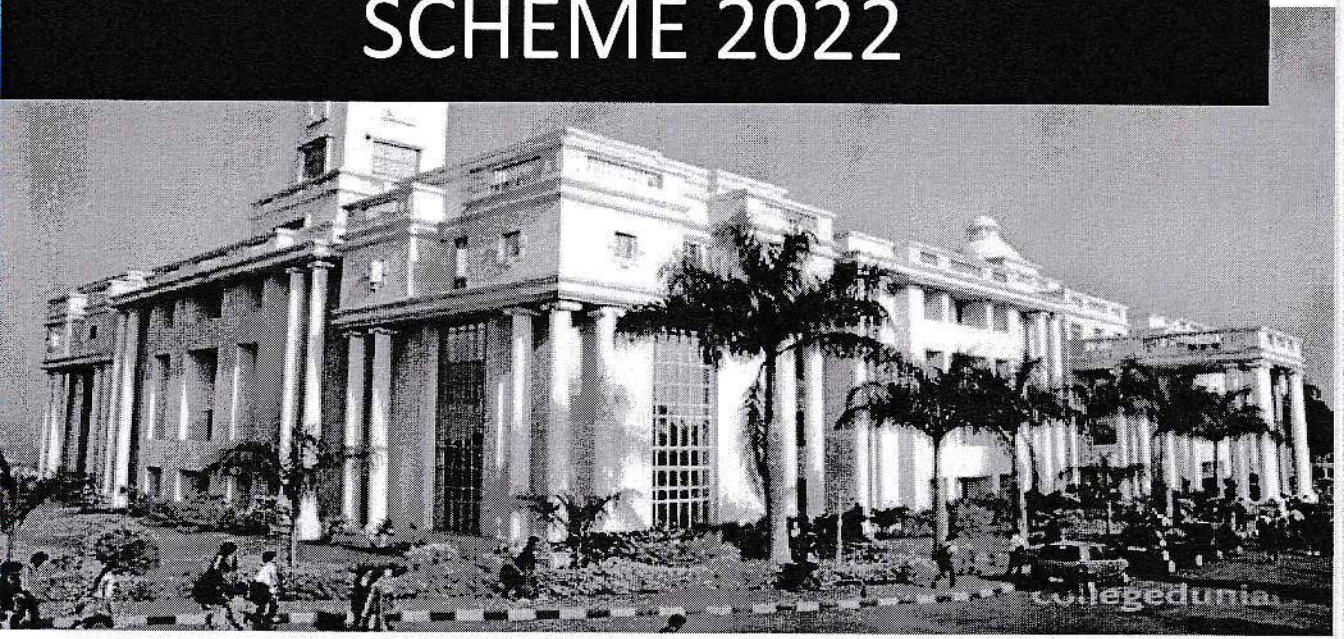
SCHEME 2022



HOD, EEE
Global Academy of Technology
Bangalore-98.

III to VIII Semester 2022 Scheme and Syllabus

Electrical & Electronics Engineering

GLOBAL ACADEMY OF TECHNOLOGY

(Autonomous institution affiliated to VTU, Belagavi.

Scheme and Syllabus
of
UG Autonomous Program – 2022 batch

III SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	22MAT31D	Transform Calculus and Numerical Methods	BS	MAT	2	2	0	50	50	100	3
2	22EEE32	Electrical Machines-I	IPC	Respective Department	3	0	2	50	50	100	4
3	22EEE33	Analog Electronic Circuits	IPC		3	0	2	50	50	100	4
4	22EEE34	Electric Circuits	PC		2	2	0	50	50	100	3
5	22EEE35	Measurements & Transducers	ESC/ETC/PLC		3	0	0	50	50	100	3
6	22EEE36	Ability Enhancement Course – I (**Theory**)	AEC		3	0	0	50	50	100	3
		OR			OR						
		Digital logic Design	AEC		2	0	2	50	50	100	3
							Total	**300**	**300**	**600**	**20**

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SEMESTER-III

Course: Transform Calculus and Numerical Methods (For EEE)

Course Code	22MAT31D	CIE Marks	50
Hours/Week (L: T: P)	2:2:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Course Objectives: To enable students to apply the knowledge of Mathematics in variousfields of engineering by making them to learn:

CLO1	Laplace Transforms
CLO2	Fourier series of periodic functions
CLO3	Fourier and Z Transforms
CLO4	Numerical methods

Content	No. of Hours/ RBT levels
Module 1 Laplace transforms of elementary functions, Laplace transforms of Periodic functions, unit-step function and Dirac delta function. Inverse Laplace Transform, Convolution theorem (without Proof), Solution ofsecond order linear differential equations using Laplace transforms.	08 Hours L2, L3
Module 2 Fourier series of periodic functions, half range Fourier sine and cosine series. Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms.	08 Hours L2, L3
Module 3 Z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems, Inverse z-transform and applications to solve difference equations.	08 Hours L2, L3
Module 4 Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson method. Finite differences: Newton's forward and backward difference formulae. Newton's divided difference formula and Lagrange's interpolation formula. Numerical integration: Simpson's 1/3rd,3/8th, Weddle's rule.	08 Hours L2, L3
Module 5 Numerical solution of ordinary differential equations of first order and first degree: Taylor's series methods, Runge-Kutta method of fourth order,Milne's and Adam-Bashforth predictor and corrector methods. Numericalsolution of second order ordinary differential equations: Runge-Kutta method and Milne's method.	08 Hours L2, L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO31.1	Determine Laplace and inverse Laplace transforms of given functions and solve linear differentialequations
CO31.2	Determine Fourier series and Fourier Transform of given function.
CO31.3	Apply numerical techniques to solve algebraic and transcendental equations.
CO31.4	Apply numerical techniques for interpolation and to evaluate definite integrals.
CO31.5	Solve ordinary differential equations of first and second order using numerical methods

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers 44th Edition, 2017
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, 2006

Reference books:

1. E. Kreyszig , Advanced Engineering Mathematics, John Wiley & Sons 10th Edition, 2016
2. N.P.Bali and Manish Goyal, A Textbook of Engineering Mathematics, LaxmiPublications 6th Edition, 2014

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproductionof research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignments	10	
SEE	Semester End Examination	50	50
Grand Total			100

CO/PO Mapping																
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO31.1	3	2	1									3				
CO31.2	3	2	1									3				
CO31.3	3	2	1									3				
CO31.4	3	2	1									3				
CO31.5	3	2	1									3				
Average	3	2	1									3				

Low-1: Medium-2: High-3

SEMESTER-III

Course: Electrical Machines – I (Integrated course)

Course Code	22EEE32	CIE Marks	50
Hours/Week (L: T: P)	3:0:2	SEE Marks	50
No. of Credits	4	Examination Hours	03

Prerequisites: Fundamentals of Electrical Engineering – 22ELE14/24

Course Objectives:

CLO1	Understand the principle of operation, constructional details, equivalent circuit andperformance of Single phase transformers by OC/SC and Sumpner's test
CLO2	Analyze the operation of Three phase transformers and other special purposetransformers
CLO3	Explain the constructional features of Three phase Induction motors and assess their performance.
CLO4	Compare the various methods of speed control of an Induction motor.
CLO5	Explain the operation of Single phase Induction motors and Fractional HP Motors.

Content	No. of Hours/ RBT levels
Module 1: Single Phase Transformers **Transformers:** Construction & Principle of operation, EMF equation, phasor diagrams- no load and on load, equivalent circuit, voltage regulation, losses, efficiency, Condition for maximum efficiency and voltage regulation, Power and distribution transformer, all day efficiency. Auto transformer.	08 Hours L3
Module 2: Testing of single-phase Transformers and Three phase Transformers **Testing of transformers:** Open circuit and short circuit, Sumpner's test, separation of hysteresis and eddy current losses. **Three phase transformers:** Construction & Principle of operation, groups, and connections, three phase connections with applications; Scott connection, open delta; Parallel operation of single phase and three phase transformers. Load sharing concept.	08 Hours L4
Module 3: Three Phase Induction Motors **Three Phase Induction Motors:** Construction & Principle of Operation, Types, Equivalent circuit, Slip-torque characteristics, Condition for maximum torque, Power flow equations ,losses and efficiency, No load and blocked rotor tests, Loadtest , Circle diagram.	09 Hours L2
Module 4: Starting and Speed Control of Three Phase Induction Motors **Starting and speed control of three phase induction motors:** slip control methods, control of supply frequency, control of stator poles. Cogging & Crawling, Double cage &Deep bar Induction Motor, Braking, and InductionGenerator. Applications	7 Hours L3
Module 5: Single Phase Induction Motors & Fractional H.P. Motors **Single Phase Induction Motors:** Construction & Principle of Operation, Double revolving field theory and operation, Equivalent circuit, No load and blocked rotor test, characteristics of single phase induction motors, Starting methods and applications of single-phase induction motors. **Fractional HP Motors:** Single phase A.C. series motor, Servo motors, Linear Induction Motor	8 hours L3

Laboratory Experiments:

