Engineering)
ELE222005: Transformers and Induction Machines

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3 hrs./week	**TH: 3**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: Fundamentals of Electrical Engineering

Course Objectives: The objectives of the course are to

1. Understand the parameters of the equivalent circuit, and its determination by conducting various tests and analyses of the transformer at various loads.
2. Understand the vector groups, parallel operations, and load sharing of transformers.
3. Study the working principle, equivalent circuit, equivalent circuit parameters, and its analysis to evaluate the performance of three-phase induction motors.
4. Study the construction, working principle, and performance of a single-phase induction motor.

Course Outcomes: On completion of the course, students will be able to –

	Course Outcomes	**Bloom's Level**
CO1	State construction and working principle of transformer and induction machines.	1-Remember
CO2	Explain various characteristics and torque speed relations of electrical machines.	2-Understand
CO3	Calculate equivalent circuit parameters of the given machines	3-Apply
CO4	Analyze the performance parameters of machines and compare with standards.	4-Analyze
CO5	Select machines for appropriate applications.	4-Analyze

COURSE CONTENTS

Unit I	**Single Phase Transformers:**	**8 hrs.**	**CO1, CO3, CO4**

Transformers on no-load and on–load, equivalent circuits. Tests to determine equivalent circuit parameters, and phasor diagrams on no-load and on-load. Efficiency, maximum efficiency, transformer ratings. Polarity test, Determination of voltage regulation. Connections for three-phase operation – star/star delta/delta, star/delta, delta/star, zigzag/star, and V/V. Tastings as per Indian Standards.

Unit II	**Three-Phase Transformers:**	**8 hrs**	**CO1, CO3, CO4**

Phase conversion and parallel operation of Three Phase Transformers
Scott connection for three-phase to two-phase conversion, vector groups. Magnetizing current in transformers

Transformer Testing: Polarity Test, Back-to-Back Test (Sumpner Test) on single phase and three phase transformer, Induction Regulators.

Special Transformers: Welding Transformers, Converter Transformers, Transformer behavior on non-sinusoidal supply (K-rated transformer)

Unit III	Three-Phase Induction Motor: Part-A	8 hrs.	CO2, CO3, CO4, CO5
Construction, the principle of working, losses and efficiency, phasor diagrams, equivalent circuit. Analysis of equivalent circuit, torque-slip and power-slip characteristics. Tests to determine the equivalent circuit parameters, circle diagram.			
Unit IV	**Three-Phase Induction Motor: Part-B**	**8 hrs.**	**CO2, CO3, CO4, CO5**
Staring of Induction motor, speed control of IM. Induction generators. , Comparison between SCIM and SRIM, Selection of motors based on application based. (NEMA standard)			
Unit V	**Single Phase Induction Motor**	**8 hrs.**	**CO2, CO3, CO4, CO5**
Construction of single phase induction motor, double field revolving theory. Equivalent circuit and torque-slip characteristics based on double-revolving field theory, Tests to determine the parameters of equivalent circuit and calculation of performance characteristics of the motor. Methods of self-starting. Types of single-phase induction motors: Split-phase motors (Resistor split-phase motor, Capacitor-start motor, Capacitor start and capacitor run the motor, and permanent capacitor motor). Comparison of 1-phase induction motor with 3-phase induction motor.			

Text Books

1. Dr. P.S. Bimbhra, "Electrical Machinery" Khanna Publications.
2. Dr. P.S. Bimbhra, "Generalized theory of Electrical Machinery" Khanna Publications.
3. Nagrath and Kothari, "Electrical Machines" 2nd Ed. Tata McGraw Hill.
4. Chenn K Krishna Reddy, "Electrical Machines- I and II" SciTech Publications (India) Pvt. Ltd. Chenn.
5. Edward Hughes, "Electrical Technology" ELBS, Pearson Education.
6. Smarajit Ghosh, "Electrical Machines" Pearson Education, New Delhi.

Reference Books

1. M.G. Say, "Performance and Design of AC. Machines", CBS Publishers and Distributors.
2. Charles I Hubert, "Electrical Machines Theory, Application, and Control", Pearson Education, New Delhi, Second Edition.
3. A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", Tata McGraw

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignment 1 (Based on Units I and II) (Deadline: before Insem)	5
2	Assignment 2 (Based on Units III and IV) (Deadline: before Endsem)	5
3.	LearniCo (Best 5 sessions out of Minimum 10 sessions)	5
4.	Class test (Before Endsem)	5

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	1	-	-	-	-	-	-	-	1	2	-
CO5	3	3	3	1	-	-	-	-	-	-	-	1	2	-

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech.
Pattern 2022 Semester: III (Electrical Engineering)
ELE222014: Engineering Ethics

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 1hrs/week	**TH-1**	**Term work-25 Marks**

Course Objectives: The objectives of the course are to

1. Prepare students for their professional responsibilities as Engineers.
2. Help them to think ethically about the problem situations that are common in Engineering
3. Evaluate the existing ethical standards for engineering practice.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Define various terms related to engineering ethics.	1-Remember
CO2	Elaborate on safety, rights, and responsibilities related to the workplace, IPR, and environment.	2-Understand
CO3	Evaluate the different situations ethically in engineering problems.	5- Evaluate

COURSE CONTENTS

Unit I	**Engineering Ethics**	**06hrs**	**CO1, CO3**

Morals, values and Ethics, Work ethic, Respect for others, Senses of Engineering Ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories.

Unit II	**Safety, Rights, and Responsibilities**	**08 hrs**	**CO1, CO2, CO3**

Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk – Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination
Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons development engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, and Corporate Social Responsibility.

TextBooks

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Reference Books

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard, and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

Guidelines for Termwork		
Sr. No.	**Components for Termwork**	**Marks Allotted**
1	Assignment 1 (Based on Unit I)	5
2	Assignment 2 (Based on Unit II)	5
3.	LearniCo (Best 5 sessions out of Minimum 10 sessions)	5
4.	Case studies	5

Strength of CO-PO-PSO Mapping														
	PO												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	--	--	--	--	--	--	--	3	--	--	--	--	--	--
CO2	--	--	--	--	--	3	--	3	--	--	--	3	--	--
CO3	--	--	1	--	--	3	--	3	--	--	--	3	--	--

K. K. Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: III (Electrical Engineering)
ELE222007: Measurement and Machines Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 4 hrs/week	**PR: 2**	**Termwork: 25 Marks** **Practical: 50 Mark**

Prerequisite Courses, if any: - Fundamentals of Electrical Engineering, Fundamentals of Electronics Engineering, Applied Physics

Course Objectives: The objectives of the course are to

1. Develop a deeper understanding of concepts in electrical measuring instruments and instrumentation.
2. Provide exposure to experimental skills in electrical and physical parameter measurement.
3. Provide exposure to experimental skills in transformer and induction motor.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Use measuring instruments, transducers, and various measuring techniques for the measurement of electrical and physical quantities.	3-Apply
CO2	Perform speed control and load test of three phase induction motor.	3-Apply
CO3	Perform experiment in the group, write a lab report, and present it effectively	3-Apply
CO4	Perform parallel operation of transformers and justify load sharing.	4-Analyse
CO5	Evaluate performance parameters of transformer and induction motor with experimentation.	4-Analyse

Part A: Measurement Lab

Perform any eight experiments from 1 to 13. An industrial visit is compulsory.

