Annexure II

Detailed syllabus of SY BTech (CBCS)

Effective from 2022-23

SPG

Approved in XXIVth Academic Council,Dated 23/07/2022

Teaching and Evaluation Scheme from year 2022-23

Second Year B. Tech. Program in Electrical Engineering

Semester III

Semester III Courses				Teaching Scheme			Continuous Evaluation in terms of Mark					
Sr No	Categor	Course Code	Course Name	TH	T	PR	Credit	ISE I	ISE II	ISE III	ESE	Total
1	BSC	MABS2002	Mathematics –III	2	1	-	3	15	15	10	60	100
2	PC- I	EEPC2001	Network Analysis	3		-	3	15	15	10	60	100
3	PC- II	EEPC2002	Electrical Machines-I	3		-	3	15	15	10	60	100
4	PC-III	EPC2003	Electrical Measurement & Instrumentation	3	-	-	3	15	15	10	60	100
5	PCIV	EEPC2004	Analog Electronic Circuits	3	-	-	3	15	15	10	60	100
6	PC- I	EEPC2005	Lab Network Analysis	-	-	2	1	25	-	-	25	50
7	PC-II	EEPC2006	Lab Analog Electronic Circuits	-	-	2	1	25	-	-	25	50
8	PC-III	EEPC2007	Lab: Electrical Machines-I	-	-	2	1	25	-	-	25	50
9	PC IV	EEPC2008	Lab Electrical Measurement & Instrumentation	-	-	2	1	25	-	-	25	50
10	OE -I			3	-	-	3	15	15	10	60	100
11	MC	~~EEMC2010~~ INMC2010	Environmental Studies	3	-	-	-	15	15	10	60	100
	Total			**17**	**1**	**08**	**22**	**190**	**90**	**60**	**460**	**900**

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Semester- IV

Semester IV Courses				Teaching Scheme			Continuous Evaluation in terms of Marks					
Sr No	**Category**	**Course Code**	**Course Name**	**TH**	**T**	**PR**	**redits**	**SE I**	**ISE II**	**ISE III**	**ESE**	**Total**
1	ESC	EES2020	Electromagnetic Field			-	3	15	15	10	60	100
2	ESC	EES2021	Numerical Computational Techniques			-	2	15	15	10	60	100
3	PC-V	EEPC2022	Electrical Machines - II			-	3	15	15	10	60	100
4	PC-VI	EPC2023	Power System - I			-	3	15	15	10	60	100
5	ESC	EES2024	Renewable Energy Systems			-	3	15	15	10	60	100
6	PC-V	EPC2025	Lab Electrical Machines -II			2	1	25	-	-	25	50
7	ESC	EES2026	Lab Numerical Computational Techniques			2	1	25	-	-	25	50
8	OE- II			3	-	-	3	15	15	10	60	100
	Total			**16**	**1**	**04**	**19**	**140**	**90**	**60**	**410**	**700**

Industrial Training of minimum4 weeks after second/third year, however credit will be awarded in VII semester.. *ISE I, II will be compulsory Class Test and 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 a method of evaluation at the beginning of the course.

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MABS 2002: Engineering Mathematics-III (for EEP, IT)	
Teaching Scheme **Lectures : 2 Hrs/Week** **Tutorial :1** **Total Credits : 03**	**Examination Scheme** **ISE I : 15 Marks** **ISE II-II : 15 Marks** **ISE III : 10 Marks** **End Semester Exam : 60 Marks**

Course description:

MABS 2002 Engineering Mathematics-III is a compulsory course to second year engineering students of EEP and IT of the institute in the Semester –III and is a continuation of previous year courses viz. MABS1001 Engineering Mathematics-I and MABS1002 Engineering Mathematics-II . This course intends to provide engineering students a coherent and balanced account of major mathematical techniques and tools.

Course Objective:

This course intends to provide an overview of analytical techniques to solve ordinary and partial differential equations and introduce different Integral Transforms i.e. Laplace Transform, Fourier Transform and Z- Transform, which we apply to solve many Engineering problems.

Course Outcomes:

After completing the course, students will be able to:

CO1	Define linear differential equations (LDE),Cauchy's and Legendre's differential equations, first order partial differential equations, Lagrange's equation, Laplace Transform, Fourier Transform and Z-Transform, region of convergence.
CO2	Summaries the solution of LDE with constant and variable coefficients, solution of homogeneous and non-homogeneous PDE, properties of Laplace Transform, Fourier Transform and Z-Transform.
CO3	Find Laplace Transform of derivative and integration, inverse Laplace Transform using properties, partial fraction method and convolution theorem, Fourier Transform of periodic functions, Z-transform of discrete functions, inverse Fourier Transform and inverse Z-transform.
CO4	Solve linear differential equations with constant and variable coefficients, first order linear and non-linear partial differential equations, second order homogeneous and non homogeneous linear partial differential equations.

Detailed syllabus:

Unit-I	Linear Differential Equations (LDE): Linear differential equations (LDE) with constant coefficients, method of variation of parameters, second order linear differential equations with variable coefficients, Cauchy's and Legendre's differential equations.	06 L+ 03T
Unit-II	Partial Differential Equations (PDE): First order linear/nonlinear partial differential equation, Lagrange's equation.solution to homogeneous and nonhomogeneous linear partial differential equations of second and higher order by complementary function and particular integral method.	06 L+ 03T
Unit-III	Laplace Transform (LT):Definition of Laplace Transform, Properties of Laplace Transform, Laplace Transform of elementary functions, Laplace Transform of derivative of functions, Laplace Transform of integration of functions.Laplace Transform of periodic functions, inverse Laplace Transform using definition, properties and partial fraction, convolution theorem.	04L+ 02T
Unit-IV	Fourier Transform (FT): Fourier integral theorem, Fourier sine and cosine integrals, Fourier transform pair, Fourier sine and cosine transform pairs, properties of Fourier transform, Fourier transform of simple functions, convolution theorem.	04 L+ 02T
Unit-V	Z Transform: Z transform of elementary functions, region of convergence, properties and theorems of Z transform, inverse of Z transform using convolution theorem, partial fraction method, inversion integral method.	04 L+ 02T

Text and Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, Willey Eastern Ltd. Mumbai.
2. Higher Engineering Mathematics by B. S. Grewal, Khanna publication, New Delhi.
3. Engineering Mathematics-A Tutorial Approach by Ravish R Singh, Mukul Bhatt.
4. Advanced Engineering Mathematics by H. K. Dass, S. Chand and Sons.
5. Calculus by G. B. Thomas and R. L. Finney, Addison- Wesley, 1996
6. Elements of Partial Differential Equations by I.N. Sneddon
7. Boyce & DiPrima, Elementary Differential Equations and Boundary Value Problems

Mapping of Course outcome with Program Outcomes (Electrical Engineering)

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	1										1
CO2	3	1										1
CO3	3	2	1									1
CO4	3	2										1

Mapping of Course outcome with Program Outcomes (IT)

Course Outcome	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	1										1
CO2	3	1										1
CO3	3	2	1									1
CO4	3	2										1

3 – High, 2 – Medium, 1– Low

ISE III Assessment: It is of 10 marks based on the following.

1) Home assignments,2) Surprise tests with multiple choice questions, Surprise Test
2. Assignment using Mathematical tools like Mathematica / MatLab or similar. 3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I (Class Test-1)	ISE II (Class Test-2)	ISE III (TA + Surprise Test)	End Semester Examination
K1	Remember	03	03		
K2	Understand	12	12	10	60
K3	Apply				
K4	Analyze				
Total Marks 100		15	15	10	60

EEPC 2001 : Network Analysis			
Teaching Scheme		**Examination Scheme**	
Lectures	: 3 Hrs/Week	ISE I	: 15 Marks
		ISE II	: 15 Marks
Tutorial	: NIL	ISE III	: 10 Marks
Total Credits	: 3	End Semester Exam	: 60 Marks

Course description: The electrical Network analysis is a set of techniques used for quantitative analysis of electrical networks. electrical circuit. This course introduces the transient analysis and steady-state analysis of electrical circuits to the students.

Prerequisites:

EEES 1001 - Basics of Electrical Engineering., MABS 1001 - Engineering Mathematics-I,II

Course Objectives:

The objectives of the course are to

1. Provide the student with a comprehensive understanding of the basic law of electric circuit & theories.
2. To make the students capable of analyzing any given electrical network.
3. To learn about the use of mathematics, Laplace Transform & differential equations for network analysis.
4. To make the students learn how to represent an electrical network in terms of different parameters.

Course Outcomes:

After completing the course, students will able to:

CO1	Solve Circuits using Topology and circuit reduction techniques.
CO2	Analyze the AC circuit using different network theorems.
CO3	Analyze the circuit for steady state and transient response.
CO4	Analyze and evaluate transient response, Steady state response, network functions in time and frequency domain
CO5	Express given Electrical Circuit in terms of A,B,C,D and Z,Y Parameter model and solve the circuits.

Detailed Syllabus:

Unit 1	**Basic Concepts:** Electrical parameters, Voltage and current sources, Classification of electrical elements, Topology of networks, Network equations on loop and node basis, Dot convention for coupled circuits, Concept of duality and dual networks.
Unit 2	**Network Theorems:** Node, Mesh, Super mesh & Super node analysis, Superposition, Thevenin's and Norton, Reciprocity, Substitution theorems, Maximum power theorem applied to networks with all types of sources.
Unit 3	**Solution of Network Equations:** Steady state and transient solution, Forced and free response, Time constants, Physical and mathematical analysis of circuit transients, Initial and final conditions in elements and in networks.

Unit 4	**Laplace Transform Method:** Solution of differential equations and network equations using Laplace transform method inverse Laplace transform, Transformed networks with initial conditions analysis of electrical circuits with applications of step, impulse and ramp functions, shifted and singular functions, The convolution integral Laplace transform of various periodic and non-periodic waveforms.
Unit 5	**Fourier method of waveform analysis:** Application of Fourier series expansion for periodic and non- sinusoidal waveforms. **Two Port Networks:** Z, Y and transmission parameters H parameters, Interrelations between these parameters, Transfer function, Concepts of poles and zeros, Transform impedance, Transform admittance, Concept of complex frequency, Driving point and transfer impedance and admittances.

Text and Reference Books:

1. William H. Hayt Jr., Jack E. Kemmerly, Steven M. Durbin, Engineering Circuit Analysis, Tata McGraw:Hill,6th edition.
2. M.E. Van Valkenburg, Network Analysis, Prentice Hall, 2nd edition.
3. Boylestad Robert L. Charles E., Introduction to Circuit Analysis, Merrill Publishing Company.
4. John R. O Malley, Circuit Analysis, Prentice Hall. .
5. Smarajit Ghosh, Network Theory: Analysis And Synthesis 1st Edition , Phi Learning Pvt. Ltd
6. C. L. Wadhwa, Electrical Circuit Analysis: Including Passive Network Synthesis 2nd Edition , NEW AGE INTERNATIONAL PUBLISHERS LTD.-NEW DELHI
7. M. Musa, Matthew N. O. Sadiku, Charles K. Alexander, Applied Circuit Analysis 1st Edition , Mcgraw Hill Education

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	1												
CO2	3	1	1												
CO3	3	2	1												
CO4	3	1	1			1	1	1							
CO5	3	2													

3 – High 2 – Medium 1 -Low

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

1. Assignments based on Numerical from exercise (unsolved problems from Textbooks).
2. Objective type test.
3. Solving network problems by MATLAB. solution

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	Test I	Test II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	5	5	4	15
K2	Understand	5	5	2	15
K3	Apply	5	5	2	15
K4	Analyze			2	15
Total Marks 100		15	15	10	60

Assessment Table:

Assessment Tool	K1+K2+k5	K3	K3+K5	K2+K3+K4	K4+K5
	C01	C02	C03	CO6	CO7
ISE I & II (30 Marks)	05	05	05	15	
ISE III (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	06	06	12	24	12

Special Instructions if any: NIL

Designed by
Prof. N. J. Phadkule

Approved in XXIVth Academic Council,Dated 23/07/2022

EEPC2002 : Electrical Machines-I			
Teaching Scheme		**Examination Scheme**	
Lectures	: 3 Hrs/Week	ISE I	: 15 Marks
Tutorial	: 0 Hr/Week	ISE II	: 15 Marks
Total Credits	: 3	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Pre-requisites: EEES 1001 -Basics of Electrical Engineering, MABS1001 - Engineering Mathematics-II

Course Description:

Electrical Machines-I is a one-semester course compulsory to all second year engineering students of the Electrical Engineering Department Course is aimed to introduce fundamentals of D.C. machines to undergraduate students. The goal of this course is to understand and apply basic principles of D C motor, D C Generator and Transformers with their applications.