Sl. No.	Experiments	No. of Hours/ RBT levels
1	Open Circuit and Short circuit tests on single phase transformer and pre- determination of (i) Efficiency and regulation (ii) Calculation of parameters of equivalent circuit.	2 hours L3
2	To perform Sumpner's test on transformers and determination of combined and individual transformer efficiency.	2 hours L3
3	Parallel operation of two single-phase transformers of different kVA ratings	2 hours L3
4	Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.	2 hours L3
5	Load test on three phase induction motor.	2 hours L3
6	No-load and Blocked rotor test on three phase induction motor to draw (i) equivalent circuit and (ii) circle diagram. Determination of performance parameters at different load conditions	2 hours L3
7	Separation of hysteresis and eddy current losses in single phase transformer	2 hours L3
8	Scott connection with balanced and unbalanced loads.	2 hours L3
9	Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics.	2 hours L3
10	Conduct suitable tests to draw the equivalent circuit of single-phase induction motor and determine performance parameters.	2 hours L3
	Simulation Experiments	
11	Testing of Induction Motor Using MATLAB/Simulink	2 hours L3
12	Testing of single phase transformer Using MATLAB/Simulink	2 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO32.1	Understand the principle of operation, constructional details, equivalent circuit and testing of single-phase transformers.
CO32.2	Analyze the operation and different connections of Three phase transformers.
CO32.3	Analyze the operation and performance of Three phase induction motors.
CO32.4	Explain the various starting and speed control methods of a three-phase induction motor.
CO32.5	Explain the operation of Single-phase Induction motors and Fractional HP Motors.

Textbooks:

1. **P.S.Bimbhra,** Electrical Machines, Khanna Publishers, 7th Edition , 2011
2. **Nagrath and Kothari,** Electrical Machines , McGraw-Hill Education India, 2018

Reference books:

1. **A.E.Fitzgerald, Charles Kingsley, Stephen D Umans,** Electrical Machinery, 6th Edition, McGraw Hill Higher Education, 2014

2. **V.Del Toro,** Basic Electric Machines, Pearson Education India, 2016
3. **Ashfaq Hussain,** Electrical Machines, Dhanpat Rai & Co, 3rd Edition , 2020
4. **Samarajit Ghosh,** Electrical Machines, 2nd Edition, Pearson Education India, 2012

E-Books / Web References

1. https://ndl.iitkgp.ac.in/result?q={%22t%22:%22search%22,%22k%22:%22electrical%20machines%22,%22s%22:[],%22b%22:{%22filters%22:[]}}
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-685-electric-machines-fall-2013/course-notes
3. https://edisontechcenter.org/Transformers.html
4. https://edisontechcenter.org/inductionMotors.html

MOOCs

1. https://nptel.ac.in/courses/108/105/108105017/
2. https://www.classcentral.com/course/swayam-electrical-machines-iitd-14030
3. E-learning: www.vtu.ac.in

Scheme of Evaluation: (Integrated courses)
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO/PSO Mapping

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO32.1	3	2	-	-	-	-	-	-	-	-	-	1	3	1	-
CO32.2	3	2	-	-	-	-	-	-	-	-	-	1	3	1	-
CO32.3	3	-	2	-	-	-	-	-	-	-	-	1	3	1	-
CO32.4	3	-	-	-	-	-	-	-	-	-	-	1	3	1	-
CO32.5	3	-	-	-	-	-	-	-	-	-	-	1	3	1	-
22EEE32	3	2	2	-	-	-	-	-	-	-	-	1	3	1	-

III SEMESTER

Course: Analog Electronic Circuits (Integrated course)

Subject Code	22EEE33	CIE Marks	50
Hours/Week (L:T:P)	3:0:2	SEE Marks	50
Credits	4	Examination Hours	03

Prerequisites: Course on Elements of Electronics Engineering

Objectives:

CLO1	Understand the various models used for transistor small signal analysis
CLO2	Classify various topologies of feedback and power amplifiers
CLO3	Design of Active filters and signal processing circuits using OPAMPS
CLO4	Understand the design of signal generators, comparators and converters
CLO5	Understand various ADCs/DACs , Timer and Voltage Regulators using OPAMPS

Content	No. of Hrs/ RBT levels
Module 1: BJT AC Analysis BJT analysis: Review of dc biasing circuits. BJT transistor modeling at low frequencies using: **r_e model:** r_e transistor model, common emitter fixed bias configuration, voltage divider bias, CE emitter bias and emitter follower configuration. **Hybrid model** Hybrid Equivalent Model, Approximate hybrid model – Fixed bias, voltage divider and emitter follower configuration.	08 Hours L2
Module 2: Feedback and Power amplifiers using BJT **Feedback Amplifiers:** Feedback concept, different feedback topologies, RC coupled amplifier, Darlington emitter follower, analysis and design. **Power Amplifiers:** Series fed class A amplifier, Transformer coupled class A amplifier, Class B amplifier operation and circuits, Amplifier distortion, Class AB and Class C amplifiers.	08 Hours L2
Module 3: Signal Processing circuits and Active filters **Basic OPAMP applications:** Inverting and non-inverting amplifier, summing and difference amplifier, voltage follower, integrator and differentiator circuits **Signal Processing Circuits:** Precision half wave rectifier, precision fullwave rectifiers, sample and hold circuit, peak detector. **Active Filters:** Introduction, First order low and high pass Butterworth filter, second order low and high pass Butterworth filter, band pass filter and band reject filter	08 Hours L2
Module 4: Signal Generators, Comparators & Converters **Signal Generators:** Triangular / rectangular wave generator, saw tooth generator, phase shift oscillator. **Comparators & Converters:** Basic comparator, zero crossing detector, inverting & non-inverting Schmitt trigger circuit, voltage to current converter with grounded load, current to voltage converter and basics of voltage to frequency and frequency to voltage converters.	8 Hours L2
Module 5: Analog/Digital Conversion, 555 Timer and Voltage Regulators **A/D & D/A Converters:** Basics, R–2R D/A Converter, Integrated circuit8-bit D/A, successive approximation ADC **555 timers:** Functional diagram, Mono stable and Astable operation **Voltage regulators:** Voltage follower regulator, Precision voltage regulator, Fixed voltage regulators, Adjustable voltage regulators using OPAMPS.	8 hours L2

Laboratory Experiments:

Sl. No.	Experiments	No. of Hours/ RBT levels
1	Design a BJT Amplifier using Matlab/ Simscape Electrical and observe the voltage gain at a given frequency.	2 hours / L3
2.	Design a single stage BJT RC coupled amplifier and plot the frequency response, determine bandwidth, input, and output impedances.	2 hours / L3
3	Determination of gain, input and output impedance of BJT Darlington emitter follower circuit.	2 hours / L3
4	Verify the operation of an op – amp as (a) voltage comparator circuit and (b) zero crossing detector.	2 hours / L3
5	Design and verify the operation of op – amp as an (a) adder (b) subtractor	2 hours / L3
6	Design and verify the operation of op – amp as an (a) integrator and (b) differentiator	2 hours / L3
7	Design and verify the output waveform of an op – amp-based RC phase shift oscillator for a desired frequency.	2 hours / L3
8	Design and realize an op – amp based first order Butterworth (a) low pass (b) high pass filters for a given cut off frequency to verify the frequency response characteristics	2 hours / L3
9	Design and realize an Inverting Schmitt trigger circuit using an op – amp for desired upper trip point (UTP) and lower trip point (LTP).	2 hours / L3
10	Design and realize an op – amp based function generator to generate sine, square and triangular waves of desired frequency	2 hours / L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO33.1	Develop r_e and hybrid models of transistors for various configurations
CO33.2	Classify different types of transistor amplifiers and its applications
CO33.3	Understand OPAMP based signal processing circuits and active filters
CO33.4	Demonstrate the applications of OPAMPS in signal generators, comparators, and converters.
CO33.5	Understand the operation of ADC/DAC, 555 Timer and voltage regulators using OPAMPS

Textbooks:

1. Electronic Devices and Circuit Theory Robert L Boylestad Louis Nashelsky Pearson 11thEdition, 2015
2. Op-Amps and Linear Integrated Circuits Ramakant A Gayakwad Pearson 4 th Edition 2015

Reference books:

1. Electronic Devices and Circuits David A Bell Oxford University Press 5th Edition, 2008
2. Operational Amplifiers and Linear ICs David A. Bell Oxford 3 rd Edition 2011
3. Operational Amplifiers and Linear Integrated Circuits K. Lal Kishore Pearson 1 st Edition, 2012
4. Linear Integrated Circuits, D. Roy Choudhury, Shail Jain, New Age International (P) Ltd., 2003.