List of Laboratory Experiments		
Sr. No.	**Laboratory Experiments**	**CO Mapped**
1	Measurement of current, voltage, and power using instrument transformer (CT & PT).	CO1, CO3
2	Measurement of Power and Power Factor of a three-phase circuit by the two-wattmeter method.	CO1, CO3
3	Measurement of reactive power by one-wattmeter method with all possible connections of current coil and pressure coil.	CO1, CO3
4	To calibrate a single / three-phase Energy Meter by comparing it with a Substandard meter.	CO1, CO3
5	To measure unknown inductance using Anderson Bridge.	CO1, CO3
6	To measure unknown capacitance using Schering Bridge.	CO1, CO3
7	To measure the low resistance by using Kelvin Double Bridge Method.	CO1, CO3
8	To study and plot the characteristic of LVDT.	CO1, CO3
9	Measurement of voltage, current, time period, frequency, and phase angle using CRO.	CO1, CO3

10	Measurement of soil resistivity using four pin Wenner method.	CO1, CO3
11	Study of programmable LCR meter; Measure L, C, R, Q, dissipation factor, and power factor of the given component.	CO1, CO3
12	Study of Digital Storage Oscilloscope: a) Different modes in DSO such as Roll, Average, and Peak detection. b) Capture transients. c) Various MATH operations.	CO1, CO3
13	Detailed study of online Energy Monitoring System, various parameters, EMS software capabilities, trending with IOT applications. Demonstration of EMS system by inviting experts.	CO1, CO3
14	Industrial Visit Report (Compulsory).	CO1, CO3

Part B: Machine Lab

Perform any eight experiments from 1 to 10. An industrial visit is compulsory.

List of Laboratory Experiments		
Sr. No.	**Laboratory Experiments**	**COs Mapped**
1	O.C. and S.C. test on single-phase Transformer. a. Determination of equivalent circuit parameters from the test data. b. Determination of voltage regulation and efficiency.	CO1, CO3, CO5
2	Parallel operation of two single-phase transformers and study of their load sharing under various conditions of voltage ratios and leakage impedance.	CO1, CO3, CO4
3	Polarity test on single phase and three phase transformer.	CO1, CO3, CO4
4	Study of Back-to-Back Test (Sumpner Test) on single phase transformer.	CO1, CO3, CO5
5	To determine the phase conversion - Scott connection for three-phase to two-phase conversion.	CO1, CO3
6	Load test on a 3-phase induction motor.	CO1, CO3, CO5
7	Determination of parameters of equivalent circuit and performance analyses of IM.	CO1, CO3, CO5
8	Speed control of 3-phase IM by pole changing (SCIM).	CO1, CO2, CO3
9	Speed control of 3-phase IM by rotor resistance (SRIM).	CO1, CO2, CO3
10	Determination of equivalent circuit parameters of single-phase IM.	CO1, CO3, CO5
11	Industrial Visit Report (Compulsory).	CO3

Guidelines for Laboratory Conduction

1. The teacher will brief the given experiment to students for its procedure, observations, calculations, and outcome.
2. Apparatus and equipment required for the allotted experiment will be provided by the lab technician using SOP.
3. Students will perform the allotted experiment in a group (2-3 students in each group) under the supervision of faculty and lab technician.

4. After performing the experiment students will check their readings and calculations from the teacher.
5. After checking they have to write the conclusion on the final results.

Guidelines for Student's Lab Journal

The write-up should include a title, aim and apparatus, circuit or block diagram, waveforms, brief theory, procedure, observations, graphs, calculations, conclusion, and questions, if any.

Guidelines for Termwork Assessment

1. Each experiment from the lab journal is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for timely completion, R-2 for understanding, and R-3 for presentation/journal writing where each rubric carries ten marks.

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	--	--	--	--	--	--	--	--	2	2	--
CO2	--	--	--	--	--	--	--	--	1	1	--	--	--	--
CO3	2	2	2	--	--	--	--	--	--	--	--	2	2	--
CO4	2	2	2	--	--	--	--	--	--	--	--	2	2	--
CO5	2	2	2	--	--	--	--	--	--	--	--	2	2	--

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: III (Electrical Engineering)
ELE232008: Analog and Digital Circuits Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 2 hrs/week	**PR-1**	**Termwork: 25 Marks** **Practical: 25 Mark**

Prerequisite Courses: Fundamental of Electronics Engineering Lab

Course Objectives: The objectives of the course are to

1. Provide hands-on experience in analog and digital circuit design.
2. Inculcate design skills to construct applications of OPAMP, combinational and sequential circuits.
3. Impart software and hardware design skills.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Apply and analyze applications of OPAMP in a closed and open loop configuration.	3-Apply 4-Analyze
CO2	Perform experiment in the group, write a lab report, and present it effectively	3-Apply
CO3	Design and implement combinational and sequential circuits.	5-Create
CO4	Design uncontrolled rectifiers with given specifications	5-Create

List of Laboratory Experiments

Sr. No.	**Laboratory Experiments** (Perform any three from 1 to 5, perform any three from 8 to 11, 6 and 7 are compulsory)	**COs Mapped**
1.	Find the phase angle difference between the same frequency signal using ZCD and AND gate. (Hardware)	CO1, CO2
2.	Design of comparator for given reference voltage. (Hardware)	CO1, CO2
3.	Design sine, and triangular wave generator. (Hardware)	CO1, CO2
4.	Design first-order high pass and low pass filters using OPAMP in any open-source software for given specifications. (Software)	CO1, CO2
5.	Measurement of CMRR of 3 OPAMP Instrumentation amplifiers. (Hardware)	CO1, CO2
6.	Design of single phase bridge rectifier with output voltage and specified ripple. (this lab should be designed for each student, perform in simulation and demonstrate with hardware in the laboratory with design documents) (Software and Hardware)	CO2, CO4
7.	Implementation of A/D and D/A Converters	CO1, CO2
8.	Design of logical circuit for the display of decimal numbers on a seven-segment display. (Hardware)	CO2, CO3
9.	Design a three-bit full adder using any open-source software. (Software)	CO2, CO3

10.	Design a logical circuit to convert code from one numbering system to another (Software/Hardware)	CO2, CO3
11.	Design a digital clock or stopwatch using a decade counter.(IC74192) (Hardware)	CO2, CO3

Guidelines for Laboratory Conduction

1. The teacher will brief the given experiment to students for its procedure, observations, calculations, and outcome.
2. Apparatus and equipment required for the allotted experiment will be provided by the lab technician using SOP.
3. Students will perform the allotted experiment in a group (2-3 students in each group) under the supervision of faculty and lab technician.
4. After performing the experiment students will check their readings and calculations from the teacher.
5. After checking they have to write the conclusion on the final results.