Course Objectives:

The objectives of the course are to learn

1. The principles of D.C. machines.
2. Fundamental concepts of Single and three phase transformer
3. The details of construction, operation, Characteristics and applications of dc motor, dc generator and transformer
4. Basic knowledge to develop practical skills

Course Outcomes:

After completing the course, students will able to

CO1.	Understand fundamental principles, performance and applications of three phase and single phase transformer
CO2	Understand fundamental principles, performance and applications of dc motor
CO3	To solve engineering problems of dc motor, dc generator and transformer
CO4	Identify type of Transformer and DC machine
CO5	Evaluate the steady state parameters, basic operating characteristics and performance of transformers and DC Machine.

Detailed Syllabus:

Unit-I	**Magnetic fields and Magnetic circuits:** Review of magnetic circuits-MMF, Flux, reluctance, inductance, review of Ampere's law and Biot-Savart law, magnetic field produced by a bar magnet and a current carrying coil through air and iron B-H curve of magnetic materials, flux linkages vs current characteristics of magnetic circuits, energy stored in magnetic circuits
Unit-II	**Single Phase Transformer:** Principle, construction and operation of single phase transformer equivalent circuit phasor diagram, voltage regulation losses and efficiency, open circuit and short circuit test, polarity test, back to back (Sumpner's)test, separation of hysteresis and eddy current losses

Unit -III	**Three phase Transformer:** Three phase transformer construction types of connections and their comparative features, parallel operation of single and three phase transformers, Auto transformers construction, principle, application and comparison with two winding transformer, harmonics in magnetizing current phase conversion Scott connection, three to six phase conversion , Tap changing transformers, no load and on load tap changing, three winding transformers , cooling of transformers, ICT
Unit-IV	**DC Machine I:** Construction of dc machine, induced emf in an armature coil, lap and wave winding, commutation, back emf equation, mmf wave, derivation of torque equation, armature reaction Types of field excitation- separately excited shunt and series characteristics of dc generator, voltage build up in shunt generator, critical field resistance, speed torque characteristics of shunt and series motors, speed control, losses and efficiency
Unit-V	**DC Machine II:** Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Text and Reference Books:

1. A. E. Fitzgerald & C. Kingsley & S. D. Umans, "Electric Machinery", TMH, New Delhi, 5th Edition.
2. I. J.Nagrath & D. P. Kothari, "Electric Machines", Tata McGraw Hill, New Delhi, 2nd Edition.
3. Dr. P. S. Bimbhra, Electric Machinery, 5th edition, Khanna Publishers, Delhi.
4.J. B. Gupta,"Theory and Performance of Electrical Machines" Kataria & Sons. 14th Edition Delhi.
5. P. S. Kenjo and S.Nagamori: Permanent Magnet DC motors, Clarendon Press, Oxford, 1985.
6. Syed A. Nasar, "Electric Machines & Power Systems", Volume I, Tata McGraw Hill
7. Alexander S. Langsdorf, " Theory of Alternating current Machines" Second Edition, TMH, New Delhi
8. George Mcphersion, "An Introduction to Electrical Machines and Transformers", John Wiley NY
9. A. F. Puchstein, T.C. Lloyd, A.G. Conrad, "Alternating current machines", John Wiley and Sons, NY

Mapping Of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	3														
CO2	3		1		1				1	1		1	1		
CO3	3		1									1	1		
CO4	3		1									1	1		
CO5	3		1									1	1		

3-High 2- Medium 1- Low

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Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K5	K5	K1+K2+K5
Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I & II 30 Marks	10	10	10	05	--
ISE III 10 Marks	2	2	2	2	2
ESE Assessment 60 Marks	12	12	24	06	06

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

Home Assignments, PowerPoint presentation, Develop working models, Surprise written Test with multiple choice questions, Quiz

Assessment Pattern:

Level No.	**Knowledge Level**	**Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	05	2	12
K2	Understand	05	3	12
K3	Apply	05	2	06
K4	Analyze			
K5	Evaluate	15	3	30
Total		30	10	60

Designed by
Dr. S. M. Shinde & V.P.Dhote

Approved in XXIVth Academic Council,Dated 23/07/2022

EEPC2003: Electrical Measurement and Instrumentation			
Teaching Scheme		**Examination Scheme**	
Lectures	: 3 Hrs/Week	ISE I	: 15 Marks
Tutorial	: NIL	ISE II	: 15 Marks
Total Credits	: 3	ISE III	: 10 Marks
		End Semester Exam	: 60 Marks

Pre-Requisites: EEES 1001 – Fundamentals of Electrical Engineering

Course Description: Electrical Measurement & Instrumentation is a one-semester course compulsory to all second year engineering students of the department which introduces analog and digital measurement of different electrical and mechanical quantities.

Course Objectives:

The objectives of the course are to

1. To impart knowledge of principles of measurement of electrical quantities.
2. To enable students to learn construction and operating principles of electrical instruments.
3. To enable students to learn static and dynamic characteristics of electrical instruments.
4. To analyze and minimize errors in measurement.
5. To impart knowledge of IS codes and be able to do the electrical testing.

Course Outcomes :

After completing the course, students will able to:

CO1	Explain the working principle of different electrical measuring instruments.
CO2	Analyze the bridges for the measurement of Resistance, Inductance and Capacitance.
CO3	Explain construction and working of electrical measuring instruments and compute the errors in CTs and PTs.
CO4	Explain working of measuring instruments for non electrical quantities.
CO5	Compare the digital measuring equipments for measurement of various electrical parameters.

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Detailed Syllabus:

Unit-I	**Basics of Measurement** Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, Cp, Cpk. **Measurement of Electrical quantities:** Measurement of voltage, current, Measurement of three phase power under balanced and unbalanced condition, Measurement of reactive power, Measurement of energy. Measurement of high ac voltage and current, Peak Voltage Measurement.
Unit -II	**Measurement of Resistance, Inductance and Capacitance:** Measurement of Low, Medium and High Resistance – Kelvin's bridge, loss of charge method. Measurement of inductance, Quality Factor - Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge. Measurement of capacitance and Loss Angle - Desauty bridge. Wien's bridge, Schering Bridge, High-voltage Schering bridge. **Instrument Transformers:** Construction, phasor diagrams, error analysis and compensation, testing and application of measuring CT, VT & CVT, IS codes (IS 2705-2 (1992), IS 3156-1 (1992))
Unit -III	**Measuring Instruments:** General features of indicating, recording & integrating instruments, Types of instruments, Construction, Principle of operation and torque equation of moving coil, moving iron, electrodynamometer, Induction, and electrostatic type instruments. Principle of operation of the thermoelectric, rectifier type instruments. Power factor meter, errors and their compensation, calibration & testing; IS codes. **AC Potentiometer:** Polar type & Coordinate type AC potentiometers, Applications of AC Potentiometer in electrical measurements, Q-meter, LCR Bridge, RX meter, Automatic bridges, Megger, Transistor tester.
Unit -IV	**Instrumentation:** Purpose of instrumentation, Classification of instrumentation system, Sensors and Transducers for physical parameters: Transducers, classification & selection of transducers, Strain gauges, Inductive & Capacitive transducers, Piezoelectric and Hall-effect transducers, Thermistors, Thermocouples, Photo-diodes & Photo-transistors, Encoder type digital transducers, Signal conditioning and telemetry systems, Measurement of non-electrical quantities such as torque, pressure, vibration, temperature, force, humidity etc., Flow, Speed and Position Sensors.
Unit -V	**Digital Measurement of Electrical Quantities:** Concept of digital measurement, Study of digital voltmeter, Frequency meter, Power Analyzer and Harmonics Analyzer; Electronic Multimeter, Data Acquisition Systems, Data transmission system. Signal generators and Function generators, CRO and DSO.

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Text and Reference Books:

1. A.K.Sawhney & Puneet Sawhney, "A Course in Electrical And Electronic Measurements and Instrumentation", 7/e, Dhanpat Rai & Co.(P) Ltd.,2005.
2. Albert D.Helfrick & William D.Cooper, "Modern Electronic Instrumentation and Measurement Technique",Low Price Edition, Pearson Education, 2005.
3. H.S.Kalsi, "Electronic Instrumentation", Technical Education Series, TMH, 2001.
4. Alan S.Morris, "The Essence of Measurement", Eastern Economic Edition,PHI India, 1997.
5. Ernest O. Doebelin, "Measurement Systems Application and Design", 5th , TMH,2004.
6. Tumanski S., " Principles of Electrical Measurement ", CRC Press, Taylor and Francis, 2006.
7. Morris A. S.," Measurements and Instrumentation Principle", 3rd Edition, Butterworth-Heinen 2001 .

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								3	1	1
CO2	2	3	1	2	1	1		1	1	1		1	2	3	1
CO3	3	2	2	2	2		1	2	1				3	3	1
CO4	2			1	1		1				1	1	3	1	1
CO5	2				2	1	1			1	1	1	2	1	1

3 – High 2 – Medium 1 – Low

Assessment Pattern:

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					
End Semester Exam 60 Marks					

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

Model/ circuit for Parameter Measurement, PPT presentation, Multiple Choice Question / Objective type Test / Quiz, Surprise test, Home assignments, Attendance.

Assessment Pattern:

Level No.	Knowledge Level	Test 1	Test 2	Teachers Assessment/ Assignment	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: Prof. W. A. Gavhane

EEPC2004: Analog Electronic Circuits			
Teaching Scheme		**Examination Scheme**	
Lectures	: 3 Hrs/Week	ISE I	: 15 Marks
Tutorial	: NIL	ISE II	:15 Marks
Total Credits	: 3	ISE III	: 10 Marks
		End Semester Exam	: 60 Marks

Prerequisites: Nil

Course description: Analog electronic circuits is a one-semester course compulsory to all second year engineering students of the department

Course Objectives:

- To impart knowledge of analog circuit components and devices
- To create awareness of concepts related to CB, CE and CC types of transistor, load lines, h-parameter, oscillators, power amplifiers using BJT,
- To introduce basic concepts of Linear and Non-linear Op-Amp Circuits
- To introduce basic concepts of Filters, Oscillators, Comparators using Op-Amp

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

	Course Outcomes
CO1	Analyze the principles and working of diode with its applications, power supply, wave shaping circuits and passive filters
CO2	Describe working of transistors, analyze CE configuration and describe application such as multi-vibrators
CO3	Describe the transistor feedback, power amplifiers and various oscillators
CO4	Explain basic principles of Linear and Non-linear Op-Amp Circuits
CO5	Describe operation of various active filters, oscillators, comparators and specialized ICs

Detailed Syllabus:

Unit 1	**Power Supplies & Wave Shaping Circuits:** **Review of Semiconductor Physics:** Introduction to PN- junction diode, I-V characteristics of a diode; BJT, FET and MOSFET; static characteristics of PN-Junction diode **DC Power Supply:** Single phase half wave, full wave and bridge rectifiers-expression for ripple factor, Efficiency, Diode Ratings, **Filters:** Capacitor, Inductor, LC Filters **Regulated Power Supply**: concept, Simple Voltage regulator , Series regulators, IC voltage regulator **Wave Shaping Circuits:** Pulse characteristics, RC-low pass, high pass circuits, differentiating and integrating circuits, clipping and clamping circuits using diodes

Unit 2	**Small Signal Amplifiers & Multivibrators:** **Small Signal Amplifiers:** Structure and I-V characteristics of a BJT, BJT as an amplifier: concepts of CB, CE, CC configurations, Input & output characteristics of common emitter configuration, comparison of three configurations, thermal runway, biasing, Concept of load lines, methods of coupling, concept of transistor as a switch, h-parameters, simplified CE hybrid mode, -3dB bandwidth, **Multivibrators:** Astable, monostable & bistable multivibrators
Unit 3	**Feedback, Power Amplifiers and Oscillators:** **Feedback Amplifiers:** Multistage amplifier, Negative and positive feedback, Types of feedback amplifiers, Voltage series/shunt, Current series/shunt amplifiers **Power Amplifiers**: Classification- class A, class B, class AB, class C, push-pull amplifiers and complementary symmetry, concept of harmonic distortion, and cross-over distortion in power amplifiers **Oscillators:** RC phase shift, LC, Hartley, oscillators (using BJT's only)
Unit 4	**Linear and Non-linear Op-Amp Circuits:** Op-Amp Fundamentals: Symbol block diagram representation, equivalent circuit Idealized analysis of op-amp circuits. open loop Op-amp configurations, negative feedback. Practical op-amp: Input bias and offset voltage and current, thermal drift, Common mode configuration and rejection ratio. Frequency response of internally compensated and non-compensated op-amps, High frequency op-amp circuit stability and slew rate
Unit 5	**Active Filters, Oscillators, Comparators and specialized ICs with applications:** **Active Filters:** Butter worth filters, low pass, high pass, band pass, band reject, all pass filters. **Oscillators:** Wein bridge and phase shift oscillator using op-amps **Comparators:** Zero crossing detector, Schmitt trigger, window detector, V to F and F to V converters, peak detector, sample and hold circuit, **Special Function ICs:** Timer IC 555, applications **Phase-Locked Loops:** PLL with applications. **Signal Generators:** Sine, triangular and square wave generators using op-amps