E-Books / Web References

1. Electronic devices and circuit theory Robert L Boylestad Louis Nashelsky http://www.rtna.ac.th/departments/elect/Data/EE306/Electronic%20Devices%20and%20Circuit%20Theory.pdf
2. Op-Amps and Linear Integrated Circuits Ramakant A Gayakwad Pearson https://civildatas.com/download/op-amps-and-linear-integrated-circuit-technology-by-ramakant-a-gayakwad

Scheme of Evaluation: (Integrated courses)
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO/PSO Mapping

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO33.1	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2
CO33.2	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2
CO33.3	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2
CO33.4	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2
CO33.5	3	-	2	1	-	-	1	-	-	-	-	2	1	2	2
22EEE33	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2

SEMESTER – III

Course: Electric Circuits (Program Core)

Course Code	22EEE34	CIE Marks	50
Hours/Week (L: T: P)	2: 2: 0	SEE marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Engineering Mathematics, Fundamentals of Electrical Engineering

Course Objectives:

CLO1	Illustrate various circuit reduction and analyzing techniques such for DC and AC circuits
CLO2	Apply different network theorems for solving complex networks
CLO3	Apply various techniques for solving circuits under transient conditions
CLO4	Computing different parameters for two port networks.
CLO5	Calculate the aftermath due unbalance nature in three phase circuits supplied by balanced three phase supply.

Content	No. of Hours/ RBT levels
Module 1: DC and AC Circuit Analysis – I Classification of circuit elements, Concept of Ideal and practical sources, **Network Reduction Techniques:** Source transformation, Source shifting and star – delta transformation techniques. **Circuit Analysis Methods:** Mesh and Node analysis with both independent and dependent sources (including Super-Mesh and Super node techniques).	8 hours L3
Module 2: DC and AC Circuit Analysis – II Network Theorems: Super Position, Reciprocity, Thevenin's, Norton's, Maximum power transfer, Millman's theorems. Analysis of DC and AC Circuits for both DC and AC excitations (independent sources only).	8 hours L3
Module 3: Transient Circuit Analysis Behaviour of circuit elements under switching action (t = 0 - and t = 0+), Initial conditions, Evaluation Response of RL and RC series circuits subjected to step excitation using time domain and Laplace transforms method.	8 hours L3
Module 4: Two-port Networks Definition and determination of Open circuit impedance, Short circuit admittance, Transmission (ABCD) parameters for simple DC, AC, and s-domain two-port networks, Inter relation among the above parameters.	8 hours L3
Module 5: Unbalanced Three Phase Systems and Coupled circuits **Unbalanced Three Phase Systems:** Analysis of three phase unbalanced systems supplied by balanced three phase supply. Evaluation of currents, voltages, real and reactive Powers. **Coupled circuits:** Self and Mutual Inductance, Concept of mutual coupling, Interrelations, Calculation of equivalent inductance in complex coupled circuit and Coupled impedance.	8 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO34.1	Apply relevant network reduction techniques for solving DC and AC circuits.
CO34.2	Solve given network by adopting relevant theorem based on the circuit configuration.
CO34.3	Analyze behavior of circuit elements under switching condition.
CO34.4	Calculate various network parameters for given two port circuit.
CO34.5	Evaluate the effect of unbalance in three-phase circuit and mutual coupling in magnetically coupled circuits.

Textbooks:

1. Engineering Circuit Analysis William H Hayt et al Mc Graw Hill 8th Edition, 2014
2. Network Analysis M.E. Van Valkenburg, Pearson 3rd Edition, 2014
3. Fundamentals of Electric Circuits, Charles K Alexander Matthew N O Sadiku Mc Graw Hill 5th Edition,2013

Reference books:

1. Engineering Circuit Analysis J David Irwin et al Wiley India 10th Edition, 2014
2. Electric Circuits Mahmood Nahvi Mc Graw Hill 5th Edition, 2009
3. Introduction to Electric Circuits, Rich and C Dorf and James A Svoboda Wiley 9th Edition, 2015
4. Circuit Analysis; Theory and Practice, Allan H Robbins Wilhelm C Miller Cengage 5th Edition, 2013
5. Basic Electrical Engineering, V K Mehta, and Rohit Mehta S Chand 6th Edition 2015

E-Books / Web References

1. https://www.allaboutcircuits.com/textbook/
2. https://sites.pitt.edu/~qiw4/Academic/MEMS0031/Introduction%20to%20Electric%20Circui ts.pdf
3. https://www.ibiblio.org/kuphaldt/electricCircuits/
4. https://openpress.usask.ca/physics155/

MOOCs

1. https://nptel.ac.in/courses/108/105/108105159/
2. https://www.openlearning.com/courses/electric-circuit/?cl=1
3. https://www.edx.org/course/principles-of-electric-circuits-2

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.
CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO34.1	3	2	-	-	-	-	-	-	-	-	-	-		3	1
CO34.2	3	3	-	-	-	-	-	-	-	-	-	1		3	1
CO34.3	3	2	-	-	-	-	-	-	-	-	-	-		3	
CO34.4	3	2	-	-	-	-	-	-	-	-	-	-		3	1
CO34.5	3	2	-	-	-	-	-	-	-	-	-	-	2	3	
22EEE34	3	2	-	-	-	-	-	-	-	-	-	1	2	3	1

SEMESTER – III

Course: Measurements and Transducers (Program Core)

Course Code	22EEE35	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Fundamentals of Electrical Engineering

Course Objectives:

CLO1	Distinguish methods to measure resistance, inductance, and capacitance using bridges.
CLO2	Describe working of different electronic & digital instruments.
CLO3	Understand working of Electric Transducers, Potentiometers and Thermistor.
CLO4	Discuss various Inductive transducers and different Capacitive Transducers.
CLO5	Describe the Smart Sensors and its Applications

Content	No. of Hours/ RBT levels
Module 1: Measurement of Resistance, Inductance and Capacitance **Measurement of Resistance:** Classification of Resistance, Measurement of Resistance - Whetstone Bridge, High resistance measurement by Loss of Charge method. Measurement of Earth Resistance – Megger. **Measurement of Inductance:** Anderson Bridge **Measurement of Capacitance:** Schering Bridge.	08 Hours L2
Module 2: Electronic and Digital Instruments **Electronic Instruments:** Electronic Voltmeter and its advantages, True RMS reading Voltmeter. Cathode Ray Oscilloscope (CRO), **Digital Instruments:** Digital Voltmeter- Ramp Type, Digital LCR Meter, Digital Multimeter, Electronic Energy Meter. (Block Diagram Approach Only), smart meters.	08 Hours L2
Module 3: Transducers Introduction, Transducers, Electric Transducers, Advantages of Electrical Transducers, Classification of Transducers, Characteristics and Choice of Transducers. Resistive Transducers, Potentiometers – Loading Effect, Power Rating of Potentiometers, Disadvantages of Resistance Potentiometers, Theory of Strain Gauges, Resistance Thermometers, Thermistor.	08 Hours L2
Module 4: Inductive and Capacitive Transducers Integrated Circuit Temperature Transducers, Variable Inductance Transducers, Linear Variable Differential Transformer (LVDT), Advantage and Disadvantage of LVDTs, Uses of LVDTs, Rotary Variable Differential Transformer (RVDT). Capacitive Transducers – Differential Arrangement, Variation of Dielectric Constant for Measurement of Displacement, Variation of Dielectric Constant for Measurement of Liquid Level, Frequency Response of Capacitive Transducers, Advantages and Disadvantages of Capacitive Transducers, Uses of Capacitive Transducers, Piezo – Electric Transducers, Hall Effect Transducers, Applications of Hall Effect Transducer.	08 Hours L2

Module 5: Smart Sensors and its Applications **Smart Sensors:** Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing - Data Communication, Standards for Smart Sensor Interface, the Automation **Sensors –Applications:** Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing – Sensors for environmental Monitoring	08 Hours L2

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO35.1	Summarize the different methods used for measuring resistance, inductance and capacitance.
CO35.2	Explain the working of various types of digital & smart meters.
CO35.3	Describe the working of Electric Transducers, Potentiometers and Thermistor.
CO35.4	Distinguish the various Inductive, different Capacitive, Piezo – Electric and Hall-effect transducers.
CO35.5	Explain the Smart Sensors and its Applications

Textbooks:

1. A. K. Sawhney, Electrical & Electronic Measurement & Instruments, Dhanpat Rai & Co. Publications, 2007.
2. "Sensors and Transducers - D. Patranabis" –PHI Learning Private Limited., 2003
3. R. K. Rajput, Electrical & Electronic Measurement & Instruments, S. Chand. 5th Edition 2015.