Guidelines for Student's Lab Journal

The write-up should include a title, aim and apparatus, circuit or block diagram, waveforms, brief theory, procedure, observations, graphs, calculations, conclusion, and questions, if any.

Guidelines for TermWork Assessment

1. Each experiment from the lab journal is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for timely completion, R-2 for understanding, and R-3 for presentation/journal writing where each rubric carries ten marks.

Strength of CO-PO-PSO Mapping

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

K. K. Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: III (Electrical Engineering)
ELE222009: Electrical Engineering Materials Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 2 hrs/week	**OR-1**	**Termwork: 25 Marks** **Oral: 25 Marks**

Prerequisite Courses: Fundamentals of Electrical Engineering, Applied Physics, Applied Chemistry.

Course Objectives: The objectives of the course are to

1. Impart knowledge of the physical properties of Electrical Engineering Materials
2. Introduce the materials used in various electrical components

Course Outcomes: On completion of the course, students will be able to

	Course Outcomes	**Bloom's Level**
CO1	Perform testing of various electrical engineering materials as per IS standard	3-Apply
CO2	Interpret and analyze the results obtained from testing of materials through experimentation.	4-Analyze
CO3	Perform experiment in the group, write a lab report, and present it effectively	4- Apply

List of Laboratory Experiments

(All experiments are compulsory)

Sr. No.	**Laboratory Experiments**	**COs Mapped**
1.	To measure the dielectric strength of solid insulating materials.	CO1, CO2, CO3
2.	To measure the dielectric strength of liquid-insulating materials	CO1, CO2, CO3
3.	To measure the dielectric strength of gaseous insulating materials using Sphere Gap-Unit.	CO1, CO2, CO3
4.	To obtain the Hysteresis Loop of the Ferro-Magnetic Material.	CO1, CO2, CO3
5.	To understand the principle of thermocouples and to obtain characteristics of different thermocouples.	CO1, CO2, CO3
6.	To measure the Insulation Resistance and kVAr capacity of the power capacitor.	CO1, CO2, CO3
7.	To measure the Resistivity of High Resistive Alloys.	CO1, CO2, CO3
8.	Testing of resins and polymers.	CO1, CO2, CO3
9.	Industrial Visit (Compulsory)	CO1, CO2, CO3

Guidelines for Laboratory Conduction
1. The teacher will brief the given experiment to students for its procedure, observations, calculations, and outcome. 2. Apparatus and equipment required for the allotted experiment will be provided by the lab technician using SOP. 3. Students will perform the allotted experiment in a group (2-3 students in each group) under the supervision of faculty and lab technician. 4. After performing the experiment students will check their readings and calculations from the teacher. 5. After checking they have to write the conclusion on the final results.
Guidelines for Student's Lab Journal
The write-up should include a title, aim and apparatus, circuit or block diagram, waveforms, brief theory, procedure, observations, graphs, calculations, conclusion, and questions, if any.
Guidelines for Termwork Assessment
1. Each experiment from the lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding, and R-3 for presentation/journal writing where each rubric carries ten marks.

Strength of CO-PO-PSO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	--	2	2	--	--	--	--	--	--	--	--	--	--	--
CO2	1	2	2	1	--	--	--	--	--	--	--	1	--	--
CO3	--	--	--	--	--	--	--	--	1	1	--	--	--	--

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: III (Electrical Engineering)
ELE222010: Python for Numerical Methods

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 2 hrs/week	**TW-1**	**Termwork: 25 Marks**

Prerequisite Courses: Applied Mathematics-III, Computer Programming

Course Objectives: The objectives of the course are to
1) Develop analytical skills using numerical methods.
2) Develop critical thinking to solve a complex engineering problem.
3) Inculcate programming skills using Python language.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Choose the correct numerical method depending on the problem definition.	2-Understand
CO2	Solve the given complex problem using selected numerical methods.	3-Analyze
CO3	Develop an algorithm and flow chart for numerical methods.	4. Apply
CO4	Write programs for numerical methods using Python with graphical representation.	5. Create

List of Laboratory Experiments

Sr. No.	**Laboratory Experiments**	**COs Mapped**
1	Develop an algorithm, draw a flow chart, and write a program to implement the following: (a) for loop and while loop-- application in Descarte's rule of the sign. (b) if-else and functions-- application in Intermediate value theorem. (c) 2DArray formation-- application in matrix data entry, transposition, and printing matrix.	CO1, CO2, CO3, CO4
2	Develop an algorithm, draw a flow chart, and write a program to implement the Birge-Vieta method.	CO1, CO2, CO3, CO4
3	Develop an algorithm, draw a flow chart, and write a program to implement the Bisection/Regula falsi /Newton-Raphson method (single variable) in the following applications (formulate problem statement in any one of the following areas (but not limited to)) (a) Finding critical clearing angle in power system stability (give equation directly) (b) Relation between voltage and current in solar PV.	CO1, CO2, CO3, CO4
4	Develop an algorithm, draw a flow chart, and write a program to implement curve fitting using a least square approximation in the following applications (formulate problem statement in any one of the following areas (but not limited to))	CO1, CO2, CO3, CO4

	(a) Voltage across capacitor during charging. (b) Relate temperature and resistance in the thermocouple. (c) Current through inductor during excitation.	
5	Develop an algorithm, draw a flow chart, and write a program to apply Newton's forward/backward interpolation method in the following applications (formulate problem statement in any one of the following areas (but not limited to)) (a) Voltage across capacitor during charging (b) Relation of speed and armature voltage in DC motor. (c) Relation of breakdown voltage and thickness of insulation	CO1, CO2, CO3, CO4
6	Develop an algorithm, draw a flow chart, and write a program to apply Newton's divided difference/Lagrange's interpolation method in the following applications (formulate problem statement in any one of the following areas (but not limited to)) (a) Power transfer equation to find power at a particular angle (b) Transformer efficiency at particular loading (data of % loading and efficiency is known at a particular power factor) (c) Growth of electricity consumption in India (year Vs. Per capita electrical consumption).	CO1, CO2, CO3, CO4
7	Develop an algorithm, draw a flow chart, and write a program to implement the trapezoidal/ Simpson (1/3)rd rule in the following applications (formulate problem statement in any one of the following areas (but not limited to)) (a) RMS/Average value of given waveform. (b) Finding current through first-order circuit (RL series) (c) kWh consumption from the load curve (d) Magnetic field intensity in overhead transmission line	CO1, CO2, CO3, CO4
8	Develop an algorithm, draw a flow chart, and write a program to implement Gauss elimination/Jordan in the following applications (formulate problem statement in any one of the following areas (but not limited to)) (a) Electrical network using KVL (b) Electrical Network using KCL	CO1, CO2, CO3, a CO4
9	. Develop an algorithm, draw a flow chart, and write a program to implement Gauss Jacobi/Seidel in the following applications (formulate problem statement in any one of the following areas (but not limited to)) (a) Electrical network using KVL (b) Electrical Network using KCaL	CO1, CO2, CO3, CO4
10	Develop an algorithm, draw a flow chart, and write a program to implement Modified Euler's/4th order RK method in the following applications (formulate problem statement in any one of the following areas (but not limited to) (a) Response of RC series circuit with DC (b) Response of RL circuit with DC (c) Deflection angle in MI-type instrument	CO1, CO2, CO3, CO4
Guidelines for Laboratory Conduction		
The Instructor Manual should contain the following related to every program • Theory related to the method • Algorithm and Flowchart of the method • Three to four different sets of problem statements for the numerical method		

- Solve numerical using the appropriate method
- Ten questions based on method and related Python commands
- Expected Output

Guidelines for Student's Lab Journal

The student's Lab Journal should contain the following related to every experiment:

- Theory related to the method
- Algorithm and Flowchart of the method
- Three to four different sets of problem statements for the numerical method
- Solve numerical using the appropriate method
- Ten questions based on method and related Python commands

Guidelines for Termwork Assessment

1. Each experiment from the lab journal is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for timely completion, R-2 for understanding, and R-3 for presentation/journal writing where each rubric carries ten marks.