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

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

3-High, 2-Medium, 1-Low

Text and Reference books

1. R. A. Gaikwad, "Op-amps and Linear Integrated Circuits Technology", PHI Publications
2. D. Roy Chaudhari, "Linear Integrated Circuits", New Age International Publishers
3. S. Franco, "Design with Operational Amplifiers and Analog ICs", Tata McGraw-Hall
4. Millman and Halkias, „Electronic Devices and Circuits", McGraw Hill
5. Allan Mottorshed, Electronic Devices and Circuits", Tata McGraw Hill
6. Boylestad and Nashelsky, Electronic Devices and Circuits„ Tata McGraw
7. G. B. Clayton, "Operational Amplifiers", Butterworth & Co. Publications
8. Millman and Halkias, Integrated Electronics, McGraw Hill
9. . Schilling and Belove, Electronic Devices and Circuits

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	07	11	08	30
K2	Understand	06	04	02	24
K3	Apply	02	00	00	06
K4	Analyze	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K1	K1	K2
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	08	07	00	00	00
ISE II (15 Marks)	00	00	08	07	00
ISE III (10 Marks)	02	02	02	02	02
ESE Assessment (60 Marks)	12	12	12	12	12
Total Marks 100	22	21	22	21	14

Designed by Prof. V. A. Kulkarni

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EEPC2005: Lab Network Analysis			
Teaching Scheme		**Examination Scheme**	
Lectures	: 2Hrs/Week	ISE I	: 25 Marks
Tutorial	: NIL	Practical/Oral	: 25 Marks
Total Credits	: 01		

Laboratory Course Outcomes

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

CO1	Apply various basic laws and theorems of electrical circuit
CO2	Understand effects of Initial and final conditions on networks.
CO3	Understand and examine behavior of the network for the applications of Step, Impulse and Ramp functions.
CO4	Explain the fundamental principle Fourier transform of Waveform Analysis.
CO5	Analysis of electrical networks using two port networks concept and Concepts of Poles and Zeros.

List of Experiments(any eight or more by simulation or Hardware)

1. Network Theory
2. Verification of Superposition Theorem
3. Verification of Thevenin's Theorem
4. Verification of Maximum Power Transfer Theorem
5. Verification of Reciprocity Theorem
6. Study of Step Response of R-L Network
7. Study of Step Response of R-C Network
8. Study of Time Response of R-L-C Network
9. Waveform Analysis by Fourier Methods
10. Verification of Two Port Network

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2						1	1				1	1	1
CO2	3	2					1	1	1				1	1	1
CO3	3	2						1	1				1	1	1
CO4	3	2	1				1	1	1				1	1	1
CO5	3	2						1	1				1	1	1

3 - High 2 – Medium 1 -Low

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					

Assessment Pattern:

Assessment Pattern Level No.	Skill Level	Term Work	Practical Examination & viva voce
S1	Imitation	10	
S2	Manipulation	05	
S3	Precision	10	
Total		25	

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

Designed by
Dr. N. J. Phadkule

EEPC2006: Lab Analog Electronic Circuits			
Teaching Scheme		**Examination Scheme**	
Lectures	: 2Hrs/Week	ISE I	: 25 Marks
Tutorial	: NIL	Practical/Oral	: 25 Marks
Total Credits	: 01		

Pre-requisites: Nil

Course description: Lab Analog Electronic Circuits is a one-semester course compulsory to all second year engineering students of the department

Course Objectives: The objectives of the course are to-

1. To expose the students to a variety of practical circuits using various analog circuits.
2. To acquire skills of designing and testing integrated circuits

Course Outcomes:

After completion of this course students will be able to-

CO1	Use basic electronic components such as diodes for various applications
CO2	To plot and analyze transistor amplifier characteristics and describe performance of of multi-vibrators
CO3	Describe the performance of transistor power amplifiers / oscillators
CO4	Perform the experiments based on linear and nonlinear op amp circuits
CO5	Construct the circuits for various applications using analog IC's

List of the Experiments

The student shall perform minimum ten experiments of the following

Sr. No.	**Title of the Experiments**
1	Regulation characteristics of half wave and full wave rectifier with and without filter
2	Measurement of line regulation and load regulation of shunt regulator
3	Measurement of line regulation and load regulation of series regulator
4	Measurement of h parameters of CE amplifier
5	Frequency response of RC coupled amplifier
6	Frequency response of Transformer coupled amplifier
7	Study of RC low pass, high pass circuit
8	Study of clipper, clamper
9	Study of differentiator, integrator
10	Study of Bistable multivibrator,astable & monostable and to observe the output waveforms using IC 555
11	Build Inverting amplifier using IC 741 and plot its frequency response
12	To build Non-inverting amplifier using IC 741 and plot its frequency response
13	To build summing amplifier in inverting and non-inverting mode
14	To measure Op-Amp parameters such as Input offset voltage, input bias current, Input offset current, PSRR and CMRR
15	To measure slew rate of Op-Amp
16	To build different types of comparators and observe the waveforms on CRO
17	To build voltage limiter and to observe the output waveforms
18	Study of Oscillator
19	To build precision rectifiers and to observe the output waveform

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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	3	2		2	1	2	3	3	3	1	3		3	3
CO2	3	3	2		2	1	2	3	3	3	1	3		3	3
CO3	3	3	2		2	1	2	3	3	3	1	3		3	3
CO4	3	3	2		2	1	2	3	3	3	1	3		3	3
CO5	3	3	2		2	1	2	3	3	3	1	3		3	3

3 – High 2 – Medium 1 - Low

Assessment:

ISE I, will be an evaluation of performance of students during the lab hours, based on timely completion of journals and given tasks, attendance, clarity of aim and grasp of the experiment performed. ISE I marks will be allotted during the mid-semester. ISE II marks will be allotted at the end of the semester. It will be the average of the marks obtained in performing half experiments till mid semester and later remaining experiments till end of the semester respectively.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI &II	End Semester Examination
S1	Imitation	15	--
S2	Manipulation	20	--
S3	Precision	15	--
Total Marks		50	--

Designed by Prof. V. A. Kulkarni

EEPC2007 : Lab Electrical Machines-I	
Teaching Scheme Practical: 2 Hrs/Week Credit:1	**Examination Scheme** ISE I : 25 Marks Practical Examination & Viva Voce :25 Marks

Course Description: Electrical Machines-I Lab (EE xx) is a one-semester course compulsory to all second year engineering students of the department.

Course Objective: On completion of this Course the student shall be able to
1. To prepare the students to have a basic knowledge of transformers.
2. To prepare the students to have a basic knowledge of D. C. motors.

Course Outcomes: At the end of the course student will have ability to

CO1	Select range of apparatus based on the ratings of DC Machines and Transformers.
CO2	Determine equivalent circuit parameters of transformer by open circuit and short circuit test
CO3	Evaluate the performance and parameters of transformer by analyzing load test results
CO4	Investigate the magnetization characteristics of dc generator and performance of dc motor at no load and full load
CO5	Select and demonstrate various methods to control the speed of D.C. machines for wide speed range

List of Experiments:

Sr. No.	Details
1	Determination of efficiency, regulation of single phase transformer using open circuit & short circuit test
2	Determination of constants of equivalent circuit using open circuit & short circuit test single phase Transformer.
3	Parallel operation of single phase/three phase Transformers
4	To determine Efficiency & regulation of single phase Transformer by direct loading.
5	To perform Sumpner's test on Transformers
6	To perform Scott: connection of single phase Transformers.
7	To verify of voltage relationships for various Three phase Transformer winding connections
8	To plot Magnetization, external and internal characteristics of a DC generator
9	To control Speed of a DC shunt motor by: (i) armature voltage control (ii) field control method
10	To Study the performance of DC shunt motor by load test.
11	Separation of transformer core loss into eddy current loss and hysteresis loss.
12	To perform Retardation test on DC Machines.
13	Study of conventional and industrial starters for DC Motors
14	Verification and analysis of no load current waveform of single phase transformer

Visit to industry related to any machine or transformer related plant

ISE I :

It consists of submitting a file for a minimum of eight experiments with neatly written records of the study, circuit diagrams, observations, and graphs with results. The term work will be assessed by the course coordinator

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Practical Examination:

The Practical Examination will consist of performing the experiment and viva voce on the syllabus. The practical will be assessed by two examiners, one will be the course coordinator and other will be an examiner appointed by DSB.

Mapping of Course outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2					1	1	2	2	2		2		2	
CO2	2	2				1	1	2	2	2		2		2	
CO3	2	2				1	1	2	2	2		2		2	
CO4	2	2				1	1	2	2	2		2		2	
CO5	2					1	1	2	2	2		2		2	

3 – High 2 – Medium 1 - Low

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	05	05
S2	Manipulation	10	10
S3	Precision	10	10
S4	Articulation	00	00
S5	Naturalization	00	00
Total		25	25

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

Assessment Table

Assessment Tool	S1	S2	S3	S4	S5
	C01	C02	CO3	CO4	CO5
ISE I (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

Prepared by
Prof. V. P. Dhote & Dr. S. M. Shinde

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EEPC2008: Lab Electrical Measurement and Instrumentation			
Teaching Scheme		**Examination Scheme**	
Lectures	: 2Hrs/Week	ISE I	: 25 Marks
Tutorial	: NIL	Practical/Oral	:25 Marks
Total Credits	: 01		

Laboratory Course Outcomes:

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

CO1	Select the suitable type and range of measuring instruments for experiments
CO2	Demonstrate the fundamental principle for measurement of power & Measure reactive power in 3-phase circuit using single wattmeter
CO3	Accurately determine the values of inductance and capacitance using a. c bridges
CO4	Determine and analyze the CT and PT ratio error and phase angle error
CO5	Calibrate various electrical measuring/recording instruments.

List of Experiments:

Sr. No.	Name of the Experiments
	Any 6 experiments from 1-14
1	Measurement of a batch of resistors and estimating statistical parameters.
2	Measurement of L using a bridge technique as well as LCR meter
3	Measurement of C using a bridge technique as well as LCR meter.
4	Measurement of Low Resistance using Kelvin's double bridge.
5	Measurement of High resistance and Insulation resistance using Megger.
6	Current Measurement using Shunt, CT, and Hall Sensor.
7	Calibration and Testing of A.C. single phase / three phase Energy meter
8	Measurement of Power in three-phase circuit using Instrument transformers / wattmeter
9	Measurement of % ratio error and phase angle of given C.T. by Silsbee's method.
10	Measurement of voltage, current and resistance using DC potentiometer
11	Measurement of parameters of a choke coil using 3 voltmeter / 3 ammeter methods.
12	Measurement of reactive power using single wattmeter in three-phase circuit.
13	Measurement of high ac voltage and current
14	Measurement of High Voltage using Sphere Gap
	Any 4 experiments from 15-23
15	Measurement of different electrical quantities & harmonics using a power analyzer.
16	Measurement of voltage, frequency & phase with the help of CRO
17	Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
18	Download one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
19	Usage of DSO to capture transients like a step change in R-L-C circuit.
20	Measurement of Displacement with the help LVDT
21	Measurement of different ranges of temperatures using i) RTD ii) Thermocouple
22	Measurement of load with the help of strain gauges
23	Experimental set up for measurement of non electrical quantities

Mapping of Course outcome with Program Outcomes:

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

3 – High 2 – Medium 1 – Low

Assessment Table:

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

Assessment Pattern:

Assessment Pattern Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	10	05
S2	Manipulation	05	05
S3	Precision	10	05
S4	Articulation		05
55	Naturalization		05
Total		25	25

Prepared by: Prof. W. A. Gavhane

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Semester IV

EEES2020: Electromagnetic Fields			
Teaching Scheme		Examination Scheme	
Lectures	:03 Hrs/Week	ISE I	: 15 Marks
Tutorial	: 00	ISE II	: 15 Marks
Total Credits	: 3	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Pre-requisites

PHBS1001- Engineering Physics MABS1001-Engineering Mathematics-II

Course description: -

This course examines electric and magnetic quasi static forms of Maxwell's equations applied to dielectric, conduction, and magnetization boundary value problems.