Reference books:

1. G.K. Banerjee, Electrical & Electronic Measurements, PHI Learning Private Limited, 2012.
2. E.W. Golding and F.C. Widdis, Electrical Measurements and measuring Instruments, 5th Edition, Reem Publications, 2011.
3. J. B. Gupta, A Course in Electronics and Electrical Measurements and Instrumentation, Katson Books, 2013 Edition.
4. David A bell, Electronic Instrumentation and Measurements, 2nd Edition.
5. K. Lal Kishore, Electronic Measurements and Instrumentation 1st Edition, Pearson

E-Books / Web Reference

1. http://www.a-zshiksha.com/forum/viewtopic.php?f=147&t=61577
2. https://www.scribd.com/document/541458088/SENSORS-AND-TRANSDUCERS-nodrm
3. https://www.academia.edu/31325204/Text_book_Electronic_Instrumentation_and_Measurements_David_A_bell_2nd_edition_pdf

MOOCs

1. https://youtu.be/iUMoVcx2UNU
2. https://youtu.be/lqgUqOvd_os
3. https://youtu.be/e1T8CXLhUU8
4. https://youtu.be/RCs0Qlpi-rU
5. http://elearning.vtu.ac.in/econtent/courses/video/EEE/10EE55.html
6. https://nptel.ac.in/courses/108/105/108105153/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module

carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.
CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO35.1	2	-	-	-	-	-	-	-	-	-	-	2	-	-	1
CO35.2	2	-	-	-	-	-	-	-	-	-	-	2	-	-	1
CO35.3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	1
CO35.4	2	-	-	-	-	1	-	-	-	-	-	2	-	-	1
CO35.5	2	-	-	-	-	-	-	-	-	-	-	2	-	-	1
22EEE35	2	-	-	-	-	1	-	-	-	-	-	2	-	-	1

SEMESTER – III

Course: Digital Logic Design (Ability Enhancement course)

Course Code	22EEE36	CIE Marks	50
Hours/Week (L: T: P)	2:0:2	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Elements of Electronic Engineering (20ELN16/26)

Course Objectives:

CLO1	Use Karnaugh maps to simplify Boolean equations
CLO2	Design Decoders, Encoders, Digital Multiplexer, Adders, Subtractors and Binary Comparators
CLO3	Understand different types of Flip-flops and Registers
CLO4	Design the counters for given sequence
CLO5	Understand the different types of memory devices

Content	No. of Hours/ RBT levels
Module 1: Principles of Combinational Logic Definition of combinational logic, canonical forms, Simplification of Boolean function using Karnaugh maps-3,4,5 variables, incompletely specified functions (Don 't care terms), Simplifying Max term equations	6 hours L1, L2,L3
Module 2: Data-Processing Circuits General approach to combinational logic design, Decoders, Encoders, digital multiplexers, using multiplexers as Boolean function generators, Adders and subtractors, cascading full adders, Look ahead carry generator, Binary comparators.	6 hours L1, L2, L3
Module 3: Sequential Circuits SR latch, applications, Gated SR latch, D, T, JK flip flops, Characteristics equations, Master/Slave JK flip-flop, Edge triggered flip flop, Registers, Types of registers	5 hours L1, L2, L3
Module 4: Designing of Sequential circuits Counters, Conversion of one flip flop to another, Design of an asynchronous MOD-8, MOD-6, MOD-5 counter using JK, D, T flip flops, Design of a synchronous MOD-8, MOD-6, MOD-5 counter using JK, D, T flipflops. counter design with random sequence	7 hours L1, L2, L3
Module 5: Memory Devices Introduction to Programmable logic devices (PLD), Programmable Read Only Memory (PROM), Programmable Array Logic (PAL), Programmable Logic Array (PLA)	4 hours L1, L2

Sl. No.	Experiments	No. of Hours/ RBT levels
1.	Realize the given expression using a suitable decoder	
2.	Realization of Half/Full adder and Half/Full Subtractors using multiplexer	2 hours L3
3.	Design and implement two-bit magnitude comparator	2 hours L3
4.	Rig up and verify Decimal-to-BCD Encoder using IC 74147	2 hours L3
5.	To set up and test a 7 segment static display system to display numbers from 0 to 9 using BCD to 7 segment decoder/driver.	2 hours L3
6.	Realize the following flip-flops using NAND gates/IC 7476 (a) Master-Slave JK flip flops (b) D flip flop (c) T flip flop	2 hours L3

7.	Design and testing of Sequence generator	2 hours L3
8.	Realization of 3-bit counters as a sequential circuit and MOD – N counter design using 7490.	2 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO36.1	Develop simplified Boolean expression using Karnaugh Maps
CO36.2	Design Multiplexer, Encoder, Decoder, Adder, Subtractors and Comparator as digital combinational circuits.
CO36.3	Describe different types of flip flops and shift registers
CO36.4	Develop counters for the given specifications
CO36.5	Understand the different memory devices

Textbooks:

1. Digital principles and applications ,Donal P leach,Albert Paul Malvino, Goutam Saha ,8th edition, McGraw Hill Education (India) Private Limited
2. Digital Design: With an introduction to Verilog HDL, VHDL and System Verilog 6th Edition by M.Morris Mano, Michel Giletti

Reference books:

1. Digital Principles and Design Donald D. Givone McGraw Hill 2002 ISBN 978-0- 07-052906-9.
2. Digital Circuits and Design D. P. Kothari and J. S Dhillon Pearson 2016, ISBN:9 789332 543539

E-Books / Web References

1. Digital Logic and Computer Design By M. Morris Mano

https://www.pdfdrive.com/digital-logic-and-computer-design-by-m-morris-mano-e34332016.html

2. Introduction to logic design and logic circuits with Verilog By Brock J.LaMeres, Springer

https://www.pdfdrive.com/introduction-to-logic-circuits-logic-design-with-verilog-d180988648.html

MOOCs

1 https://nptel.ac.in/courses/117/105/117105080/

2. https://www.khanacademy.org/

3. E-learning: www.vtu.ac.in

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO36.1	3	1													
CO36.2	3	1	1		1							1			2
CO36.3	3	1			1							1			2
CO36.4	3	1	1		1							1			2
CO36.5	3	1	1									1			2
Average	3	1	1		1							1			2

Scheme and Syllabus
of
UG Autonomous Program – 2022 batch

IV SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	22MAT41D	Complex Variables and Probability	BS	MAT	2	2	0	50	50	100	3
2	22EEE42	Electrical Machines-II	IPC	Respective Department	3	0	2	50	50	100	4
3	22EEE43	Control Systems	IPC		3	0	2	50	50	100	4
4	22EEE44	Power System –I	PC		2	2	0	50	50	100	3
5	22EEE45	Signal and Systems	ESC/ETC/PLC		2	2	0	50	50	100	3
6	22EEE46	Ability Enhancement Course – II **(Theory)**	AEC		3	0	0	50	50	100	3
		OR			**OR**						
		Data structures using C	AEC		2	0	2	50	50	100	3
							Total	**300**	**300**	**600**	**20**

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Global Academy of Technology,
Rajarajeshwarinagar, Bengaluru-98

Global Academy of Technology
HOD, EEE
Bangalore

SEMESTER IV

Course: Complex Variables and Probability

Course Code	22MAT41D	CIE Marks	50
Hours/Week (L: T: P)	2:2:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Course Objectives: To enable students to apply the knowledge of Mathematics in variousfields of engineering by making them to learn:

CLO1	Analytic functions and complex line integrals
CLO2	Probability distributions
CLO3	Sampling distributions and testing of hypothesis

Content	No. of Hours/ RBT levels
Module 1 Function of a complex variable, Analytic Functions-Cauchy-Riemann equations in Cartesian and polar forms. Construction of analytic functions using Milne Thomson method.	08 Hours L2, L3
Module 2 Conformal Transformations, Bilinear transformations. Complex lineintegrals, Cauchy's theorem, Cauchy's integral formula, Singularities, poles, residues, Cauchy's residue theorem.	08 Hours L2, L3
Module 3 Probability, Axioms of probability, Conditional probability, Bayes theorem,Discrete and continuous random variables, Moments, Moment generating functions, Binomial, Uniform, exponential, Poisson, Normal distributions.	08 Hours L2, L3
Module 4 Joint distributions (both discrete and continuous), Marginal and conditional distributions, Expectation and Covariance. Transformation of random variables, Central limit theorem and law of large numbers.	08 Hours L2, L3
Module 5 Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, student's t-distribution, chi-square distribution as a test of goodness of fit, F Test.	08 Hours L2, L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO41.1	Apply Cauchy Riemann equations to study different properties of analytic functions
CO41.2	Evaluate complex line integrals
CO41.3	Solve problems associated with random variables using probability distributions
CO41.4	Solve problems related to testing of hypothesis

Textbooks:

1. T Veerarajan, Probability, Statistics and Random Processes for Engineers, Tata McGraw Hill,3rd Edition, 2008
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers 44th Edition, 2017

Reference books:

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, 2006
2. N.P.Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications 6thEdition, 2014
3. Richard H Williams, Probability, Statistics and Random Processes for Engineers, CengageLearning, 1st Edition, 2003

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is addedto test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproductionof research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignments	10	
SEE	Semester End Examination	50	50
Grand Total			100

CO/PO Mapping																
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO41.1	3	2	1									3				
CO41.2	3	2	1									3				
CO41.3	3	2	1									3				
CO41.4	3	2	1									3				
Average	3	2	1									3				

Low-1: Medium-2: High-3

SEMESTER IV

Course: Electrical Machines – II (Integrated Program Core)

Course Code	22EEE42	**CIE Marks**	50
Hours/Week (L: T: P)	3:0:2	**SEE Marks**	50
No. of Credits	4	**Examination Hours**	03

Prerequisites:

Fundamentals of Electrical Engineering – 22ELE14/24

Course Objectives:

CLO1	Understand the working principle, constructional details, and performance of DC Generators.
CLO2	Analyze the performance characteristics of DC Motors by conducting suitable tests and control the speed by suitable methods.
CLO3	Understand the working principle, construction and various excitation systems in Synchronous Generators.
CLO4	Analyze the performance of Synchronous Generators under various conditions.
CLO5	Explain the operation of Synchronous motors and its starting methods.