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	--	--	--	--	--	--	--	--	--	--	--	--
CO2	3	3	3	--	--	--	--	--	--	--	--	--	--	--
CO3	3	3	3	2	2	--	--	--	2	2	--	2	--	--
CO4	--	--	--	2	2	--	--	--	2	2	--	2	--	--

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: IV(Electrical Engineering)
ELE222011: Electrical Network Analysis

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3hrs/week	**TH-3**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: Fundamentals of Electrical Engineering, Applied Mathematics, and Applied Physics.

Course Objectives: The objectives of the course are to
1. Impart the mathematical skills applied to Electrical networks.
2. Provide an overview of the behavior of the steady state and transient states in RLC circuits.
3. Develop an ability to design concepts for different filters.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Define different laws and theorems related to electrical networks.	1-Remember
CO2	Apply theorems and Laplace transform for solving electrical network problems.	3-Apply
CO3	Analyze transient response and steady state of AC/DC electrical circuits in time and Laplace domain.	4-Analyze
CO4	Design the low pass and high pass filters based on the given specification.	4- Analyze
CO5	Evaluate the different parameters in two-port networks.	5-Evaluate

COURSE CONTENTS

Unit I	**Basis Circuit Analysis**	**(8hrs)**	**CO1,CO2**

Types of sources, the concept of source transformation, voltage and current divider, mesh and super mesh-analysis in AC and DC circuit, nodal and super nodal analysis AC and DC circuit. Concept of dot convention, magnetic coupled circuit, and duality of networks.

Unit II	**Network Theorem for AC and DC Networks**	**(8hrs)**	**CO1,CO2**

Superposition, Thevenin, Norton, Maximum Power Transfer, Reciprocity, and Millman Theorems. Graph Theory: Incidence, tie set, and cut set matrix.

Unit III	**Transients in Electrical Networks**	**(8hrs)**	**CO3**

Concept of the transient and steady-state response of passive element, transient response of R-L, R-C, and R-L-C network in the time domain, with source and source free responses, time constants steady state and transient state response.

Unit IV	**Transient Analysis in S-domain and Filters**	**(8hrs)**	**CO4**

Laplace transform representation of R, L, C in S-domain, application of Laplace Transform to solve series and parallel R-L, R-C, and R-L-C circuits (Source free, Source driven). Filters: First order high pass and low pass filters, design of filters.

Unit V	**Two Port Network**	**(8hrs)**	**CO5**

Two port networks, various two-port network parameters, and their interrelationships. Network Functions & Responses: Concept of complex frequency, driving point, and transfer functions for one port and two port network, poles & zeros of network functions, Restriction on Pole and Zero locations of network function. Impulse response and complete response. Time domain behavior form a pole-zero plot.

Text Books

1. M. E. Van Valkenberg, "Network Analysis", Third Edition, Prentice Hall of India Publication.
2. W. H. Hayt. Jr. and J. E. Kemmerly, "Engineering Circuit Analysis", Fifth Edition, Tata-McGraw Hill Edition.
3. Desoer and Kuh, "Basic circuit theory", Tata McGraw Hill Edition.
4. Joseph A Edminster, "Theory and Problems of Electric Circuits", Shaum Series.
5. G. K. Mittal, "Network Analysis and Synthesis", Khanna Publication.

Reference Books

1. D. Roy Choudhury, "Networks and systems" New Age International Publishers.
2. A Sudhakar and Shaymmohan S Palli, "Circuit & Network Analysis and Synthesis", TMH Publication.
3. Abhijit Chakraborty, "Circuit Theory", DhanpatRai and Company.
4. Ravish R Singh, "Network Analysis and synthesis", McGraw Hill Education (India).

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignment 1 (Based on Units I and II) (Deadline: before Insem)	5
2	Assignment 2 (Based on Units III and IV) (Deadline: before Endsem)	5
3.	LearniCo (Best 5 sessions out of Minimum 10 sessions)	5
4.	Class test based on units III to V	5

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	--	--	--	--	--	--	--	--	--	--	--	--
CO2	3	3	3	3	--	--	--	--	--	--	--	--	--	--
CO3	3	3	3	3	--	--	--	--	--	--	--	--	2	2
CO4	3	3	3	3	--	--	--	--	--	--	--	--	2	2
CO5	3	3	3	3	--	--	--	--	--	--	--	--	2	2

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: IV (Electrical Engineering)
ELE222012: Microcontroller and Embedded Systems

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3 hrs/week	**TH: 3**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: Analog and Digital Circuits

Course Objectives: The objectives of the course are to

1. Explore the architecture, software, and hardware features of the microcontroller and embedded system.
2. Introduce students to the protocol for serial communication and times in microcontroller systems.
3. Provide students with concepts of interfacing and circuit development for simple applications using 8051 and ARM processors.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Describe the architecture, hardware, and software features of the microcontroller and embedded systems.	2-Understand
CO2	Write assembly language programs to perform a given task.	3- Apply
CO3	Use operating modes of I/O ports, Timers/Counters, control registers, and various types of interrupts of 8051 and STM32F103.	3- Apply
CO4	Design circuits using STM32F103 and 8051 microcontroller in real-time.	6 -Create

COURSE CONTENTS

Unit I	**Introduction to Microcontrollers**	**8 hrs**	**COs Mapped - CO1, CO2, CO3**

Features of MCS51, its architecture, pin diagram, memory organization, external memory interfacing, special function registers in MCS51, Parallel I/O interrupt ports, serial communication, timer, and Interrupts.

Unit II	**Addressing modes and Instructions set, assembly programming**	**8 hrs**	**COs Mapped - CO1, CO2**

Addressing modes of 8051, Arithmetic, logical, Boolean, and Program instructions of 8051, programs using assembly language.

Unit III	**Introduction to embedded systems**	**8 hrs**	**COs Mapped –CO1, CO2, CO3**

Understanding an embedded system, its design metrics and challenges, technologies for embedded systems, introduction to ARM (RISC) processor, an overview of its architecture, different modes of ARM processor, program status register, and comparison between CISC and RISC.