Course objectives: -

The objectives of the course are to learn

1. Have an ability to determine and describe static and dynamic electric and magnetic fields for technologically important structures: the coil, charge distributions, the dipole, the coaxial cable, dielectric and conducting spheres.
2. Understand the coupling between electric and magnetic fields through Maxwell's equations.
3. Knowledge of, physical interpretation, and ability to apply Maxwell's equations
4. Determine field waves, potential waves, and energy and charge conservation conditions.

Course Outcome:

After completing the course students will able to,

CO1	Apply vector calculus to understand the behavior of static electric fields in standard configurations.
CO2	Apply vector calculus to understand the behavior of static magnetic fields in dielectrics.
CO3	Apply Maxwell's equation to dielectrics, conductors.
CO4	Evaluate displacement current and motion of particles and conductors in time varying fields.
CO5	Describe and analyze electromagnetic wave propagation in free-space ,dielectric.

Detailed Syllabus:

UNIT-I	**Static Electric Field**: Coulomb's law, Electric field intensity due to different charge distribution, Electric flux density, Gauss' law, Divergence and Divergence theorem, Maxwell's first equation Potential and potential difference, Potential field of system of charges, Potential gradient, Dipole, The energy density in electric field.
UNIT-II	**Static Electric Field in Dielectrics**: Continuity of current, Conductor properties and boundary conditions Nature of dielectrics, Boundary conditions for perfect dielectric material polarization and its effect in dielectric.
UNIT-III	**Steady Magnetic Field:** Biot-Savart law, Ampere's circuital law Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Nature of magnetic material, Magnetic field and magnetization, Boundary conditions in magnetic field
UNIT-IV	**Time Varying Field:** Faraday's law, displacement current, Maxwell's Equations i point form and integral form

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UNIT-V	**Uniform Plane Wave**: Wave propagation in free space, in dielectrics, Pointing vector and power consideration, Wave propagation in good conductor: Skin effect Reflection of uniform plane waves at normal incidence, Standing wave ratio.

Text and Reference Books:

1. William H. Hayt, Jr& John A. Buck," Engineering Electromagnetics," 7th edition, Tata McGraw:Hill.
2. D. Kraus," Electromagnetic" 5th Edition, McGraw Hill Book Company.
3. Matthew N.O.Sadiku & S.V.Kulkarni, " Principles of Electromagnetics" 6th Edition Oxford University Press
4. S P Ghosh,"Electromagnetic Field Theory" 1st Edition, Mcgraw Hill Education
5. S.P. Seth,"Elements of Electromagnetic Fields" DhanpatRai & Co. Ltd. Educational & Technical Publishers, 2001.
6. G. S. N. Raju," Electromagnetic Field Theory and Transmission Lines "1st Edition, Pearson India

Mapping of Course outcome with program outcomes :

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1				1	1	1				2	3	2
CO2	3	2					1	1	1				2	3	2
CO3	3	3											2	3	2
CO4	3	3	1						1				2	3	2
CO5	3	2	1			2	1	1	1				2	3	2

3 – High 2 – Medium 1 - Low

Teaching Strategies:

The teaching strategy is planned through the lectures, tutorials 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 III Assessment: Teacher's Assessment of 10 marks is based on one of the /or combination of the few of the following.

1) Home Assignments , 2) Develop working models, 3) Surprise written Test with multiple choice question

Assessment table:

Assessment Tool	K1+K3+K4+K5	K3+K4+K5	K2+K3+K4	K4+K5	K1+K2+K4
Course outcomes	CO1	CO2	CO3	CO4	CO5
Class Test 30 Marks	10	10	05	05	
Teachers Assessment 10 Marks	03	02	02	02	01
ESE Assessment 60 Marks	18	12	12	12	06

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**Test 1**	**Test 2**	**Teachers Assessment /Assignment**	**End Semester Examination**
K1	Remember	2.5		02	06
K2	Understand	2.5	2.5	03	06
K3	Apply	05	05	03	18
K4	Analyze	05	05	02	18
K5	Evaluate		2.5		12
Total		15	15	10	60

Designed by

Dr. N. J. Phadkule

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EEES2021: Numerical Computational Techniques			
Teaching Scheme		**Examination Scheme**	
Lectures	: 2Hrs./Week	ISE 1	: 15 Marks
Total Credits	:2	ISE II	: 15 Marks
		ISE III	: 20 Marks
		End -Semester Exam	: 00 Marks

Pre-Requisites:

MA1001: Engineering Mathematics- I, MA1002:Engineering Mathematics- II

MA2001: Engineering Mathematics-III, EE2004:Computer Programming

Course Description: Numerical Computational Techniques is a compulsory course to second year electrical engineering students of the department in the Semester –IV.

Course Objective:

This course strives to enable students

1. To provide the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology
2. To emphasize the need of computational techniques and analyze errors involved in the computation.
3.To provide an overview of numerical techniques to solve ordinary and partial differential equations, which we apply to solve many engineering problems of electrical Engineering.
4. To apply various numerical methods to obtain solutions of different types of equations such as transcendental, simultaneous, and also for interpolation, integration and differentiation.

Course Outcomes Expected:

After completion of this course students will be able to

CO1	To demonstrate different types of computational techniques to find the roots of the equations
CO2	Apply appropriate numerical method for solution of Transcendental and polynomial equation
CO3	Apply and compare various numerical methods to solve first and second order ODE
CO4	Apply different numerical methods for interpolation, numerical differentiation and integration.
CO5	To demonstrate the applications of numerical computational techniques to engineering problems drawn from industry and other engineering fields.

Detailed Syllabus

Unit-I	**Nonlinear Equations**: Bisection Method, Rule of False Position, The Secant Method, Newton–Raphson Method **Linear Equations-**Matrices-Substitution methods, Gauss elimination method, Gauss Jordan Method, triangularization method, Gauss Seidel iterative method
Unit-II	**Curve Fitting:** Linear Interpolation, Polynomial Interpolation, Least Squares Approximation
Unit-III	**Numerical Differentiation:** Method based on interpolation and finite difference **Ordinary Differential Equations**: Euler's Method, Runge–Kutta Methods, Boundary Value Problems
Unit-IV	**Numerical Integration**: The Trapezium Rule, Quadrature Rules, Simpson's Rule

Unit -V	**Optimization :** Introduction to Optimization, Unconstrained Optimization: Golden Search Method, Steepest Descent Method, Newton Method, evolutionary optimization method(any one), Lagrange Multiplier Method

Text and Reference Books:

1. Numerical Methods for Scientific and Engineering Computations – M. K. Jain / S. R. K. Iyengar / R. K. Jain
2.V Rajaraman., " Computer oriented Numerical Methods", Prentice Hall Publication
3.Francis Scheid, "Numerical Analysis", Tata McGraw Hill Publication
4. Calculus of Finite Difference and Numerical Analysis – Gupta / Malik.
5. Numerical Methods for Engineers by Steven Chapra, Raymond P. Canale – Tata McGraw Hill Publication.
6. Numerical Methods, second edition, S. Arumugan, A. Thangapandi Isaac, A. Somasundaram, SCITECH Publications (India) Pvt. Ltd.
7. Numerical Mathematical Analysis – J. B. Scarborough.
8. Robert Schilling, Sandra L. Harries, "Applied Numerical Methods for Engineers", Thomson
9. Numerical Methods – E. Balgurusamy - Tata McGraw Hill Publication
10. Numerical Methods with Programs in C and C++ - T. Veerarajan and T. Ramchandran- TMH.

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3				1							1			
CO2	3				1							1			
CO3	3				1							1			
CO4	3				1							1			
CO5	3				1							1			

3 – High 2 – Medium 1 – Low

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

1. Home Assignments, 2. Surprise written Test with multiple choice question
3. Solution of different numerical problems using software, 4. Quizzes,5. Application development.

Assessment Table

Assessment Tool	K1,K2,K3	K1,K2,K3	K1,K2,K3	K1,K2,K3	K1,K2,K3
Course outcomes	CO1	CO2	CO3	CO4	CO5
Class Test 15 Marks	07	08	00	00	00
Class Test 15 Marks	00	00	08	07	00
Teachers Assessment 20 Marks	04	04	04	04	04
ESE Assessment 60 Marks					

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Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 1	Test 2	Teachers Assessment /Assignment	End Semester Examination
K1	Remember	05	05	00	00
K2	Understand	05	05	10	00
K3	Apply	05	05	10	00
Total		15	15	20	00

Designed by
Dr. N. J. Phadkule

EEPC2022 : Electrical Machines-II			
Teaching Scheme		**Examination Scheme**	
Lectures	: 03 Hrs./Week	ISE	: 15 Marks
Tutorial	: 00	ISE II	: 15 Marks
Total Credits	: 03	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Pre-Requisites: EEES1001 -Basics of Electrical Engineering, MABS1001 - Engineering Mathematics-II

Course Description:

Electrical Machines-II is a one-semester course compulsory to all second year engineering students. The Electrical Engineering Department Course is aimed to introduce fundamentals of A.C. machines to undergraduate students. The goal of this course is to understand and apply the basic principle of induction motor, synchronous motor, alternator and special purpose machines with their applications.

Course Objectives:

The objectives of the course are to learn

1. The principles A.C. machines.
2. Fundamental concepts of induction motor, synchronous motor and alternator.
3. The details of construction, operation, Characteristics and applications induction motor, synchronous motor and alternator
4. Fundamental concepts special purpose machines.
5. Basic knowledge to develop practical skills

Course Outcomes:

After completing the course, students will able to

CO1.	Understand fundamental principles, performance and applications of three phase and single phase induction motor
CO2	Understand fundamental principles, performance and applications of synchronous motor and Alternator
CO3	To solve engineering problems of induction motor, synchronous motor and alternator
CO4	To find regulation of synchronous alternators by various methods & to understand the parallel operation and synchronization of synchronous alternators.
CO5	Understand the operation principles and identify the suitable applications of PMDC, PMSM, BLDC, SR motors and Linear Induction motors.

Detailed Syllabus:

Unit-I	**Three Phase Induction Motors:** Construction, Types, Rotating magnetic field, Principle of operation, Torque equation, Torque slip characteristics, Losses & efficiency, Phasor diagram & equivalent circuit, No load test, Block rotor test, Circle diagram, Speed control & Starting of Induction Motors, EFFECT of Harmonics on I.M. Introduction to Double Cage Induction Motor, Induction Generator and Starters used in industries
Unit-II	**Single Phase Induction Motors:** Construction, Double field revolving theory, Equivalent circuit, Torque slip characteristics, Starting methods & types.