Content	No. of Hours/RBT levels
Module 1: DC Machine- I Construction & Principle of operation, method of excitation, types of DC machines, EMF equation, armature reaction and methods of limiting armature reaction, Commutation process and methods for improving commutation; Characteristics of DC Generators, Power flow diagram, losses and efficiency calculations, Parallel operation of DC Generators.	**8 Hours/ L2**
Module 2: DC Machine- II Principle of operation of DC motors, Concept of back EMF, Torque equation, operating characteristics of DC motors, Starting of DC motors- 3 point and 4 point starters, speed control of DC shunt and series motors, Efficiency Calculations. Testing of D.C. Machines: Direct Method, Indirect method – Swinburne, Hopkinson, Retardation and Field tests. Application of DC machines	**8 Hours/L4**
Module 3: Synchronous Generators- I Construction and principle of operation of Synchronous Machines; types of generators; excitation systems; Armature windings, winding factors, EMF equation. Harmonics–causes, reduction and elimination. Armature reaction, Synchronous reactance, Equivalent circuit, relation between generated voltage and terminal voltage, voltage regulation of alternators using synchronous impedance, MMF, ZPF method	**9 Hours/L2**
Module 4: Synchronous Generators-II Salient pole machines- two reaction theory, equivalent circuit model and phasor diagram; Slip test; regulation of salient pole alternator, Short Circuit Ratio and its significance; power angle characteristics; Synchronization & parallel operation and load sharing; synchronizing current, synchronizing power and synchronizing torque coefficient; effect of varying excitation and mechanical torque. Analysis of short circuit oscillogram, determination of various transient, sub transient and steady reactance and time constants.	**7 Hours/ L4**

Module 5: Synchronous Motors	
Principle of operation, Torque equation, V and inverted V curves, Power equations, Starting methods, effect of varying excitation, effect of load changes in a synchronous motor, Synchronous condenser, hunting and damping phenomena. Applications of synchronous motors.	**8 hours/ L2**

Laboratory Experiments

Sl. No.	Experiments	No. of Hours/ RBT levels
1	Magnetization and Load characteristics of DC shunt generator.	02 Hours/ L3
2	Speed control of DC shunt motor.	02 Hours/ L3
3	Swinburne s Test on DC shunt motor.	02 Hours/ L3
4	Performance characteristics of DC series motor.	02 Hours/ L3
5	Retardation test on DC shunt motor.	02 Hours/ L3
6	Regenerative test on DC shunt machines.	02 Hours/ L3
7	Voltage regulation of an alternator by EMF and MMF methods.	02 Hours/ L3
8	Voltage regulation of an alternator by ZPF method.	02 Hours/ L3
9	Slip test – Measurement of direct and quadrature axis reactance and predetermination of regulation of salient pole synchronous machines.	02 Hours/ L3
10	V and inverted V curves on synchronous motor.	02 Hours/ L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO42.1	Explain the working principle, constructional details, and performance of DC Generators.
CO42.2	Analyze the performance characteristics of DC Motors by conducting suitable tests and control the speed by suitable methods.
CO42.3	Explain the working principle, construction and various excitation systems in Synchronous Generators.
CO42.4	Analyze the performance of Synchronous Generators under various conditions.
CO42.5	Explain the operation of Synchronous motors and its starting methods.

Textbooks:

3. **P.S.Bimbhra,** Electrical Machines, Khanna Publishers, 7th Edition , 2011
4. **Nagrath and Kothari,** Electrical Machines , McGraw-Hill Education India, 2018

Reference books:

5. **A.E.Fitzgerald, Charles Kingsley, Stephen D Umans,** Electrical Machinery, 6th Edition, McGraw Hill Higher Education, 2014
6. **V.Del Toro,** Basic Electric Machines, Pearson Education India, 2016
7. **Ashfaq Hussain,** Electrical Machines, Dhanpat Rai & Co, 3rd Edition , 2020
8. **Samarajit Ghosh,** Electrical Machines, 2nd Edition, Pearson Education India, 2012

E-Books / Web References

1. https://ndl.iitkgp.ac.in/result?q={%22t%22:%22search%22,%22k%22:%22electrical%20mac hines%22,%22s%22:[],%22b%22:{%22filters%22:[]}}
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-685-electric- machines-fall-2013/course-notes
3. https://edisontechcenter.org/Transformers.html
4. https://edisontechcenter.org/inductionMotors.html

MOOCs

1. https://nptel.ac.in/courses/108/105/108105017/
4. https://www.classcentral.com/course/swayam-electrical-machines-iitd-14030
5. E-learning: www.vtu.ac.in

Scheme of Evaluation: (Integrated courses)
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO42.1	3	2	-	-	-	-	-	-	-	-	-	1	3	1	-
CO42.2	3	2	-	-	-	-	-	-	-	-	-	1	3	1	-
CO42.3	3	-	2	-	-	-	-	-	-	-	-	1	3	1	-
CO42.4	3	-	-	-	-	-	-	-	-	-	-	1	3	1	-
CO42.5	3	-	-	-	-	-	-	-	-	-	-	1	3	1	-
22EEE42	3	2	2	-	-	-	-	-	-	-	-	1	3	1	-

SEMESTER IV

Course: Control Systems (Integrated Program Core)

Subject code	22EEE43	CIE Marks	50
Number of Lecture Hours/Week	3:0:2	SEE Marks	50
Credits	4	Exam Hours	03

Course Objectives: This course enables the students to

CLO1	Construct mathematical models of electrical and mechanical system.
CLO2	Apply Block Diagram reduction techniques and Signal Flow Graph to derive transfer function of linear systems.
CLO3	Calculate time response and frequency response specifications.
CLO4	Analyse a system in time domain and frequency domain with respect to stability.
CLO5	Understand the design procedure of PID controller, lag compensator and lead compensator.

CONTENT	No. of Hours/ RBT levels
Module 1: Mathematical Modeling of Physical Systems **Introduction to Control Systems:** Introduction, Open loop and Closed loop control system. **Mathematical Modelling of physical systems**: Transfer functions, poles and zeros. Mathematical modelling of electrical systems, mechanical systems, procedure for deriving transfer functions. Electrical analogy of mechanical system. Servomechanism. AC and DC servomotors.	8 hours L5
Module 2: Block Diagram and Signal Flow Graph **Block Diagram**: Block diagram representation of closed loop system, block diagram reductions techniques to derive transfer function. **Signal Flow Graph**: Construction of signal flow graph for a given electrical network from system equations. Mason's Gain formula.	8 hours L3
Module 3: Time Domain Analysis and Stability **Time Domain Analysis**: Standard test signals, time response of first order and second order systems [unit step input only], time domain specifications, steady state errors and error constants. **Concept of Stability**: BIBO stability, Routh-Hurwitz criterion, relative stability analysis.	8 hours L3, L4
Module 4: Stability Analysis using Root locus and Bode Plot **Root Locus Technique:** Introduction, Construction of Root loci, Stability analysis using root loci. **Frequency Domain Analysis**: Frequency domain specifications. **Bode Plots:** General procedure for construction of bode plots, computation of gain margin and phase margin, Stability Analysis using Bode Plot.	8 hours L3,L4
Module 5: Stability Analysis using Nyquist Plot, Controllers, Compensators **Nyquist plot**: Nyquist stability criterion, assessment of relative stability using Nyquist criterion. **PID controller:** Effect of P, PI, PD and PID controller. [elementary statements only] **Design of Compensators**: Need of compensators, design Steps of lag and lead compensators. [elementary statements only]	8 hours L3

Sl. No.	Experiments	No. of Hours/ RBT levels
1	Conduct a load test to draw Speed-Torque characteristics of AC and DC Servomotor.	02 hours/**L2**
2	**a.** Experiment to Determine Frequency Response specifications of a second order system. **b.** Determine the effect of damping ratio on frequency response.	02 hours/**L3**
3	Design a passive phase lead compensator for a given maximum phase lead and determine the transfer function experimentally.	02 hours/**L3**
4	Design a passive phase lag compensator for a given maximum phase lag and determine the transfer function experimentally.	02 hours/**L3**
5	Study the effect of P, PI, PD and PID controller on the step response of a second order feedback control system.	02 hours/**L2**
6	(a) Determine the step response of a second order system and determine. The time domain specifications. (b) Evaluate the effect of addition of poles and zeros on time response of 2^{nd} order system.	02 hours/**L3**
7	Verify the effect of input waveform (step, ramp and parabolic) and system type on steady state error.	02 hours/**L2**
8	Design a lead compensator using simulation for a given system to obtain required frequency domain specification.	02 hours/**L3**
9	Obtain the root locus plot of a given open loop transfer function and determine: **a)** The range of open loop gain K for which the closed loop system is stable. **b)** The breakaway and/or break-in points and the corresponding gain. **c)** Determine the effect of addition of poles and zeros on stability of system.	02 hours/**L3**
10	Judge the stability of a given system using Bode plot and Nyquist plot and compare the result.	02 hours/**L4**

Course Outcomes:

Upon successful completion of this course, the student shall be able to:

CO1	Construct models of electrical and mechanical systems using mathematical modelling.
CO2	Apply block diagram reduction techniques and Mason's Gain Formula to obtain the transfer function of the given system.
CO3	Calculate time response and frequency response specifications of the given System.
CO4	Analyze linear systems with respect to stability using different methods in time and frequency domain.
CO5	Apply the standard design procedure to design passive lead compensator, lag compensator and PD, PI, PID controller for a given specifications and obtain the frequency responses.