Unit IV	**Instruction Set and Programming using ARM Processor**	**8 hrs**	**COs Mapped - CO1, CO2**

Data transfer instruction – Arithmetic instruction - Logical Instruction, Multiply instruction, Branch instruction, Load/Store instruction, Swap instruction, Solving a simple equation, generation of the square waveform, Memory operations.			
Unit V	**Real-world interfacing**	**8 hrs**	**COs Mapped – CO4**
Interfacing with simple devices such as LCD, keyboard, motor control, sensors (temperature, voltage and current, etc.), LED 7 segment display, DTMF decoder, analog-digital converter, global system for mobile communication, etc. with 8051 microcontroller and STM32F103 ARM processor.			

Text Books

1. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide, Morgan Kaufmann Publishers, 1st Edition, 2004.
2. Mohammad Ali Mazidi, Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded, Pearson Education India Publisher, 2nd Edition, 2006.
3. Mazidi, Mazidi, and McKinley, "The 8051 microcontroller and Embedded systems", Pearson Publication, 2nd Edition, 2006.

Reference Books

1. Kenneth J. Ayla, "The 8051 Microcontroller", Thomson learning, 3rd Edition, 2010.
2. D Karuna Sagar, "Microcontroller 8051", Oxford: Alpha Science, 2011.
3. P.V Guruprasad, "Arm Architecture System on Chip and More", Apress, 2013.

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignment 1 (Based on Units I and II) (Deadline: before Insem)	5
2	Assignment 2 (Based on Units III and IV) (Deadline: before Endsem)	5
3.	LearniCo (Best 5 sessions out of Minimum 10 sessions)	5
4.	Mini project	5

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	--	--	--	--	--	--	--	--	--	--	--	--
CO2	3	3	3	--	3	--	--	--	--	--	--	--	--	--
CO3	3	3	3	1	3	--	--	--	--	--	--	1	--	1
CO4	3	3	3	1	3	--	--	--	--	--	--	1	--	1

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: IV (Electrical Engineering)
ELE222013: Power Electronics

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3hrs/week	**TH-3**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses: Analog and Digital Circuits, Applied Mathematics III

Course Objectives: The objectives of the course are to
1. Introduce different power semiconductor devices
2. Introduce different converter topologies, their operation, and applications.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Select switching devices for a given power converter	2-Understand
CO2	Draw circuit diagrams and waveforms for converter circuits with different loads	3- Apply
CO3	Analyze the operation and performance of power electronics converters	4- Analyze
CO4	Design simple power electronics converter circuits	6- Create

COURSE CONTENTS

Unit I	**Power Semiconductor Devices**	**(8 hrs.)**	**CO1, CO2**

Concept of power electronics, scope, and applications, types of power converters, power semiconductor switches: power diodes, power transistors, SCRs, TRIAC, GTO, power MOSFETs, IGBTs-Principles of operation, characteristics, Thyristor ratings, protection, gate drive circuits and commutation (class C&D).

Unit II	**Controlled Rectifiers**	**(8 hrs.)**	**CO1, CO2**

Introduction to the uncontrolled and controlled rectifier, Principles of single-phase fully-controlled converter with R, RL, and RLE load, Principles of single-phase half-controlled converter with R, RL and RLE load, Principles of three-phase fully-controlled converter operation with R load, Effect of load and source inductances, Introduction to dual converters.

Unit III	**DC-DC Converters**	**(8 hrs.)**	**CO3,CO4**

Step-down and step-up chopper, control strategy, Introduction to types of choppers-A, B, C, D, and E, Switched mode regulators- Buck, Boost, Buck-Boost regulator, Introduction to Resonant Converters.

Unit IV	**DC-AC converters**	**(8 hrs.)**	**CO3, CO4**

Single-phase and three-phase voltage source inverters (both 180 and 120 degrees conduction mode), Voltage and harmonic Control, PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM, Introduction to Multilevel Converter, Current source inverter.

Unit V	**AC-AC converters**	**(8 hrs.)**	**CO2, CO3**

Single and three-phase controllers, phase control, PWM AC voltage controller, Principle of ON-OFF control and cyclo-converters, Introduction to Matrix converters.

Text Books
1. Muhammad H. Rashid, “Power Electronics - Circuits, Devices and Applications”, Pearson, 4th Edition, 2018. 2. Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics”, John Wiley & Sons Publications, 3rd Edition, 2006.
Reference Books
1. P.S.Bimbhra, “Power Electronics”, Khanna Publishers, 6th Edition, 2016 2. Vedam Subramaniam, “Power Electronics”, New Age International (P) Ltd Publishers, 2001.

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignment 01 (Based on Units I and II) (Deadline: before Insem)	5
2	Assignment 02 (Based on Units III and IV) (Deadline: before Endsem)	5
3.	LearniCo (Best 5 sessions out of Minimum 10 sessions)	5
4.	Class test (Before End sem)	5

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	3	--	--	--	--	--	--	--	--	--	--	--	--
CO 2	--	3	3	--	3	--	--	--	--	--	--	--	--	--
CO 3	3	3	3	3	3	--	--	--	--	--	--	3	3	3
CO 4	3	3	3	3	3	--	--	--	--	--	--	3	3	3

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: IV (Electrical Engineering)
ELE222014: Power System Engineering

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3 hrs./week	**TH-03**	**CCE: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses: Fundamentals of Electrical Engineering

Course Objectives: The objectives of the course are to

1. Enable students to learn the basic structure of electrical power systems, various electrical terms related to the power system, and tariffs.
2. Help students to understand the specifications and applications of various major electrical equipment present in power plants.
3. Get knowledge of the mechanical and electrical design of overhead and underground transmission systems.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Define various terminologies related to load curve, tariff, economical load dispatch, and transmission system.	1. Remember
CO2	Elaborate tariff and allocation of generating units on an economical basis.	2- Understand
CO3	Calculate electrical and mechanical parameters and factors in the power station and transmission system.	3- Apply
CO4	Model and analyze the performance of the overhead transmission line	3- Analyze
CO5	Evaluate different types of tariffs and methods of economical load dispatch and unit commitment.	5 -Evaluate

COURSE CONTENTS

Unit I	**Structure of Power System and Tariff**	**08 hrs**	**CO1, CO2, CO3, CO5**

Structure of Electrical Power Systems: Structure of electrical power system, Different factors associated with generating stations and Load curve, Load duration curve, Concept of base load and peak load stations (04 hrs)

Tariff: Introduction of Tariff, objectives, desirable characteristic, various consumer categories, two-part tariff, three-part tariff, Time of day tariff for H.T and L.T industrial and commercial consumers, Introduction to Availability based tariff (ABT), kVAh tariff (4 hrs)

Unit II	**Economical Load Dispatch and Unit Commitment**	**08 hrs**	**CO1, CO2, CO3, CO5**

Economic load dispatch: Cost curve of thermal and hydro plant, equal incremental cost method, method of Lagrange multiplier (neglecting transmission losses), Bmn coefficient, economic scheduling of thermal plant considering the effect of transmission losses, penalty factor (05 hrs)

Unit commitment: Concept of unit commitment, constraints on unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming, (03 hrs)