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Unit-III	**Synchronous Motor:** Principle of operation, Phasor diagram, Methods of starting, Operation at constant power & fixed excitation, Equivalent circuit, Power developed, Effect of excitation, Hunting and methods of suppression, Effect of harmonics, Synchronous condenser
Unit-IV	**Synchronous Generator:** Construction, Types, Applications, Winding factors, EMF equation, Armature reaction, Phasor diagram, Load characteristics, Voltage regulation by synchronous impedance method, MMF method, Zero power factor method, Two reaction theory, Slip test. Parallel operation of Synchronous Generators, Methods of synchronization, Synchronization power Synchronizing torque, Operation of Synchronous Generator on infinite bus bar, Effect of load on synchronization power, Effect of unequal voltages
Unit-V	**Special Purpose Machines:** Construction and principle of operation of Permanent magnet DC motors, Brushless DC motors, Permanent Magnet Synchronous Motors, Switched Reluctance Motors, Linear Induction motors and their Applications,

Text and Reference Books:

1. A. E. Fitzgerald & C. Kingsley & S. D. Umans, "Electric Machinery", TMH, New Delhi, 5th Edition.
2. I. J.Nagrath & D. P. Kothari, "Electric Machines", Tata McGraw Hill, New Delhi, 2nd Edition.
3.Dr. P. S. Bhimbra, Electric Machinery, 5th edition, Khanna Publishers, Delhi.
4. J.B.Gupta, "Theory and Performance of Electrical Machines" S.K.Kataria& Sons. 14th Edition, Delhi.
5.P.S. Kenjo and S.Nagamori: Permanent Magnet DC motors, Clarendon Press, Oxford, 1985.
6. Syed A. Nasar, "Electric Machines & Power Systems", Volume I, Tata McGraw Hill, New
7. Alexander S. Langsdorf, " Theory of Alternating current Machines" 2nd Edition, TMHl, New Delhi
8. George Mcpherson ,"An Introduction to Electrical Machines and Transformers", Wiley & Sons, NY

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3												1	1	
CO2	3				3				3	3			1	1	
CO3	3	1	1										1	1	
CO4	3	1	1										1	1	
CO5	3	1	1										1	1	

3 – High 2 – Medium 1 - Low

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Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K5	K5	K1+K2+K5
Course outcomes	CO1	CO2	CO3	CO4	CO5
Class Test 30 Marks	10	10	10	05	--
Teachers Assessment 10 Marks	2	2	2	2	2
ESE Assessment 60 Marks	12	12	24	06	06

ISE III Assessment: It is based on one of the /or combinations of the few of the following. Home Assignments, PowerPoint presentation, develop working models ,surprise written Test with multiple choice questions, Quiz

Assessment Pattern:

Level No.	Knowledge Level	Test	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	05	2	12
K2	Understand	05	3	12
K3	Apply	05	2	06
K4	Analyze			
K5	Evaluate	15	3	30
Total		30	10	60

Designed by
Dr. S. M. Shinde & V. P. Dhote

Approved in XXIVth Academic Council,Dated 23/07/2022

EEPC2023: Power Systems-I			
Teaching Scheme		**Examination Scheme**	
Lectures	: 3 Hrs./Week	ISE 1	: 15 Marks
Total Credits	: 3	ISE II	: 15 Marks
		ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Pre-Requisites: EEEs1001 Fundamentals of Electrical Engineering

Course Description:

Power System -I (EEPC 2023) is a one-semester course compulsory to all second year Electrical Engineering students. It is the fundamental course related to Power System Engineering.

Course Objectives: The objectives of the course are to

1. Introduce Electrical Power System
2. Introduce operation of various power plants, transmission network and distribution network
3. Develop an understanding of the environmental aspects of power generation
4. Develop professional skills required to design electrical power transmission system
5. Provide fundamental knowledge required for modeling and analyzing transmission networks

After completion of this course students will be able to

CO1	Demonstrate working of various power plants
CO2	Explain merits and demerits of high transmission voltage; Compare the conductor costs for various transmission systems
CO3	Illustrate constructional and other aspect related to overhead conductors and underground cables
CO4	Compare various distribution systems, calculate voltages *etc.* related to distribution systems and describe various aspects related to substation
CO5	Describe fundamentals related to corona and power factor improvement and its impact on power system

Detailed Syllabus

Unit-I	**Introduction:** Typical Layout of an Electrical Power System, Present Power Scenario in India. **Generation of Electric Power: Conventional Sources (Qualitative):** Hydro station, Steam Power Plant, Nuclear Power Plant and Gas Turbine Plant. **Renewable energy Sources (Qualitative):** Wind Energy, Fuel Cells, and Solar Energy.
Unit-II	**Economics of Generation:** Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer. **AC Distribution:** Introduction, AC distribution, Single phase, 3-phase, 3 phase 4 wire system, bus bar arrangement, Selection of site and layout of substation.
Unit-III	**Overhead Line Insulators:** Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators. **Insulated Cables:** Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.

Unit-IV	**Transmission line sag calculation:** The centenary curve, Sag tension calculations, Supports at different levels, Stringing Chart **Line Constants:** Line conductors, resistance of line, skin effect, proximity effect, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, GMD and GMR, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance.
Unit-V	**Corona:** Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona, interference between power and Communication lines. Related numerical problems **Power Factor Improvement:** Introduction, Advantages of Power factor Improvement, methods of improving power factor.

Text and Reference Books:

1. Grainger John J and W D Stevenson Jr "Power system analysis" Mc-Graw Hill.
2. I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis" 3rd TMH Co Ltd., 2003.
3. W. D Stevenson Elements of Power System Analysis,4th Edition, McGraw Hill, 1984.
4. O. I. Elgerd, "Electrical energy systems theory: An introduction" TMH 1999.
5. Hadi Sadat, "Power system analysis", McGraw Hill International, 1999.
6. A. R. Bergen and Vijay Vittal, "Power system analysis", 2nd Edition, Pearson Edu. Asia, 2001.
7. J. D. Glover and M. Sarma ,"Power System Analysis and Design ",3rd Edition, Brooks/ Cole 2002
8. C.L. Wadhwa Electrical Power Systems, Fifth Edition, New AgeInternational,2009
9. H. Cotton & H. Barber-The Transmission and Distribution of Electrical Energy, 3rd Edit ELBS,B.I.Pub.,1985

Mapping Of Course Outcome with Program Outcomes:

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PS03
CO1	3					1	1					1			
CO2	3					1	1					1	2		
CO3	3					1	1					1	2		
CO4	3					1	1					1	2		
CO5	3					1	1					1	2		

3 – High 2 – Medium 1 – Low

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					
End Semester Exam 60 Marks					

ISE III Assessment: It is based on attendance of the student and any one component of the following. However, the course co-ordinator 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

Assessment Pattern:

Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE 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. S P Ghanegaonkar Dr. V A Kulkarni

EES2024 : Renewable Energy Technology			
Teaching Scheme		**Examination Scheme**	
Lectures	: 03 Hrs/Week	ISE I	: 15 Marks
Tutorial	: 0	ISE II	: 15 Marks
Total Credits	: 03	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Pre-Requisites: Engineering Physics, Electrical Machines, Power Systems

Course Description:

In this curriculum, students will be explored in Renewable Energy Technologies such as Wind energy, Solar energy. They will be introduced to concepts of fuel cells and biomass energy.

Course Objectives:

The objectives of the course are to learn

1. Different types of energy sources
2. Various solar PV technologies and its characteristics
3. Various solar thermal technologies and its applications
4. Wind energy technologies and its operations
5. Grid integration of wind energy systems and its associated issues

Course Outcomes:

After completing the course, students will able to

CO1.	Elaborate different types of energy sources
CO2	Explain various solar PV technologies and its characteristics and solve numerical on it
CO3	Describe various solar thermal technologies and its uses in various applications
CO4	Discuss wind energy technologies and explain its operations
CO5	Explain grid integration of renewable energy systems and its associated issues

Detailed Syllabus:

Unit-I	**Basics of Energy:** Energy and Power, Hubert peak, Energy Scenario in India, Environmental impact of fossil fuels, Different types of energy sources - tidal, geothermal, wave energy, Introduction to fuel cells and Biomass
Unit -II	**Wind Power systems** History of wind power, Indian and Global statistics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions and related numerical based on it. Modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent- Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control
Unit-III	**The Solar Resource and Solar PV:** Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control. Design of standalone PV systems

Unit-IV	**Solar thermal power generation:** Parabolic trough calculation of surface area of receiver and concentrator and focal point, central receivers calculations related to power tower, parabolic dish its focal point, Fresnel, solar pond, Solar still
Unit-V	**Network Integration Issues:** Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems

Text and Reference Books:

1. Thomas Ackermann, Editor, "Wind Power in Power Systems", John Willy and sons ltd., 2005,ISBN 0- 470-85508-8.
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", John Willy and sons,2004, ISBN 0-471-28060-7.
3. S. P. Sukhatme, "Solar Energy", Tata McGrew Hill, second edition, 1996, ISBN 0-07-462453-9.
4. ChetanSingh Solanki, "Solar Photovoltaics", fundamental, technologies and applications, PHI-second edition, 2011.
5. Siegfried Heier, "Grid integration of wind energy conversion systems" John Willy and sons ltd.2006.
6. Mullic and G.N.Tiwari, "Renewable Energy Applications", Pearson Publications.
7. John A. Duffie, William A. Beckman, "Solar Engineering of Thermal Processes", Wiley Inter science Publication, 1991

Mapping Of Course Outcomes with Program Outcomes:

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3		1		2	1	2	1	1	1	1	1	1	1	
CO2	3	2	1	3	1	1	2	1	1	1	1	1	1	1	
CO3	3	2	1		1	1		1	1	1	1	1	1	1	
CO4	3	2	1	3	1	1	2	1	1	1	1	1	1	1	
CO5	3	2	1	3	1	1	2	1	1	1	1	1	1	1	

3 – High 2 – Medium 1 - Low

Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K2+K3	K2+K3	K4
Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I & ISE II 30 Marks	8	7	8	7	
ISE III 10 Marks	2	2	2	2	2
ESE Assessment 60 Marks	12	12	12	12	12

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

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

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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
K5	Evaluate				
K6	Create				
Total		15	15	10	60

Designed by
Dr. S. M. Shinde

SRG

Approved in XXIVth Academic Council,Dated 23/07/2022

EEES2021: Lab Numerical Computational Techniques	
Teaching Scheme	**Examination Scheme**
Lectures : 2 Hrs./Week	ISE 1 : 25 Marks
Total Credits : 1	ISE II : 00 Marks
	ISE III : 00 Marks
	End -Semester Exam : 25 Marks

Laboratory Course Outcomes

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

CO1	Grasp the basic elements of numerical methods
CO2	Solve linear & nonlinear algebraic equations and curve fitting
CO3	Understand the basics of approximation, integration and differentiation.
CO4	Apply the numerical solution of differential equation
CO5	Apply the numerical solution of optimization

At least two programs(two different methods) on each of the following numerical methods by using Matlab/ C/C++/ Python or any other language

1. Nonlinear Equations
2. Linear Equations
3. Curve Fitting
4. Numerical Differentiation
5. Numerical Integration
6. Ordinary Differential Equations
7. Optimization

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	PO 13	PO 14	PO 15
CO1	3	2						1	1				1	1	1
CO2	3	2					1	1	1				1	1	1
CO3	3	2						1	1				1	1	1
CO4	3	2	1				1	1	1				1	1	1
CO5	3	2						1	1				1	1	1

3 – High 2 – Medium 1 - Low

Assessment Table:

Assessment Tool	S1	S1	S3	S2	S3
Course Outcomes	CO 1	CO 2	CO 3	CO 4	CO 5
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

Assessment Pattern:

Assessment Pattern Level No.	Skill Level	Practical Examination & viva voce
S1	Imitation	10
S2	Manipulation	05
S3	Precision	10
Total		25

Designed by
Dr. N. J. Phadkule

EEPC2022 :Lab- Electrical Machines-II	
Teaching Scheme Practical: 2 Hrs./Week Credit : 01	**Examination Scheme** ISE I : 25 Marks Practical Examination & Viva Voce :25 Marks

Course Objectives:

On completion of this course the student shall be able to

1. To prepare the students to have a basic knowledge of induction motor
2. To prepare the students to have a basic knowledge of synchronous machines

Course Outcomes:

At the end of the course student will have ability to

CO1	Have knowledge of various parts of induction motor, synchronous machine
CO2	To conduct experiments on induction motor, synchronous motor and alternator.
CO3	To evaluate the induction motor constants
CO4	To perform various tests on induction motor
CO5	To evaluate regulation of alternator by various methods

List of Experiments:

Term work shall consist of a record of minimum eight experiments performed from the following list.

Sr. No.	Details
1	Effect of variation of applied voltage on the performance of Induction motor
2	Perform No load test and block rotor test on 3-phase Induction motor & Plot Circle diagram of 3-phase Induction motor
2	Determine of equivalent circuit parameters of single phase Induction Motors
3	Determine parameters of equivalent circuit of 3-phase Induction motor
4	Speed Control of slip ring 3-phase Induction motor using cascade connection
5	Perform Load Test on three phase Induction motor
6	Determine regulation of a three phase Synchronous Generator by synchronous impedance method
7	Determine regulation of a three phase Synchronous Generator by MMF method
8	Determine regulation of a three phase Synchronous Generator by ZPF method
9	Determine regulation of a three phase Synchronous Generator by direct loading
10	Determine direct and quadrature axis synchronous reactance by using slip test
11	Plot V and inverted V curves of synchronous motor
12	Study of induction motor starters
13	Study of ISI- standards for Energy efficient motors
14	Synchronizing of alternators: Lamp Methods and use of Synchroscope

Term Work:

The term work will consist of submitting a file for minimum eight experiments with neatly written records of the study, circuit diagrams, observations, and graphs with results. any another experiment can be added by course coordinator except above list of experiment The term work will be assessed by the course coordinator

Practical Examination:

The Practical Examination will comprise of performing the experiment and viva voce on the syllabus

The practical will be assessed by two examiners, one will be the course coordinator and other will be an examiner appointed by DSB.