Text books:

1. Control Systems Engineering by I.J Nagrath, M Gopal, New Age International Publishers; 6th edition 2017.
2. Control System Engineering by Norman S. Nise, Wiley India Edition 2018

Reference books:

3. Modern Control Engineering by Ogata, Pearson Education India; 5th edition 2015
4. Control Systems by Anand Kumar, PHI, 2nd Edition 2014
5. Control Systems (Schaum's Outline Series) by Joseph Distefano et al. McGraw Hill Education; 3rd edition 2017.
6. Control Systems, by Jairath A, Ane Books Pvt Ltd, 2008.
7. Ramesh Babu P Anandanatarajan R, Control Systems Engineering, Scitech Publications (India) Pvt Ltd, December 2018.
8. A.Nagoor kani, Control Systems Engineering, RBA Publications, January 2014.

E-Books / Web References

1. Vincent Del Toro, Principles of Control Systems Engineering, Mc Graw Hill, https://babel.hathitrust.org/cgi/pt?id=mdp.39015000451032&view=1up&seq=9&skin=2021
2. https://en.wikibooks.org/wiki/Control_Systems
3. https://www.youtube.com/watch?v=HcLYoCmWOjI&list=PLBlnK6fEyqRhqzJT87LsdQKYZBC93ezDo

MOOCs

1. https://nptel.ac.in/courses/108/106/108106098/
2. https://nptel.ac.in/courses/108/102/108102043/
3. http://elearning.vtu.ac.in/econtent/courses/web/EEE/17EE61.html

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO43.1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	1
CO43.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	1
CO43.3	3	2	-	2	3	-	-	2	2	2	-	2	-	-	2
CO43.4	3	2	2	2	3	-	-	2	2	2	-	2	-	-	2
CO43.5	3	2	2	2	3	-	-	2	2	2	-	2	-	-	3
22EEE43	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**2**

SEMESTER – IV

Course: Power System – I (Program Core)

Course Code	22EEE44	CIE Marks	50
Hours/Week (L: T: P)	2:2:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Electric Circuits, Fundamentals of Electrical EngineeringCourse Objectives:

CLO1	Understand the Structure of Power Systems and other Economic Aspects
CLO2	Explain the modelling of transmission line with passive elements
CLO3	Analyze the performance of transmission system under given loading condition
CLO4	Describe the factors affecting overhead Insulator design of Transmission lines along with mechanical aspects
CLO5	Compare the distribution systems with overhead transmission system

Content	No. of Hours/ RBT levels
Module 1: Structure of Power Systems and other economic aspects: Introduction, Typical Power Systems Structure, definitions of commonly used terms-connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve etc. Load characteristics, relation between load factor and loss factor, power factor of various equipment, causes and disadvantages of low power factor Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer.	8 hours L2
Module 2: Transmission line parameters Introduction to line parameters- resistance, inductance, and capacitance – Calculation of inductance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines – Inductance of composite conductors, Advantages of single circuit and double circuit lines. Calculation of capacitance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines – Capacitance of composite conductor.	8 hours L3
Module 3: Performance evaluation of Transmission line Classification of lines, Current and voltage interrelations, Calculation of line regulation and efficiency – Nominal T and nominal Pi circuits – Long lines considering hyperbolic form equations. Equivalent circuit of a long line with T and Pi configurations, ABCD constants – Ferranti, Ferro resonance and proximity effects.	8 hours L3
Module 4: Overhead Transmission line aspects Line Insulators: Types of insulators, Potential distribution over a string of suspension insulators, String efficiency, Methods of increasing string efficiency. Sag: Importance of sag, Sag calculation – supports at same and different levels, effect of wind and ice, Line vibration and dampers. Corona: Phenomena, disruptive and visual critical voltages, corona loss. Advantages and disadvantages of corona. Methods of reducing corona.	8 hours L3
Module 5: Distribution Systems AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system, AC distribution calculations, AC distributors with concentrated loads. DC distribution systems – Classification, DC distributor Fed at one end, DC distributor Fed at both ends, parallel feeders, Stepped or Tapered Distributor, Ring Main Distributor.	8 hours L2

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO44.1	Explain the structure of power systems and other economic aspects
CO44.2	Analyze the transmission line parameters for given transmission line configuration
CO44.3	Analyze the performance of given power transmission system
CO44.4	Interpret the mechanical aspects involved in design of overhead transmission lines
CO44.5	Distinguish the distribution with transmission system

Textbooks:

1. A Textbook on Power System Engineering; By A. Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, Dhanpat Rai & Co. (P) Limited, 2016.
2. Electrical Power Systems; By D. Das, New Age International Publishers, 2006.
3. Power System Analysis and Design; By B.R. Gupta, S Chand & Company; Re-Issue Edition,2005
4. Principles of Power System; By V.K.Mehta and Rohit Mehta, S Chand & Company;

Reference books:

1. Electrical Power Systems, By C.L Wadhwa, New Age Internationals; 7th Edition, 2016.
2. Power System Analysis, By John Grainger and William Stevenson Jr., Mcgraw Hill Education,2017.
3. Electrical Power Transmission System Engineering: Analysis and Design, By Turan Gonen, CRCpress; 2nd Edition, 2009.
4. Power System Engineering, By D. P. Kothari And I.J. Nagrath , Mcgraw-Hill; 3rd Edition, 2019.

E-Books / Web References

1. https://engineeringonline.ucr.edu/blog/power-systems-engineering-a-career-on-the-grid/
2. https://pserc.wisc.edu/
3. https://cusp.umn.edu/power-systems/advanced-power-systems-1-2

MOOCs

1. https://www.cousera.org/learn/electric-power-systems
2. https://nptel.ac.in/courses/108/105/108105104/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-061-introduction-to-electric-power-systems-spring-2011/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-

thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO44.1	3	2	-	-	-	-	-	-	-	-	-	1	-	3	-
CO44.2	3	2	-	-	-	-	-	-	-	-	-	1	-	3	-
CO44.3	3	2	-	-	-	-	-	-	-	-	-	1	-	3	-
CO44.4	3	2	-	-	-	-	-	-	-	-	-	1	-	3	-
CO44.5	3	2	-	-	-	-	-	-	-	-	-	1	-	3	-
22EEE44	3	2	-	-	-	-	-	-	-	-	-	1	-	3	-

SEMESTER – IV

Course: Signals and Systems

Course Code	22EEE45	CIE Marks	50
Hours/Week (L: T: P)	2:2:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Fourier Transforms, Z transforms, complex variables

Course Objectives:

CLO1	Understand generation of signals, elementary signals and properties of systems.
CLO2	Apply convolution in both continuous and discrete domain for the analysis of systems given impulse response of a system.
CLO3	Perform Fourier analysis for continuous and discrete time, linear time invariant systems.
CLO4	Apply Z-transform and properties of Z transform for the analysis of discrete time systems.

Content	No. of Hours/ RBT levels
Module 1 – Introduction **Introduction:** Definitions of signals and a system, classification of signals, **Basic operations on signals**: Amplitude Scaling, addition, multiplication, differentiation, integration, time scaling, time shifting and time reversal. **Elementary Signals and functions**: Exponential, sinusoidal, step, impulse and ramp functions.	08 hours L2
Module 2: Properties of systems and Time domain representation of LTI system **Properties of systems** – Linear, nonlinear, Time variant, time invariant, causal, non-causal, static, dynamic, stable, unstable, invertible. **Time – Domain Representations for LTI Systems:** Convolution sum, convolution integral, impulse response, Computation of convolution sum and convolution integral using graphical method.	08 hours L3
Module 3: Fourier Representation of signals and LTI systems Discrete time periodic signals, Discrete Time Fourier series (DTFS), Continuous Time periodic signals, Continuous Time Fourier Series (CTFS), Properties of CTFS and DTFS – Linearity, time shift, frequency shift, convolution, Perseval's theorem, symmetry.	08 hours L4
Module 4: Fourier Transforms Discrete time aperiodic signals, Discrete-time Fourier transform (DTFT), continuous time aperiodic signal, continuous time Fourier transform (FT). Properties of continuous and discrete time Fourier transform.	08 hours L4
Module 5: Z Transform Introduction, Z-transform, properties of region of convergence, properties of Z-transforms, Inverse Z-transform using power series and partial fraction expansion.	08 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO45.1	Explain the generation of signals, properties of system and the basic operations that can be performed on signals
CO45.2	Compute the response of a continuous and discrete time LTI system using convolution sum and convolution integral.
CO45.3	Analyze the frequency response of a given periodic continuous and discrete time signal using Fourier series and its properties.
CO45.4	Analyze the frequency response of a given aperiodic continuous and discrete time signal using Fourier transform and its properties.
CO45.5	Determine the Z-transform, inverse Z-transform and transfer functions of complex LTI system.