Unit III	Mechanical Design of Transmission System	08 hrs	CO1, CO3

Overhead Line Insulators: Types of insulators, its construction, and their applications such as Pin type, Suspension type, Strain type, Shackle type, Post insulators, and bushing. Potential distribution over suspension insulators, String efficiency, and Methods of improving string efficiency (03 hrs)

Sag Calculations: Main components of overhead lines, Various types of line supports, Conductor spacing, Length of span, Calculation of sag for equal and unequal supports, and effect of ice and wind loading. (02 hrs)

Underground Cables: Construction of Cables, Classification of cables, XLPE cables, Capacitance of single core and three core cable, Dielectric stresses in single core cable, Grading of cables, inter sheath grading, capacitance grading. (03 hrs)

Unit IV	Electrical Design of Transmission System	08 hrs	CO1, CO3

Resistance of Line: Resistance of transmission line, Skin effect, and proximity effect, Factors responsible for the production of these effects,

Inductance and capacitance calculations: Internal and external flux linkages of single conductor, Electric potential at a single charged conductor, Potential at the conductor in a group of charged conductors, Inductance and capacitance of single phase two wire line, the necessity of transposition, inductance, and capacitance of three-phase line with symmetrical and unsymmetrical spacing with transposition (Based on GMD and GMR Approach), Inductance of bundled conductors.

Unit V	Modeling of Transmission System	08 hrs	CO1, CO4

Classification of lines based on length and voltage levels, modelling of short, medium, and long transmission line, generalized constant of transmission line, the concept of complex power, and power flow equations using a generalized constant.

Text Books

1. V.K.Meheta, Rohit Mehta, "Principles of Power System", 2022 Color Edition, S. Chand Publication.
2. J.B. Gupta, "Transmission and Distribution", 2018-Edition, S.K. Kataria and Sons, New Delhi.
3. A Chakraborty, M.L.Soni, P.V. Gupta, U.S.Bhatnagar," A text book on Power System Engineering",2009 Edition, Dhanpatrai& Co, Delhi.

Reference Books

1. W.D.Stevenson, "Power System Analysis", 2nd Edition, Tata McGraw Hill Publications.
2. M.V. Deshpande," Elements of Power Station Design", PHI Publication.
3. I.J. Nagrath and D.P.Kothari," Modern Power System Analysis", 4th Edition Tata McGraw Hill
4. D. Das," Electrical Power System", New Age Publication
5. Hadi Sadat, “Power System Analysis”, McGraw Hill

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignment 01 (Based on Units I and II) (Deadline: before Insem)	4
2	Assignment 02 (Based on Units III and IV) (Deadline: before Endsem)	4
3.	Learnico (Best 5 sessions out of Minimum 10 sessions)	4
4.	Class test (Before Endsem) Based on Units III to V	4
5.	Industrial Visit assessment	4

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	--	--	--	--	--	--	--	--	--	--	--	3	--
CO2	3	3	--	--	--	--	--	--	--	--	--	--	3	2
CO3	3	3	2	2	--	--	--	--	--	--	--	--	3	--
CO4	3	3	2	2	--	--	--	--	--	--	--	1	3	2
CO5	3	3	2	2	--	--	--	--	--	--	--	1	3	2

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: IV (Electrical Engineering)
ELE222015: Design Thinking for Academic Projects

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 3 hrs/week	**TH: 3**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses:

Course Objectives: The objectives of the course are to

1. Highlight the significance of the academic project in acquiring employability skills
2. Make aware of the design thinking strategy in the project topic finalization
3. Introduce good practices in project planning and execution

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Select the topic for the academic project, define the project problem statement, scope, and objectives	2-Understand
CO2	Develop a system block diagram and outline important steps in project planning, execution, and completion	3- Apply
CO3	Apply design thinking strategy in project execution	3- Apply
CO4	Prepare and present project poster, presentation, and report	3-Apply

COURSE CONTENTS

Unit I	**Project Life Cycle**	**8 hrs**	**COs Mapped – CO1**

Introduction to project, the importance of the academic project, characteristics of the project, project failure, project management, selecting project topic, selecting team members, competency matrix, Project life cycle (Activity I)

Unit II	**Design Thinking and Ideation**	**10 hrs**	**COs Mapped – CO3**

Introduction to design thinking, importance, the impact of design thinking, design innovation, desirable, feasible, viable, human-centered design, double diamond approach
Ideation definition, ideation strategies, brainstorming, Opposite thinking, idea sketching, mind mapping (Activity II)

Unit III	**Project Definition**	**6 hrs**	**COs Mapped –CO3**

Defining project problem statement, project objectives and scope, developing system/process/project block diagram, methodology, developing project plan (Activity III)

Unit IV	**Project Execution**	**6 hrs**	**COs Mapped – CO2**

Literature survey, reading a research paper, summarizing the research paper, Types of modeling: Mathematical, software, hardware modeling, the need of modeling, procedure of modeling, detailed design, and development of the project, (Activity IV)

Unit V	**Project Presentation**	**10 hrs**	**COs Mapped**

			– CO4
Preparation for various competitions and hackathons, making project presentations, delivering Presentations, Project Report Writing, Research Paper writing, Project Proposal writing, and identifying IPR potential in the project. (Activity V)			
Text Books			
1. Tim Brown Change by Design How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publications			
Reference Books			
1. Andrew Shea, Bryan Boyer, Jennifer May, Mariana Amatullo, "Design for Social Innovation Case Studies from Around the World," Taylor & Francis, 2021 2. Jason Westland, "The Project Management Life Cycle A Complete Step-By-Step Methodology for Initiating, Planning, Executing & Closing a Project Success" Kogan Page Publication, 2007			

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Activities I to V (4 marks for each activity)	20

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	--	2	3	3	--	1	1	1	--	--	--	3	--	--
CO2	--	2	3	3	1	--	--	--	--	--	3	3	--	--
CO3	--	--	3	3	--	1	1	1	--	--	3	3	--	--
CO4	--	--	--	--	--	--	--	--	1	1	3	3	--	--

K. K. Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: IV(Electrical Engineering)
ELE222016: Solar Photovoltaic Systems

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory: 1 hr./week	**No Credit**	**No Exam**

Prerequisite Courses: Applied Physics

Course Objectives: The objectives of the course are to

1. Introduce the solar PV system.
2. Highlight the importance of onsite solar PV in transforming our grid and providing a sustainable home.
3. Enable students to get familiar with the economic risks and benefits of Solar PV.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Draw various curves related to solar PV generation.	1-Remember
CO2	Handle software tools for solar PV systems.	4-Analyze
CO3	Design solar PV systems for small and large installations.	6-Create

COURSE CONTENTS

Unit I	**Basics of Solar PV Systems**	**6 hrs.**	**CO1, CO2**

The PV cell, series and parallel interconnection, energy from the sun, incident energy estimation, sizing PV, SPV curves, maximum power point tracking, and MPPT algorithms.

Unit II	**Design of Solar PV System**	**6 hrs.**	**CO1, CO2, CO3**

Software for solar PV design, PV-battery interfaces, Peltier cooling, PV and water pumping, PV-grid interface-I, PV-grid interface-II, and life cycle costing.