Mapping Of Course Outcome with Program Outcomes:

Course outcome	PO 01	PO 02	PO 03	PO 04	PO05	PO06	PO 07	PO08	PO09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3						1	1	1	1		1	1		
CO2	3			2			1	1	1	1		1	1		
CO3	3			2			1	1	1	1		1	1		
CO4	3			2			1	1	1	1		1	1		
CO5	3			2			1	1	1	1		1	1		

3 – High 2 – Medium 1 - Low

Assessment Pattern:

Level No.	**Skill Level**	**Term Work**	**Practical Examination & viva voce**
S1	Imitation	05	05
S2	Manipulation	10	10
S3	Precision	10	10
S4	Articulation	00	00
S5	Naturalization	00	00
Total		25	25

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

Assessment Table:

Assessment Tool	S1	S2	S3	S3	S3
	C01	C02	CO3	CO4	CO5
Term Work (25 Marks)	05	05	05	05	05
Practical Examination & Viva Voce (25 Marks)	05	05	05	05	05

Designed by

Dr. S. M. Shinde & V.P.Dhote

Annexure VI

Open Electives offered by Electrical department

Sr.No.	Course Code	Course Name	Pre-requisite	Eligible students from departments	Credits L-T-P	Offered Semester	Suggested by dept
1	EEOE0010	Energy and Environment	No	All branches	3-0-0	(III sem) Odd	Electrical Dept
2	EEOE1020	Renewable Energy Technology	No	All branches except Electrical	3-0-0	(IV sem) Even	Electrical Dept
3	EEOE0030	Engineering Optimization	No	All branches	3-0-0	(V sem) Even	Electrical Dept
4	EEOE1040	Electric Vehicles	No	All branches except Electrical	3-0-0	(VI sem) Even	Electrical Dept
5	EEOE0050	Industrial Automation and Control	No	All branches	3-0-0	(VII sem) Odd	Electrical Dept

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EEOE0010 : Energy and Environment (Open Elective III sem)	
Teaching Scheme Lectures : 03 Hrs/Week Tutorial : 0 Total Credits : 03	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Outcomes:

After completing the course, students will able to

CO1.	Explain concepts related with energy and power
CO2	Discuss environmental impacts of energy production
CO3	Demonstrate ecosystem and impact of industrial systems on environment
CO4	Correlate major local and regional environmental issues with changes in ecology and human health.
CO5	Develop sustainable energy systems

Detailed Syllabus:

UNIT-I	**Basic Introduction to Energy:** Energy and power, forms of energy,primary energy sources, energy flows, world energy production and consumption,Key energy trends in India:Demand, Electricity, Energy production and trade, Factors affecting India's energy development: Energy prices and affordability,
UNIT-II	**Energy and it's uses:** Importance of energy resources, conventional and unconventional energy sources and its uses, global and indian scenario, Solar energy, wind energy and biofuels; Wave, ocean thermal, tidal energy and ocean currents; Geothermal energy; Future energy sources; Hydrogen fuels, Environmental impact of energy production-Nuclear, Thermal etc.
UNIT-III	**Ecosystem:** Concept, Energy flow, Structure and function of an ecosystem. Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems, Ecological succession. Industrial systems and environment
UNIT-IV	**Environment pollution, global warming and climate change:** Air pollution (local, regional and global); Water pollution problems; Land pollution and food chain contaminations; Carbon cycle, greenhouse gases and global warming; Climate change – causes and consequences; Carbon footprint; Management of greenhouse gases at the source and at the sinks
UNIT-V	**Energy Management:** Earth's global energy balance, Energy budget- past and present, Energy conservation, Energy efficiency, Concept of sustainability and sustainable energy systems

Text and Reference Books:

1. Bharucha, E., Textbook of Environmental Studies, Universities Press (2005).
2. S.Rao & Dr.B.B.Parulekar,"Energy Technology: Non-conventional, Renewable and Conventional" Khanna Publishers
3. Dr. Suresh Damecha, environmental studies, S K Kataria and Sons, New Delhi
4. Beggs and Clive, "Energy Management Supply and Conservation" Wall Mart Publishers
6. R A Ristinen, J J Kraushaar, Jeffry Brack, Energy and Environment and Wiley publication

7. Energy Conservation Act 2001 8. Bureau of Energy Efficiency India web-site http://www.bee-india.co

Mapping of Course outcome with program outcomes:

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	1				3	3					2
CO2	1	2	1			3	3					2
CO3	1	2	1			3	3					2
CO4	1	1	1			3	3					2
CO5	2	2	2		3	3	3					2

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	10	10	10		
Teachers Assessment 10 Marks				5	5
ESE Assessment 60 Marks	8	8	12	16	16

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	12
K2	Understand	5	5	2	12
K3	Apply	5	5	3	12
K4	Analyze			3	12
K5	Evaluate				12
Total		15	15	10	60

Designed by

Dr. S. M Shinde

EEOE1020: Renewable Energy Technology (Open Elective IV sem)	
Teaching Scheme	**Examination Scheme**

Approved in XXIVth Academic Council,Dated 23/07/2022

Lectures	: 03 Hrs/Week	ISE I	: 15 Marks
Tutorial	: 0	ISE II	: 15 Marks
Total Credits	: 03	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Course Description:

In this curriculum, students will be explored in Renewable Energy Technologies such as Wind energy, Solar energy. They will be introduced to concepts of fuel cells and biomass energy.

Course Objectives:

The objectives of the course are to learn

1. Different types of energy sources
2. Various solar PV technologies and its characteristics
3. Various solar thermal technologies and its applications
4. Wind energy technologies and its operations
5. Grid integration of wind energy systems and its associated issues

Course Outcomes:

After completing the course, students will able to

CO1.	Elaborate different types of energy sources
CO2	Explain various solar PV technologies and its characteristics and solve numerical on it
CO3	Describe various solar thermal technologies and its uses in various applications
CO4	Discuss wind energy technologies and explain its operations
CO5	Explain grid integration of wind & solar pv energy systems and its associated issues

Detailed Syllabus:

UNIT-I	**Basics of Energy:** Energy and Power, Hubert peak, Energy Scenario in India, Environmental impact of fossil fuels, Different types of energy sources - solar, wind, tidal, geothermal, wave energy, Introduction to fuel cells and Biomass
UNIT-II	**Solar PV Technology:** Amorphous mono-crystalline, poly-crystalline, V-I characteristics, Shading impact, PV module, Array, Maximum Power Point Tracking, Grid connected and standalone systems
UNIT-III	**Solar Thermal Technology:** Solar Spectrum, Solar Geometry, Sun Earth angles, Solar radiation at given locations, Flat plate collector, Parabolic trough, Central receiver, parabolic dish, Fresnel, solar pond, solar still
UNIT-IV	**Wind Energy Technology:** History of wind power, types of wind turbines, power in the wind, Betz limit, Tip speed ratio, stall and pitch control, wind speed statistics, probability distribution, wind generator topologies, voltage and reactive power control, power quality standard for wind turbines
UNIT-V	**Grid Integration of Wind & Solar PV Systems:** Wind farms, real and reactive power regulation, voltage and frequency operating limits, wind farm behavior during grid disturbances, power system interconnection, Economic aspects, Grid integration principle of Solar PV System, Single phase and three phase on grid systems, Different topologies

Text and Reference Books:

1. Thomas Ackermann, Editor, "Wind Power in Power Systems", John Willy and sons ltd., 2005,ISBN 0- 470-85508-8.

2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", John Willy and sons,2004,ISBN0-471-28060-7.
3. S. P. Sukhatme, "Solar Energy", Tata McGrew Hill, second edition, 1996, ISBN 0-07-462453-9.
4. ChetanSingh Solanki, "Solar Photovoltaics", fundamental, technologies and applications, PHI- second edition, 2011.
5. Siegfried Heier, "Grid integration of wind energy conversion systems" John Willy and sons ltd.2006.
6. Mullic and G.N.Tiwari, "Renewable Energy Applications", Pearson Publications.
7. John A. Duffie, William A. Beckman, "Solar Engineering of Thermal Processes", Wiley Inter science Publication, 1991

Sample Assessment Table:

Assessment Tool	K1+K2+K3	K1+K2+K3	K2+K3	K2+K3	K4
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

Teacher's 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:

Level No.	Knowledge Level	Test	Teachers Assessment /Assignment	End Semester Examination
K1	Remember	10	02	10
K2	Understand	10	02	20
K3	Apply	10	02	20
K4	Analyze		02	10
K5	Evaluate		02	
Total		30	10	60

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

Approved in XXIVth Academic Council,Dated 23/07/2022

EEOE030 : Engineering Optimization (Open Elective V sem)	
Teaching Scheme Lectures : 03 Hrs/Week Tutorial : 0 Total Credits : 03	**Examination Scheme** ISE I : 15 Marks ISE II : 15 Marks ISE III : 10 Marks End -Semester Exam : 60 Marks

Course Outcomes:

After completing the course, students will able to

CO1	Explain and use the basic theoretical principles of optimization and various optimization techniques
CO2	Analyze and solve complex optimization problems in Engineering.
CO3	Develop and select appropriate models corresponding to problem descriptions in engineering and solve them using appropriate techniques
CO4	To develop and Implement optimization algorithms and use software tools to solve problems in engineering.
CO5	Make sound recommendations based on these solutions, analysis and limitations of these models.

UNIT-I	**Introduction and classical optimization methods:** Introduction to optimization, classical optimization: single variable, multivariable optimization techniques
UNIT-II	**Linear programming:** Standard form of LPP, simplex method, concept of duality, transportation problems
UNIT-III	**Nonlinear programming:** One dimensional minimization methods for NLP, unconstrained NLP optimization,
UNIT-IV	**Dynamic programming:** Development of dynamic programming, application of dynamic programming approach to find shortest route
UNIT-V	**Evolutionary Optimization techniques:** Modern optimization techniques such as swarm intelligence, Genetic algorithms, solving problems related to engineering

Text and Reference Books:

1. S. S. Rao, "Engineering Optimization-Theory and practice", Fourth edition, Wiley Easter Publications, January 2009.
2. K. V. Mital and C. Mohan, "Optimization Methods in Operations Research and System Analysis", New age International Publishers, Third edition, 1996.
3. Bazaraa M. S., Sherali H.D. and Shetty C. "Nonlinear Programming Theory and Algorithms", John Wiley and Sons, New York 1993.

Mapping of Course outcome with program outcomes :

1- LOW 2- MEDIUM 3- HIGH

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	1	1									
CO2	2	3	1									1
CO3	2	2	3									2
CO4	1	2	2	1	3							2
CO5	2	2	2	3								2

Sample Assessment Table:

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Assessment Tool	K1+K2	K1+K2+K3	K1+K2+K3	K1 to K4	K1 to K5
Course outcomes	CO1	CO2	CO3	CO4	CO5
Class Test 30 Marks	10	10	10		
Teachers Assessment 10 Marks				10	
ESE Assessment 60 Marks	6	8	12	16	18

Teacher's 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		12
K2	Understand	5	5		14
K3	Apply	5	5		14
K4	Analyze				12
K5	Evaluate				8
K6	Create				
Total		15	15	10	60

Designed by

Dr. S P Ghanegaonkar

EEOE1040: ELECTRIC VEHICLES (Open Elective VI sem)	
Teaching Scheme	**Examination Scheme**
Lectures : 03Hrs/Week	ISE I : 15 Marks

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Tutorial	: 0	ISE II	:15 Marks
Total Credits	: 03	ISE III	: 10 Marks
		End Semester Exam	: 60 Marks

Prerequisites: Nil

Course Description: This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. Various aspects of hybrid and electric vehicles such as their configuration, types of electric machines that can be used, energy storage devices, etc. will be covered in this course.