Textbooks:

9. Signals and Systems, Simon Haykin, Berry Van Veen Wiley India, 2nd Edition,2008.

Reference books:

1. Signals and Systems Nagoor Kani McGraw Hill 1st Edition 2010.
2. Fundamentals of Signals and Systems Michael J. Roberts, Govind K Sharma McGraw Hill 2nd Edition 2010

E-Books / Web References

1. https://www.ece.uvic.ca/~frodo/sigsysbook/downloads/signals_and_systems-3.0.pdf
2. https://mlichouri.files.wordpress.com/2013/10/fundamentals-of-signals-and-systems.pdf

MOOCs

1. https://archive.nptel.ac.in/courses/108/104/108104100/
2. https://archive.nptel.ac.in/courses/108/106/108106163/
3. https://www.udemy.com/course/signals-and-systems-c/

Scheme of Evaluation: (Ability Enhancement courses)
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.
CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO45.1	3	2	-	-	-	-	-	-	-	-	-	2	-	-	1
CO45.2	3	3	-	-	-	-	-	-	-	-	-	2	-	-	1
CO45.3	3	3	-	-	-	-	-	-	-	-	-	2	-	-	1
CO45.4	3	3	-	-	-	-	-	-	-	-	-	2	-	-	1
CO45.5	3	3	-	-	-	-	-	-	-	-	-	2	-	-	1
22EEE45	3	3	-	-	-	-	-	-	-	-	-	2	-	-	1

SEMESTER – IV

Course: Data structures using C (Ability Enhancement course)

Course Code	22EEE46	CIE Marks	50
Hours/Week (L: T: P)	2:0:2	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: C Programming

Course Objectives:

CLO1	Understand the working of different data structures
CLO2	Identify and apply appropriate data structure to solve a given problem
CLO3	Implement data structure algorithms using C programming
CLO4	Develop applications using data structure algorithms.

Content	No. of Hours/ RBT levels
Review of C Programming concepts – arrays, pointers, structures. Introduction to Data structure, Classifications (Primitive and Non-primitive), Data structures operations **Searching** – linear search and binary search	05 Hours L3
Sorting – Insertion Sort, selection sort, radix sort **Linked List** – Linked list vs arrays, Singly linked list and doubly linked list– traversing, searching, insertion and deletion	05 Hours L4
Stack Introduction, definition and examples, primitive operations, Implementing pop, push and peek operations using C. Linked representation of stack, Stack Application – Parenthesis checker, tower of Hanoi.	06 Hours L2
Queue Queue and its array representation, primitive operations, Implementation of linear queue using C. Circular Queue and priority queue.	6 Hours L3
Binary Trees Introduction and definition, Node representation of binary tree, linked representation of binary tree, binary search tree, Creating a binary tree from a general tree. Traversing a binary tree – preorder, post order, in-order, level-order traversal.	6 hours L3

Sl. No.	Programs	No. of Hours/ RBT levels
1	Write a program to search an element in an array using the linear search technique.	2 hours L3
2	Write a program to search an element in an array using binary search.	2 hours L3
3	Write a program to sort an array using a. selection sort algorithm. b. insertion sort algorithm	2 hours L3

4	Write a C Program to Create a Linked List and Display it.	2 hours L3
5	Write a program to perform Push, Pop, and Peek operations on a stack	2 hours L3
6	Write a program to check nesting of parentheses using a stack.	2 hours L3
7	Write a program to implement stacks using Array to perform Push, Pop and Peek operations.	2 hours L3
8	Write a program to implement a linear queue.	2 hours L3
9	Write a program to implement a circular queue.	2 hours L3
10	Write a program in C to construct a binary tree	2 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO46.1	Comprehend different types of data structures and its applications in problem solving.
CO46.2	Implement searching and sorting algorithms.
CO46.3	Implement basic operations on linked list and stack.
CO46.4	Describe primitive operations on linear, circular and priority queue.
CO46.5	Implement basic operations on binary tree.

Textbooks:

5. Data Structure using C, Reema Thereja, Oxford University Press, 2nd edition (2014).

Reference books:

10. Data structures using C and C++, Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Pearson, 2nd Edition (2020)
11. Seymour Lipschutz, Data Structure with C, Schaum's Outlines, Special Indian Edition, 13th reprint, Tata McGraw Hill Education, 2015.

E-Books / Web References

1. https://aa.bbs.tr/lab/cen215-data-structures/Data-Structures-Using-C-2nd-edition.pdf
2. https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf

MOOCs

1. https://nptel.ac.in/courses/106102064
6. https://www.udemy.com/course/data-structures-and-algorithms-in-c/

Scheme of Evaluation: (Ability Enhancement courses)
Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

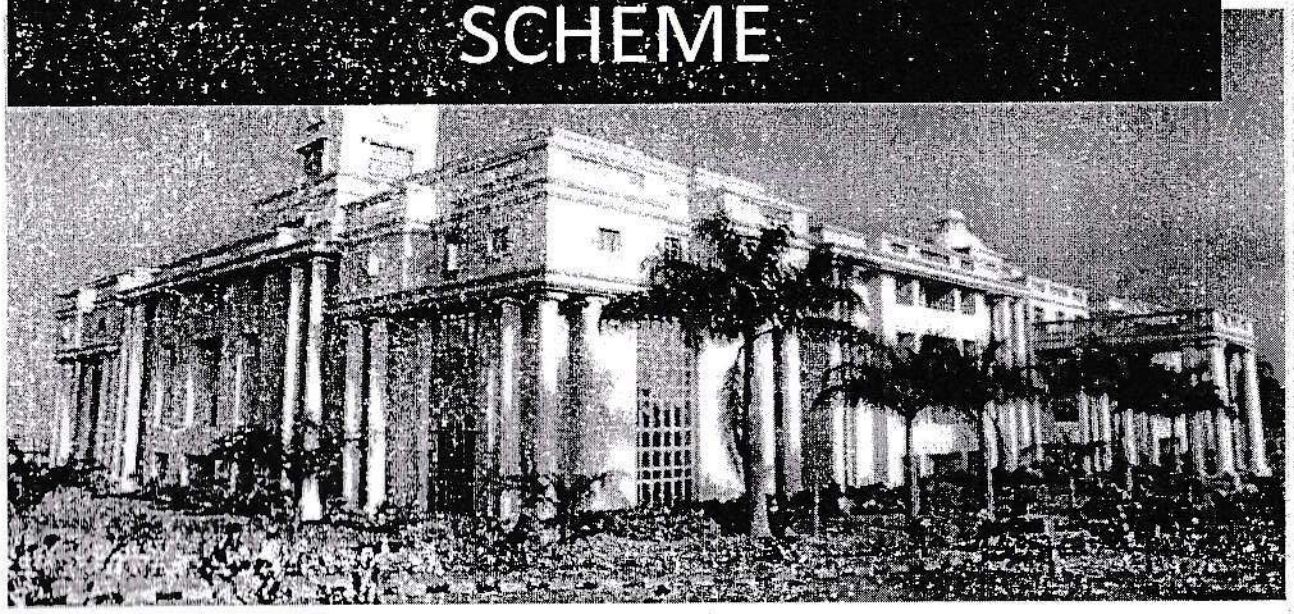
Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO46.1	3	3	2	-	2	-	-	-	-	-	-	2	-	-	-
CO46.2	3	3	2	-	2	-	-	-	-	-	-	2	-	-	-
CO46.3	3	3	2	-	2	-	-	-	-	-	-	2	-	-	-
CO46.4	3	3	2	-	2	-	-	-	-	-	-	2	-	-	-
CO46.5	3	3	2	-	2	-	-	-	-	-	-	2	-	-	-
22EEE46	3	3	2	-	2	-	-	-	-	-	-	2	-	-	-

SCHEME



V Semester 2022 Scheme and Syllabus

Electrical & Electronics Engineering

GLOBAL ACADEMY OF TECHNOLOGY

(Autonomous Institution affiliated to VTU, Belagavi)

Accredited by NAAC with 'A' grade

Global Academy of Technology

(An Autonomous Institution, affiliated to VTU, Belagavi, recognized by Karnataka and Approved by AICTE, New Delhi.)