Books

1. Chamming, H. and White, R.M., "Solar Cells: From Basic to Advanced Systems", McGraw Hill Book co, 1983.
2. Hans S. Rauschenbach, "Solar Cell Array Design Handbook", New York, 1980.
3. Proceeding of IEEE Conference on Photovoltaic Specialists Conferences. https://ieeexplore.ieee.org/xpl/conhome/1000561/all-proceedings
4. Solar Energy Journal. https://www.sciencedirect.com/journal/solar-energy
5. Prof. L Umanand, "Design of Photovoltaic Systems", IISc Bangalore https://onlinecourses.nptel.ac.in/noc22_ee71/preview.

Strength of CO-PO-PSO Mapping

	PO												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	--	--	--	3	--	--	--	--	--	--	3
CO2	--	--	--	2	2	--	--	--	--	--	--	--	--	3
CO3	3	3	3	2	2	--	3	--	--	--	--	1	--	3

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech. **Pattern 2022 Semester: IV (Electrical Engineering)** **ELE222017: Power Electronics Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 4 hrs/week	**PR- 2**	**Termwork: 25Marks** **Practical: 50 Mark**
Prerequisite Courses: Analog and Digital circuits, Applied Mathematics III		
Course Objectives: The objectives of the course are to 1. Enable students to develop hands-on experience in analyzing, designing, and carrying out experiments on power electronic circuits. 2. Introduce the switching devices, power converters, and their applications in various systems for power control.		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	**Bloom's Level**
CO1	Simulate and analyze various power electronic converters with different control techniques	3- Apply
CO2	Perform experiment in the group, write a lab report, and present it effectively	3-Apply
CO3	Analyze the results of different power electronic converters with various control techniques under varying operating conditions.	4-Analyze
CO4	Design the magnetic circuit, power circuit, and control circuit of various power electronic converters.	6-Create

List of Laboratory Experiments

Sr. No.	**Laboratory Experiments** **(Perform any 16 Experiments)**	**COs Mapped**
1	Static V-I Characteristics of SCR and TRIAC	CO1,CO2
2	Static V-I Characteristics of MOSFET and IGBT	CO1,CO2
3	Gate firing circuits of SCR (R, RC & UJT)	CO1,CO2
4	Single-phase Half Controlled SCR Converter	CO1,CO2,CO3
5	Single-phase Fully Controlled SCR Converter	CO1,CO2,CO3
6	Three-phase AC-DC fully controlled bridge converter R and RL load	CO1,CO2,CO3
7	Study of single-phase dual converter with RL loads	CO1,CO2,CO3
8	To study DC-DC converter i) Buck converter ii) Boost converter.	CO2,CO3,CO4
9	Buck-Boost Converter using IGBT	CO2,CO3,CO4
10	Solar-fed boost converter	CO2,CO3,CO4
11	Single-phase Inverter using IGBT	CO1,CO2,CO3
12	To study the Three-phase inverter.	CO1,CO2,CO3
13	Single-phase step-down Cyclo-converter	CO1,CO2,CO3
14	AC Voltage regulators using SCR/TRIAC.	CO1,CO2,CO3
15	Power Quality Analysis (Harmonic and PF measurement Converter.	CO1,CO2,CO3

16	Performance analysis of three-phase diode clamped Multilevel inverter	CO1,CO2,CO3
17	Simulation of i) Single phase half wave rectifier. ii) Single phase full wave fully controlled rectifier [R, R-L, and RLE].	CO1,CO2,CO3
18	Simulation of the following experiments using PSIM/Matlab I. AC Voltage regulator using SCR II. Single phase inverter using self-controlled devices such as IGBT/MOSFET (Single PWM, Multiple PWM, sinusoidal PWM)	CO1,CO2,CO3
19	Simulation of the following experiments using PSIM/Matlab i) Three-phase inverter. ii) DC-DC converter a. Buck converter. b. Boost converter	CO2,CO3,CO4
20	Industrial Visit to Power Electronics manufacturing unit/Renewable energy (Compulsory)	CO3,CO4

Guidelines for Laboratory Conduction

1. The teacher will brief the given experiment to students for its procedure, observations, calculations, and outcome.
2. Apparatus and equipment required for the allotted experiment will be provided by the lab technician using SOP.
3. Students will perform the allotted experiment in a group (2-3 students in each group) under the supervision of faculty and lab technician.
4. After performing the experiment students will check their readings and calculations from the teacher.
5. After checking they have to write the conclusion on the final results.

Guidelines for Student's Lab Journal

The write-up should include a title, aim and apparatus, circuit or block diagram, waveforms, brief theory, procedure, observations, graphs, calculations, conclusion, and questions, if any.

Guidelines for Termwork Assessment

1. Each experiment from the lab journal is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for timely completion, R-2 for understanding, and R-3 for presentation/journal writing where each rubric carries ten marks.

Strength of CO-PO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	2	2	2	-	-	-	-	-	-	2	2	-
CO2	-	-	-	-	-	-	-	-	1	1	-	-	-	-
CO3	1	2	2	2	2	-	-	-	-	-	-	2	2	1
CO4	1	2	2	2	2	-	-	-	-	-	-	2	2	1

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S. Y. B. Tech.
Pattern 2022 Semester: IV Electrical Engineering
ELE232018: Electrical Network Analysis Laboratory

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 2 hrs/week	**OR-1**	**Teamwork: 25 Marks** **Oral: 25 Mark**

Prerequisite Courses: Fundamentals of Electrical Engineering, Application of Mathematics, and Applied Physics.

Course Objectives: Objectives of the course are to-

1. Provide hands-on experience in circuit design to students.
2. Enable students to apply network theorems to electrical circuits.
3. Impart skills in software simulation and hardware design.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Verify electrical network theorems through experiments.	3 - Apply
CO2	Perform experiment in the group, write a lab report, and present it effectively.	3 - Apply
CO3	Find electrical network parameters and evaluate them for different circuits.	4 - Analyze
CO4	Design different filters for given specifications.	6 - Create

List of Laboratory Experiments (Perform any 8 of the following)

Sr. No.	**Experiments Title**	**COs Mapped**
1	Verification of superposition theorem in A.C. circuits. (Hardware)	CO1, CO2
2	Verification of Thevenin's theorem in A.C. circuits. (Hardware)	CO1, CO2
3	Verification of reciprocity theorem in A.C. circuits. (Hardware)	CO1, CO2
4	Verification of Norton's theorem in A.C. circuits. (Hardware)	CO1, CO2
5	Verification of Maximum Power Transfer theorem in A.C. circuits. (Hardware)	CO1, CO2
6	Determination of time response of R-C circuit to a step D.C. voltage input. (Charging and discharging of a capacitor through a resistor) (Hardware)	CO2, CO3
7	Determination of time response of R-L circuit to a step D.C. voltage input. (Rise and decay of current in an inductive circuit) (Hardware)	CO2, CO3
8	Determination of time response of R-L-C series circuit to a step D.C. voltage input using simulation.	CO2, CO3
9	Design of Low-Pass Filter and High-Pass Filter. (Software)	CO2, CO4
10	Determination of parameters of Two Port Network. (Hardware)	CO2, CO3

Guidelines for Laboratory Conduction
1. The teacher will brief the given experiment to students for its procedure, observations, calculations, and outcome. 2. Apparatus and equipment required for the allotted experiment will be provided by the lab technician using SOP. 3. Students will perform the allotted experiment in a group (2-3 students in each group) under the supervision of faculty and lab technician. 4. After performing the experiment students will check their readings and calculations from the teacher. 5. After checking they have to write the conclusion on the final results.
Guidelines for Student's Lab Journal
The write-up should include a title, aim and apparatus, circuit or block diagram, waveforms, brief theory, procedure, observations, graphs, calculations, conclusion, and questions, if any.
Guidelines for Termwork Assessment
1. Each experiment from the lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding, and R-3 for presentation/journal writing where each rubric carries ten marks.