Course Objectives:

The objectives of the course are to introduce and explain

1. The concepts of electrical vehicles and their operation.
2. The basic components of the EV and their design.
3. Power converters & energy storage devices for electrical vehicles

Course Outcomes:

After completing the course, students will able to:

CO1	Explain the operation of electrical vehicles.
CO2	Explain Power Converters for Electric and hybrid Vehicles
CO3	Identify the Electrical Machines for Electric and hybrid Vehicles
CO4	Design the components of the electrical vehicles.
CO5	Describe different Energy Storage options for the Electric and hybrid Vehicles

Detailed Syllabus:

Unit 1	History of electric & hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Dynamics of the electric and hybrid electrical vehicles- motion and dynamic equation for vehicles, Vehicle Power Plant and Transmission Characteristics, Basic Architecture of Hybrid Drive Trains and Analysis of Series Drive Train, Power Flow in HEVs, Torque Coupling and Analysis of Parallel Drive Train, Basic Architecture of Electric Drive Trains
Unit 2	Power Converters- DC-DC converters for EV and HEV applications, DC-AC converters in EV & HEV
Unit 3	AC Electrical Machines for hybrid and Electric Vehicles- Induction motors, Permanent Magnet Motors. SRM motors, their control and applications in EV/HEV
Unit 4	Design of Electrical EV/HEV – Principles, Drive cycles and its detail analysis, sizing of electrical machines
Unit 5	Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Text and Reference Books

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", WIELY USA, 2012.
2. Chris Mi, M. Abdul Masrur & David Wenzhong Gao, "Hybrid Electric Vehicles: Principles and Applications with practical prespective", WIELY, 2011
3. Electric Cars The Future is Now!: Your Guide to the Cars You Can Buy Now and What the Future Holds, by ArvidsLinde, Veloce Publishing, 2010.
4. Abu-Rub, Malinowski and Al-Haddad, "Power Electronics for renewable energy systems, transportation, Industrial Applications", WILEY, 2014.

5. Mehrdad Ehsani, YiminGao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", Second Edition (Power Electronics and Applications Series) by CRC Press, 2009
6. John Miller, " Propulsion Systems for Hybrid Vehicles," Institute of Electrical Engineers, UK, 2004
7. C.M. Jefferson & R.H. Barnard, " Hybrid Vehicle Propulsion," WIT Press, 2002
8. Iqbal Husain, "Electric and Hybrid Vehicles – Design Fundamentals," CRC Press, 2010
9. James Larminie and John Lowry, " Electric Vehicle Technology Explained, " Oxford Brookes University, Oxford, UK, 2003

ISE III Assessment: Assessment of 10 marks is based on **attendance** of the student and one of the / or combination of few of following. However, the course co-ordinator has to announce assessment components at the beginning of the course.

Presentation on latest topics/Real life problems related with the subject , 2.MCQ, 3.Simulations problems, 4.Quiz

Sample Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**Class Test**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	10	04	10
K2	Understand	05	04	20
K3	Apply	05	04	30
K4	Analyze	-	04	-
K5	Evaluate	-	04	-
Total Marks: 100		20	20	60

Sample Assessment table:

Assessment Tool	K1+K2+ K3	K1+K2+K3	K1+ K2	K1+K2+ K3+K4	K1+K2+K3
	CO1	CO2	CO3	CO4	CO5
Class Test (20 Marks)	10	10	-	-	-
Teachers Assessment (20 Marks)	04	04	04	04	04
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
Prof.V.P.Dhote

EEOE0050: INDUSTRIAL AUTOMATION AND CONTROL

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(Open Elective VII sem)			
Teaching Scheme		**Examination Scheme**	
Lectures	: 3 Hrs/Week	ISE I	: 15 Marks
Tutorial	: 0 Hr/Week	ISE II	:15 Marks
Total Credits	: 3	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Pre-requisites: Nil

Course Description: - Provides the student with basic knowledge of industrial automation. This course introduces the basic concept of process control, building blocks of automation, and various control configurations.

Course Objectives: -The objectives of the course are to

1. Describe various measurement systems using sensors
2. Explain various process control configuration
3. Illustrate various controllers used in industry
4. Explain PLC, SCADA, PDC systems
5. Describe and Illustrate valves used in Industry

Unit wise Course Outcomes expected: Students will be able to

CO1. Use of various sensors for measurement of physical parameters
CO2. Analyze various control configurations used in process control
CO3. Use controller such as P, PI, PID
CO4. Design systems using PLC, DDC configuration as control values for application
CO5. Differentiate various control valves

Detail syllabus:

UNIT-I	**Introduction to Industrial Automation and Control** Architecture of Industrial Automation Systems, Introduction to sensors and measurement systems, Temperature measurement, Pressure and Force measurements , Displacement and speed measurement, Flow measurement techniques, Measurement of level, humidity, pH etc., Signal Conditioning and Processing
UNIT-II	**Introduction to process Control:** Evolution of Process Control Concept , Definition and Types of Processes Benefits, Difficulties and Requirements of Process Control Implementation , Classification of Process Variables, Open-loop Vs Closed Loop control, Servo Vs Regulator Operation of Closed Loop System, Feedback and Feed forward Control Configuration, Steps in Synthesis of Control System, process dynamics and Mathematical Modeling, Aspects of the process dynamics, Types of dynamic processes, Common systems, Mathematical Modeling, Cascade, Feed forward, and Ratio Control, multi loop Cascade Control, Feed forward Control, Feed forward- Feedback control configuration, Ratio Controller
UNIT-III	**Type of Controllers:** Introduction, PID control, Classification of Controllers, Controller Terms, Introduction, Transfer functions of closed loop, Proportional controller in closed loop, Integral controller in closed loop, Proportional-integral controller in closed loop, Proportional derivative controller in closed loop, Proportional-integral-derivative controller in closed loop, Integral windup and Anti-windup, Comparison of various controller configurations, Controller Tuning
UNIT-IV	**PLC, DCS system:** Introduction, Basic parts of a PLC, Operation of a PLC, Basic symbols used in PLC realization, Difference between PLC and Hardwired systems, Difference between PLC and computer, Relay logic to ladder logic, Ladder commands, Examples of PLC ladder diagram realization, PLC timers, PLC counters and examples, Classification of PLCs. History of DCS, DCS concepts, DCS hardware & software, DCS structure, Advantages and disadvantages of DCS. Components and Working of DDC, Benefits of DDC, Digital controller realization,

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	discrete domain analysis, Networking of sensors, Actuators, controllers, CANBUS, PROFIBUS AND MODBUS..
UNIT-V	**Control Valves:** Introduction various automation devices used in industry, Control of Machine tools, Analysis of a control loop, Introduction to Actuators: Flow Control Valves, Hydraulic Actuator Systems : Principles, Components and Symbols, Pumps and Motors, Proportional and Servo Valves Pneumatic Control Systems, System Components, Controllers and Integrated Control Systems, Electric Drives, Energy Saving with Adjustable Speed Drives.

TEXT BOOKS:

1. Dobrivojie Popovic, Vijay P. Bhatkar, "Distributed Computer Control for Industrial Automation", Dekker Publications.
2. Webb and Reis," Programmable Logic Controllers: Principles and Applications", PHI.
3. S.K. Singh, "Computer Aided Process Control", PHI
4. Garry Dunning, "Introduction to Programmable Logic Controllers", Thomson Learning.
5. N. E. Battikha, "The Management of Control System: Justification and Technical Auditing", ISA
6. Krishna Kant, "Computer Based Process Control", PHI
7. Fu, Lee, Gonzalez, "Robotic Control, sensing and Intelligence", Tata McGraw-Hill

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	1	2		1							
CO2	1	1	2		1							
CO3	1	1	2		1							
CO4	1	1	2		1							
CO5	1	1	2		1							

1- Low 2- Medium 3- High

ISE III: This is based on any one or combination of any two of the following schemes.

1. Assignments, 2. Objective type test , 3. Modeling of electrical machines using any electrical software
4. Technical/Industrial visit report / Quiz

3. Assessment table:

Assessment Tool	K1+K2+ K3	K1+K2+ K3	K1+ K2	K2	K1+K3
Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I & ISE II 30 Marks	10	05	10	05	
ISE III Assessment 10 Marks				05	05
ESE Assessment 60 Marks	12	12	12	12	12

4. Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I & ISE II**	**Teachers Assessment /Assignment**	**End Semester Examination**
K1	Remember	10		15
K2	Understand	20	05	40
K3	Apply		05	05
K4	Analyze			
Total		30	10	60

Designed By:
S. S. Kulkarni

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Annexure VII

HSS

Offered by Electrical department

Sr.No.	Course Code	Course Name	Pre-requisite	Eligible students from departments	Credits L-T-P	Offered Semester	Suggested by dept
1	EEHS0001	Consumer Psychology	No	All branches except Electrical	3-0-0	V sem (Odd)	Electrical Dept
2	EEHS1002	Energy Economics and policy	No	All branches except Electrical	3-0-0	VI sem (Even)	Electrical Dept
3	EEHS1003	Macroeconomics	No	All branches	3-0-0	VIII sem (Even)	Electrical Dept

SPG

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EEHS0001: Consumer Psychology(Odd) V sem			
Teaching Scheme		**Examination Scheme**	
Lectures	:3 Hrs/Week	ISE I	: 15 Marks
Tutorial	: -	ISE II	: 15 Marks
Total Credits	: 3	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Pre-requisites: NIL

Course description: - Human has basic needs that they fulfill by making transactions in the market. Transactions mostly in the form of monetary exchange for goods and services are very basic for the survival of the human race. This course is designed to study how consumers behave in the market and the consequences of various behavior patterns. Additionally, this course also looks at various psychological factors that shape the behavior and actions of the consumer in the global market

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

CO1	Identify the key terms, concepts, and theories of consumer behavior
CO2	Evaluate the principal theories of consumer behavior; critically assess strengths, limitations and applications
CO3	Apply consumer behavior concepts to real world marketing problems
CO4	Develop better marketing programs and strategies to influence those behaviors
CO5	Analyze the current trends in consumer behavior; and apply them to the marketing of an actual product or service

Detailed Syllabus:

UNIT-I	Introduction to Consumer Psychology The individual decision-making processes that influence consumer behavior. Investigate how basic cognitive processes (e.g., attention, learning and memory, self-control, and emotions) shape consumer decision-making.
UNIT-II	Consumer Decision Making, Need and Information Search, Alternate Evaluation and Choice Consumption and Post-Purchase Behavior. The psychology of decision-making: When presented with a choice between different products, how do individuals assess the value of different alternatives? Are consumer preferences stable across time and situations, or do subtle contextual factors influence choices? Do consumers make rational (optimal) decisions, or are there systematic biases in the ways people make decisions.

UNIT-III	The Individual Consumer, Consumer perceptions, Memory and Learning, Mood, Emotion and Involvement, Consumer Attitude, Marketing communications
UNIT-IV	Emphasize the social processes that affect consumers. This will address how social groups, cultural differences, and recent developments in technology influence the way that consumers make decisions.
UNIT V	The ways in which interactions with consumer brands are similar to (and different from) interactions with human agents. Discuss different theoretical approaches, such as cross-cultural psychology, evolutionary psychology, and positive psychology. Research on how to improve public policies and individual well-being of consumer.

TEXT BOOKS:

1. Henry Assael, Consumer Behavior and Marketing Action, Cengage Learning
2. Jay Lindquist, Consumer Behavior, Cengage Learning
3, Leon Schiffman, Consumer Behavior, Pearson Press
4, Zubin Sethna, Consumer Behavior

Mapping of Course outcome with program outcomes (Electrical Engineering):

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
CO1	1	1		2	1	1						2
CO2	1	1		2	1	1						2
CO3	1	1		2	1	1						2
CO4	1	1		2	1	1						2
CO5	1	1		2	1	1						2

3 – High 2 – Medium 1 - Low

Assessment Table:

Assessment Tool	K1+K2	K1+K2+K3	K1+K2+K3	K1 to K3
Unit wise Course outcomes	CO1	CO2	CO3	CO4
ISE I, II Test 30 Marks	10	10	10	
ISA III 10 Marks		05	05	
ESE Assessment 60 Marks	12	12	18	18

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III Assessment	End Semester Examination
K1	Remember	05	05	02	10
K2	Understand	10	05	04	30
K3	Apply		05	04	20
K4	Analyze				
Total Marks: 100		15	15	10	60

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ISE III Assessment: Assessment will be based on **any ONE** of the following:
1. Multiple Choice Objective Test, 2. Assignments/PPT presentation on allotted topics 3. Written Test, 4. Quiz

Designed by
Dr. N. J. Phadkule

Approved in XXIVth Academic Council,Dated 23/07/2022

EEHS1002: Energy Economics and Policy (Even) VI sem			
Teaching Scheme		**Examination Scheme**	
Lectures	: 3 Hrs/Week	ISE I	: 15 Marks
Tutorial	: --	ISE II	: 15 Marks
Total Credits	: 3	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Pre-requisites: Nil

Course description

Course covers a variety of theoretical and empirical topics related to energy demand, energy supply, energy prices, environmental consequences of energy consumption and production, and various public policies affecting energy demand, supply, and price.