Strength of CO-PO-PSO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	2	--	--	--	--	--	--	--	--	--	--	2	--
CO2	--	--	--	--	--	--	--	--	1	1	--	--	--	--
CO3	2	2	1	--	1	--	--	--	--	--	--	--	2	--
CO4	2	2	1	--	1	--	--	--	--	--	--	--	2	--

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech.
Pattern 2022 Semester: IV Electrical Engineering
ELE222019: Microcontroller and Embedded Systems Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 2 hrs/week	**OR: 1**	**Term work: 25 Marks;** **Oral: 25 Marks**

Prerequisite Courses: Analog and Digital Circuits

Course Objectives: Objectives of the course are to
1) Develop skills to work with microcontrollers and embedded processors.
2) Inculcate programming skills using assembly language programs for various applications.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Perform experiment in the group, write a lab report, and present it effectively	3-Apply, 4 -Analyze
CO2	Write the program for 8051 in assembly language for the given operations	4 -Analyze
CO3	Write the program by using the timer, interrupt, and serial ports /parallel ports.	4 -Analyze
CO4	Interface the memory and I/O devices to the 8051 microcontroller.	6 - Create

List of Laboratory Experiments

Sr. No.	**Laboratory Experiments**	**COs Mapped**
1	Identify various blocks of the 8051 microcontroller development board.	CO1
2	Write an assembly language program (ALP) to perform arithmetic operations: addition, subtraction, multiplication, and division.	CO1,CO2
3	Write an ALP to find the smallest/largest number from the given data bytes stored in internal/external data memory locations	CO1,CO2, CO3 ,CO4
4	Write an ALP for arranging numbers in ascending /descending order stored in external memory locations	CO1,CO2, CO3 ,CO4
5	Interface LED with microcontroller and turn it ON with microcontroller interrupt.	CO1,CO2, CO3 ,CO4
6	Interface 7-segment display to display the decimal number from 0 to 9.	CO1,CO2, CO3 ,CO4
7	Interface relay with microcontroller and turn it ON and OFF.	CO1,CO2, CO3 ,CO4
8	Interface ADC with 8051 microcontroller and verify input/output.	CO1,CO2, CO3 ,CO4
9	Interface the stepper motor to a microcontroller and rotate in a clockwise and anti-clockwise direction at the given angles.	CO1,CO2, CO3 ,CO4
10	Industrial Visit with visit report.	CO1

Guidelines for Laboratory Conduction

- The teacher will brief the given experiment to students for its procedure, observations, calculations, and outcome.
- Apparatus and equipment required for the allotted experiment will be provided by the lab technician using SOP.
- Students will perform the allotted experiment in a group (2-3 students in each group) under the supervision of faculty and lab technician.
- After performing the experiment students will check their readings and calculations from the teacher.
- After checking they have to write the conclusion on the final results.

Guidelines for Student's Lab Journal

The student's Lab Journal should contain the following related to every experiment:

- Title of the program
- Related Theory
- Algorithm and Flowchart
- Pin Diagram for the connection
- Result

Guidelines for Termwork Assessment

1. Each experiment from the lab journal is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for timely completion, R-2 for understanding, and R-3 for presentation/journal writing where each rubric carries ten marks.

Strength of CO- PO- PSO Mapping

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

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: IV Electrical Engineering
ELE222020: Project-Based Learning

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 2 hrs./week	**TW: 1**	**Term work: 25 Marks**

Prerequisite Courses- Fundamentals of Electrical and Electronics Engineering, Mathematics I, II, and III, Soft skills.

Course Objectives: The objectives of the course are to

1. Impart technical knowledge and skills, and develop a deeper understanding to integrate knowledge and skills from various areas.
2. Build critical thinking, problem-solving, communication, collaboration and creativity, and innovation amongst students.
3. Develop habits of self-evaluation and self-criticism, against self-competency and trying to see beyond own ideas and knowledge.
4. Provide every student the opportunity to get involved either individually or as a group to develop team skills and learn professionalism for long-term goals.

Course Outcomes: On completion of the course, students will be able to

	Course Outcomes	**Bloom's Level**
CO1	Interact with different audiences in oral, visual, and written forms	2-Understand
CO2	Apply knowledge of mathematics, basic sciences, and electrical engineering fundamentals to develop solutions for the project.	3-Apply
CO3	Draw information from a variety of sources and be able to filter and summarize the relevant points.	3-Apply
CO4	Identify, formulate, and analyze the project problem and provide solutions considering social, economical, and environmental aspects	5-Evaluate

Guidelines for Project-Based Learning Conduction

A group of 4-5 students will be assigned to a faculty member called a mentor. Based on the engineering knowledge of a group and societal and industry problems, the mentor has to guide a group to identify project problems and plan the work schedule. Here, the expected outcomes of the project must be noted. The complete work plan should be divided into the form of individual tasks to be accomplished with targets. Weekly review of the completed task should be taken and further guidelines are to be given to a group. The final activity will be to present the work completed and to submit the report. A group should be promoted to participate in a competition or write a paper.

A problem needs to refer back to a particularly practical, scientific, social, and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and the structure of the activity. It may have

1. A few hands-on activities may or may not be multidisciplinary.
2. Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize, and present their learning.

Activities on solving real-life problems, investigation /study, and writing reports of in-depth study,

and fieldwork.

Guidelines for Assessment and Evaluation

Assessment:

The mentor is committed to assessing and evaluating both students' performance and course effectiveness. The progress of PBL is monitored regularly every week. During the process of monitoring, continuous assessment, and evaluation the individual and team performances are to be measured by the supervisor /mentor and authorities.

Evaluation:

All the activities are to be recorded in a PBL workbook regularly. Regular assessment of work to be done and proper documents are to be maintained at the department by both students as well as a mentor. Continuous Assessment Sheet (CAS) is to be maintained by all mentors.

Evaluation will have parameters like idea development suggestive solutions, hardware and software development, report writing, and presentation.

Term Work Guidelines	**Marks Allotted**
PBL Review I (After 5th week)	10
PBL Review II (After the 10th week)	10
Final documentation and demonstration (Before End-sem exam)	5
Total Marks	25

Strength of CO-PO-PSO Mapping

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