After completion of this course students will be able to-

CO1	Understand various methods of energy economic analysis
CO2	Understand the energy economic policy
CO3	Sensitize the student to National Income Accounting
CO4	Sensitize to environmental impacts on energy economic policy
CO5	Understand deregulation of power

Detailed syllabus:

UNIT-I	Introduction and Background Review of the Basics of energy supply and the economics of depleted resources. Supply, Demand and Price Formation in Competitive Markets. Introduction to Engineering Economics, Fundamental concepts, Time value of money, Cash flow and Time Diagrams, Choosing between alternative investment proposals, Methods of Economic analysis (Pay back, ARR, NPV, IRR and B/C ratio) Depreciation and methods of calculating depreciation (Straight line, Sum of the years digit method, declining Balance Method, Annuity Method, Sinking Fund method).
UNIT-II	Economic Policy, LPG, Power sector reforms in India, present pricing strategies, role of private sector participation in India. Role of technology in nation growth. World oil markets and energy Security Natural Gas Price Regulation, Deregulation and Markets
UNIT-III	National Income Accounting, Methods of Estimation, Various Concepts of National Income, Significance of National Income Estimation and its limitations.
UNIT-IV	Internalizing Environmental Externalities with a Focus on CO_2 Emissions Cap and Trade Mechanisms of Coal Electricity, Risk Management, Futures Markets and Derivatives Energy and Climate Change
UNIT-V	Type of deregulation, solar power generation drives, revival of Power Markets, energy exchange and power exchange. Demand supply and equilibrium price consumer surplus, producer surplus, latent demand, Energy Efficiency Policies, Renewable Energy Policies

Text & reference books

1. D N Dwivedi "Managerial Economics", Vikas Publishing House Private Limited
2. Agrawal AN, "Indian Economy" Wiley Eastern Ltd, New Delhi
3. R.K Sharma and Sashi K Gupta," Financial Management", Kalyani Publications

Source- Internet

- Latest trends in Indian Economy.
- Capitaline Plus Database –http://www.capitaline.com/
- Ministry of Finance –http:/finmin.nic.in/
- Database of Indian Economy -http://dbie.rbi.org.in
- www.indiastat.com/ orhttp://mospi.nic.in/

Mapping of Course outcome with program outcomes (Mechanical Engineering):

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
CO1	1		1			2	1				1	2
CO2	1		1			2	1				1	2
CO3	1		1			2	1				1	2
CO4	1		1			2	1				1	2
CO5	1		1			2	1				1	2

3 – High 2 – Medium 1 - Low

Assessment Table:

Assessment Tool	K1+K2	K1+K2	K1+K2+K3	K1+K2+K3	K1+K2+K3
Unit wise Course outcomes	CO1	CO2	CO3	CO4	CO5
ISE I, II Test 30 Marks	10	10	10		
ISA III 10 Marks				05	05
ESE Assessment 60 Marks	6	6	12	18	18

Assessment Pattern:

Sample Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III Assessment	End Semester Examination
K1	Remember	05	05	02	10
K2	Understand	10	10	04	40
K3	Apply			04	10
K4	Analyze				
Total Marks: 100		15	15	10	60

Teaching Strategies: The teaching strategy is planned through the lectures, tutorials 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 III Assessment: The Assessment of 10 marks is based on one of the /or combination of the few of the following.
1. Home Assignments, 2.Tutorials, 3.Surprise written Test with multiple choice questions

Designed by
S. S. Kulkarni

EEHS1003 : Macroeconomics(Even)VIII sem			
Teaching Scheme		**Examination Scheme**	
Lectures	:3 Hrs/Week	ISE I	: 15 Marks
Tutorial	: -	ISE II	: 15 Marks
Total Credits	: 3	ISE III	: 10 Marks
		End -Semester Exam	: 60 Marks

Course Outcomes: At the end of the course, the student will be able to

CO1	Explain the concept of macroeconomics.
CO2	Apply the circular flow of income and expenditure.
CO3	Analyze the income determination through classical and Keynesian economics.
CO4	Demonstrate investment multipliers and inflation
CO5	Integrate the role of fiscal and monetary policies in regulating economy.

Detailed syllabus

UNIT-I	Macroeconomics: Meaning, Nature and Scope. Basic Concepts, Stock and Flow Variables, Partial and General Equilibrium, Static and Dynamic Analysis, Circular Flow of Income and Expenditure, storage of biomass electricity.
UNIT-II	National Income: Concepts, Measurement, Difficulties and Importance.Theory of Income and Employment: Classical Theory of Output and Employment, Say's Law of Markets. Keynesian Theory of Income Determination. Consumption Function: Meaning, Determinants and Importance.
UNIT-III	Theory of Consumption: Absolute Income Hypothesis, Relative Income Hypothesis, Permanent Income Hypothesis, Life Cycle Hypothesis. Theory of Investment: Types of Investment, Determinants of Investment, Marginal Efficiency of Capital, Net Present Value, Internal Rate of Return Interest Rate Determination: Classical, Neo-Classical and Keynesian Theories.
UNIT-IV	Theory of Multiplier: Static and Dynamic Multiplier, Leakages from Multiplier, Importance and Limitations. Inflation: Meaning, Types and Theories.
UNIT V	Stabilization Policies: Monetary and Fiscal Policies. Money: Its function and role, Quantity theory of money, Fisher and Cambridge equations. Keynes views about money and prices.

Text books

1. Olivier Blanchard, 'Macroeconomics', Englewood Cliffs: Prentice Hall.
2. Dornbusch, Fischer and Startz,'Macroeconomics', McGraw Hill
3. D.N. Dwivedi, 'Macroeconomics: Theory and Policy', Tata McGraw Hill.
4. Richard T. Froyen, Macroeconomics, Pearson Education Asia.
5. Andrew B. Abel and Ben S. Bernanke, Macroeconomics, Pearson Education, Inc.

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
CO1		1		1							2	2
CO2		2		1							2	2
CO3		2		1							2	2
CO4		2		1							2	2
CO5		2		1							2	2

3 – High 2 – Medium 1 - Low

Assessment Table:

Assessment Tool	K1+K2	K1+K2	K1+K2	K1+K2	K1+K2
Unit wise Course outcomes	CO1	2O2	CO3	CO4	CO5
ISE I, II Test 30 Marks	10	05	10	05	
ISA III 10 Marks	0	0	05	05	
ESE Assessment 60 Marks	6	6	12	18	18

Assessment pattern

Assessment Pattern Level no.	Knowledge Level	Test	Teachers Assessment/assignment	End Semester Examination
K1	Remember	10		15
K2	Understand	20		40
K3	Apply		10	05
K4	Analyze			
TOTAL		30	10	60

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

1. Home Assignments, 2.Tutorials, 3.Surprise written Test with multiple choice questions

Designed by

Dr. S.P. Ghanegaonkar

Approved in XXIVth Academic Council,Dated 23/07/2022

Annexure V- Mandatory Course

~~EEMC2010~~: Environmental Studies INMC2010	
Teaching Scheme	**Examination Scheme**
Lectures : 3 Hrs/Week	ISE I : 15 Marks
Tutorial : --	ISE II : 15 Marks
Total Credits : 0	ISE III : 10 Marks
	End -Semester Exam : 60 Marks

Pre-requisites: Nil

Course objectives:

1. To become aware about the various types of pollution, its sources, effects and control measures
2. To become aware about present environmental issues
3. To become aware of the importance of natural resources and environmental legislation
4. To become aware about environmental biotechnology and bio monitoring
5. To become aware of the biodiversity, conservation methods and factors for the loss of biodiversity

Unit wise Course Outcomes expected:

After completion of this course students will be able to-

CO1. Learn about the basics of environment
CO2. Understand the harmful effects of human activities on environment and their solutions
CO3. Understand the use of biotechnology and bio monitoring for the treatment of environment
CO4. Understand the concept of climate change, global warming, acid rain, various disasters and its mitigation measures

Detailed syllabus:

UNIT-I	**A) Concepts of Environmental Sciences** Environment, Levels of organizations in environment, Structure and functions in an ecosystem; Biosphere, its Origin and distribution of land, in water and in air, Broad nature of chemical composition of plants and animals **B) Natural Resources** Renewable and Non-renewable Resources, Forests, water, minerals, Food and land (with example of one case study); Energy, Growing energy needs, energy sources (conventional and alternative)
UNIT-II	**A) Biodiversity and its conservation** Biodiversity at global, national and local levels; India as a mega-diversity nation; Threats to biodiversity (biotic, abiotic stresses),and strategies for conservation **B)Environmental Pollution** Types of pollution- Air, water (including urban, rural, marine), soil, noise, thermal, nuclear; Pollution prevention; Management of pollution- Rural/Urban/Industrial waste management [with case study of any one type, e.g., power (thermal/nuclear), fertilizer, tannin, leather, chemical, sugar], Solid/Liquid waste management, disaster management **C) Environmental Biotechnology** Biotechnology for environmental protection- Biological indicators, bio-sensors; Remedial measures- Bio-remediation, phyto remediation, biopesticides, bio-fertilizers; Bio-reactors-Design and application
UNIT-III	**A) Social Issues and Environment** Problems relating to urban environment- Population pressure, water scarcity, industrialization; remedial measures; Climate change-Reasons, effects (global warming,

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	ozone layer depletion, acid rain) with one case study; Legal issues- Environmental legislation (Acts and issues involved), Environmental ethics **Environmental Monitoring** Monitoring- Identification of environmental problem, tools for monitoring (remote sensing, GIS); Sampling strategies- Air, water, soil sampling techniques
UNIT-IV	**Laboratory Work including Practical and Field Work** covering, of biogeographical zones and expanse of territorial waters on the map of India; Identification of biological resources (plants, animals, birds) ata specific location; Determination of (i) pH value, (ii) water holding capacity and (iii) electrical conductivity of different types of soils; Determination of energy content of plants by bomb calorimeter; Measurement and classification of noise pollution; Determination of particulate matter from an industrial area by high volume sampler; Determination of ico-chemical parameters (pH, alkalinity, acidity, salinity, COD, BOD) of tap water, well water, rural water supply industrial effluent and sea water & potability issues; Demonstration of Remote Sensing and GIS methods; Industrial visit for environmental biotechnology processes (e.g., any one of the fermentation, tissue culture, pharmaceutical industries)

Text books & Reference books

1. A Text Book of Environmental Studies by Bharucha E, University Press (India) Pvt. Ltd, 2005
2. A Text Book of Environmental Studies by Nadaf F. M., Pawaskar V. R., Intellectual Book Bureau, Bhopal,2006
3. Fundamental of Ecology by Odum E. P, Natraj Publishers, Dehradun, 1996
4. Introduction to Environmental Engineering and science by Gilbert M and Wendell P., Pearson Education India, 2015
5. Environmental Science by S.C Santra, New Central Book Agency, 2011
6. Environmental Education by Sharma R. A, 1998

Mapping of Course outcome with program outcomes (Mechanical Engineering):

Corse outcome	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO1 3	PO 14	PO1 5
CO1	3		1												
CO2	3		1												
CO3	3		1												
CO4	3		1												
CO5	3		1												

3 – High 2 – Medium 1 - Low

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Annexure V- Mandatory Course

Assessment Table:

Assessment Tool	K1+K3	K1+K3	K1+K3	K1+K3
Unit wise Course outcomes	CO1	CO2	CO3	CO4
Class Test 30 Marks	10	10	10	
Teachers Assessment 10 Marks		05	05	
ESE Assessment 60 Marks	18	18	12	12

Assessment Pattern:

Assessment Pattern Level no.	Knowledge Level	Test	Teachers Assessment/assignment	End Semester Examination
K1	Remember	10		12
K2	Understand	10		24
K3	Apply	10	10	12
K4	Analyze			12
	TOTAL	30	10	60

Teaching Strategies:
The teaching strategy is planed through the lectures, tutorials 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.

Teacher's Assessment: Teacher's Assessment of 20 marks is based on one of the /or combination of the few of the following.

1) Home Assignments
2) Tutorials
3) Surprise written Test with multiple choice questions

Designed by
Dr. V. S. Potdar

Approved in XXIVth Academic Council,Dated 23/07/2022