B.E. in EEE Engineering Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS	22EEE51	**Management & Economics**	TD: EEE PSB: EEE	3	0	0		03	50	50	100	3
2	IPCC	22EEE52	**Power Electronics**	TD: EEE PSB: EEE	3	0	2		03	50	50	100	4
3	PCC	22EEE53	**Power Systems II**	TD: EEE PSB: EEE	3	2	0		03	50	50	100	4
4	PCCL	22EEEL54	**Auto CAD**	TD: EEE PSB: EEE	0	0	2		03	50	50	100	1
5	PEC	22EEE55X	**Professional Elective - I**	TD: EEE PSB: EEE	3	0	0		03	50	50	100	3
6	PROJ	22EEEP56	**Mini Project**	TD: EEE PSB: EEE	0	0	4		03	100		100	2
7	AEC	22RMIK57	**Research Methodology and IPR**	EEE	3	0	0		03	50	50	100	3
8	MC	22CIVK58	**Environmental Studies**	TD: CV/Env/Chem PSB:CV	2	0	0		02	50	50	100	2
9	MC	22NSK59	**National Service Scheme (NSS)**	NSS coordinator	0	0	2			100		100	0
		22PEK59	**Physical Education (PE) (Sports and Athletics)**	Physical Education Director									
		22YOK59	**Yoga**	Yoga Teacher									
									Total	**500**	**300**	**800**	**22**

H.M. Rajashekhar

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Rajarajeshwarinagar, Benga 98

HOD, EEE

Professional Elective Course - I					
22EEE55A	Object Oriented Programming Using C++		22EEE55C	Digital System Design Using Verilog HDL	
22EEE55B	Embedded Systems		22EEE55D	Electromagnetic Field Theory	

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L**: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course.

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

SEMESTER V

Course: Management and Economics

Course Code	22EEE51	CIE Marks	50
Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	3	Examination Hours	3

Course Learning Objectives:

CLO 1	Discuss importance of Management and Planning
CLO 2	Understand the Nature and Characteristics of Organization and Leadership Styles.
CLO 3	Explain the project management, control techniques and economic concepts.
CLO 4	Understand uncertainty, risk and demand.
CLO 5	Discuss market, capital and policy.

Content	No. of Hours/ RBT levels
Module 1: Introduction to Management & Planning **Management**: Definition, Importance – Nature and Characteristics of Management, Management Functions, Roles of Manager, Levels of Management, Managerial Skills, Management & Administration, Management as a Science, Art &Profession. **Planning**: Nature, Importance and Purpose of Planning, Types of Plans, steps in Planning, Limitations of Planning, Decision Making – Meaning, Types of Decisions- Steps in Decision Making. Understanding aspects of finance, marketing and resources management in business.	08 / L2
Module 2: Organizing, Staffing, Directing and Controlling **Organizing and Staffing**: Meaning, Nature and Characteristics of Organization – Process of Organization, Principles of Organization, Departmentalization, Committees – meaning, Types of Committees, Centralization Versus Decentralization of Authority and Responsibility, Span of Control (Definition only), Nature and Importance of Staffing, Process of Selection and Recruitment. **Directing and Controlling**: Meaning and Nature of Directing-Leadership Styles, Communication – Meaning and Importance, Coordination- Meaning and Importance, Techniques of Coordination. Controlling – Meaning, Steps in Controlling. Brief review of Innovation management.	08 / L2
Module 3: Project Management Objectives & Characteristics, Project Identification-Meaning & Importance; Project Life Cycle, Project Scheduling, Capital Budgeting, Generating an Investment Project Proposal, Project Analysis-Market, Technical, Financial, Economic, Ecological, Project Evaluation and Selection, Project Financing, Project Implementation Phase, Human & Administrative aspects of Project Management, Prerequisites for Successful Project Implementation. New Control Techniques-PERT and CPM, Steps involved in developing the network, Uses and Limitations of PERT and CPM.	08 / L2
Module 4: Fundamental Economic Concepts Introduction to Engineering Economy: Necessities and Luxuries, Market segments, Supply and Demand, diminishing returns, Economic Indicators (GDP, GNP, GNI, Fiscal Deficit etc.); Time Value of Money: Time value equivalence, Problem solving and decision making, Laws of demand and supply, Difference between Microeconomics & Macroeconomics, equilibrium between demand & supply, elasticity of demand, price elasticity, income elasticity. Law of Returns, Interest and interest factors, simple and compound interest, Cash flow diagrams, personal loans and EMI payment calculation with flexible interest rates, Discussion and problems	08 / L2
Module 5: Breakeven Analysis; Demand Forecasting, Financial Management, Process, Balance sheet and financial ratios; General Replacement Studies: Defender and challenger (both equal and unequal lives), When to replace; Benefit-Cost Analysis: Benefit/cost criterion, Benefit/cost comparisons; Depreciation: Purpose and use, Declining value and replacement of assets, Depreciation and tax, Straight line method, Declining and double declining balance method; Inflation and its effects, Inflation, its causes and consequences.	08 / L2

Course Outcomes

Upon completion of this course, student will be able to:

CO 51. 1	Explain the importance of Management and Planning
CO 51. 2	Discuss the Nature and Characteristics of Organization and Leadership Styles.
CO 51. 3	Describe the role of project management, control techniques and economic concepts.
CO 51. 4	Understand the uncertainty and risk in business and the types of demands.
CO 51. 5	Explain the marketing structures, strategy, capital budgeting and monetary and fiscal policies.

TEXTBOOKS:

1. Principles of Management P.C.Tripathi, P.N.Reddy McGraw Hill, 6th Edition, 2017
2. Managerial Economics, M.L. Jhingan and J.K.Stephen, Vrinda Publications (P) LTD 2nd Edition, 2009.

REFERENCE BOOKS:

1. Essentials of Management: An International, Innovation and Leadership perspective Harold Koontz, Heinz Weihrich McGraw Hill 10thEdition 2016

E-Books / Web References

https://www.youtube.com/watch?v=8GFXOWxlySs

MOOCs

https://onlinecourses.nptel.ac.in/noc20_mg58/preview

Scheme of Examination:

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE (40) + AAT (10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO – PO Mapping With Strengths

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 51. 1	2	-	-	-	-	-	-	1	-	-	-	1	-	-	-
CO 51. 2	2	-	-	-	-	-	-	1	-	-	-	1	-	-	-
CO 51. 3	2	-	-	-	-	-	-	1	-	-	-	1	-	-	-
CO 51. 4	2	-	-	-	-	-	-	1	-	-	-	1	-	-	-
CO 51. 5	2	-	-	-	-	-	-	1	-	-	-	1	-	-	-
22EEE51	2	-	-	-	-	-	-	1	-	-	-	1	-	-	-

V SEMESTER

Course: Power Electronics

Course Code	22EEE52	CIE Marks	50
Hours/Week (L: T: P)	3:0:2	SEE Marks	50
No. of Credits	4	Examination Hours	03

Prerequisites: Elements of Electronics Engineering

Course Objectives:

CLO1	Understand the working principle and characteristics of different power electronic devices.
CLO2	Understand turn on, turn off, and protection methods of thyristor.
CLO3	Analyse the operation of single phase and three phase controlled rectifier circuits connected to different types of loads.
CLO4	Discuss the working of different types of chopper circuit, buck converter, boost converter and cycloconverter.
CLO5	Analyse the operation of AC voltage controllers and single-phase inverter circuits.

Content	No. of Hours/ RBT levels
Module 1: Power Semiconductor Devices Introduction to Power Electronics, Power Diodes – Diode Characteristics, Reverse Recovery Characteristics, Power MOSFETs – static characteristics, switching characteristics, IGBTs – static characteristics, switching characteristics, Silicon Controlled Rectifier – static Characteristics, Two-Transistor Model of Thyristor. Types of thyristors.	8 hours L1, L2
Module 2: Thyristor triggering, commutation and protection Thyristor Turn On, Thyristor Turn-Off, Thyristor Firing Circuits, Gate triggering, R & R-C triggering, Unijunction Transistor. UJT triggering. Natural & Forced commutation. di/dt Protection, dv/dt Protection. Snubber circuit. Series parallel combination of thyristors.	8 hours L1, L2, L3
Module 3: Controlled Rectifiers Introduction, Principle of uncontrolled and controlled rectifier, Single phase half wave controlled rectifier with R load, RL Load, RL Load and Freewheeling Diode, Full controlled and half controlled converter (with R, RL, RLE load). Single-Phase Dual Converters, Principle of operation of Three-Phase full Converters.	8 hours L1, L2, L3
Module 4: DC-DC Converter and Cycloconverter DC-DC converter – Principle of step-down chopper and its analysis with R-L Load. Step up chopper. Class A, B, C, D and E choppers. Performance parameters. Switched mode regulator, Buck converter and boost converter. Cycloconverter – Principle of operation of Single phase cycloconverter.	8 hours L1, L2, L3
Module 5: AC voltage controllers and Inverters AC Voltage Controllers: Introduction, Principle of phase control, Single-Phase Full-Wave Controllers with Resistive Loads, Single- Phase Full-Wave Controllers with Inductive Loads. DC-AC Converters: Introduction, principle of operation single-phase bridge inverters, three-phase bridge inverters 120 degree and 180 degree mode of operation, Voltage control of single-phase inverter – single pulse-width, multi-pulse width and sinusoidal pulse width modulation.	8 hours L1, L2, L3

Sl. No.	Experiments	No. of Hours/ RBT levels
1	Static Characteristics of SCR	2 hours/L2
2	Static Characteristics of MOSFET and IGBT	2 hours/L2
3	SCR digital triggering circuit for single phase controlled rectifier and AC voltage controller.	2 hours/L3
4	SCR turn on circuit using synchronized UJT relaxation oscillator.	2 hours/L3
5	Single phase controlled full wave rectifier with R load and R –L load.	2 hours/L3
6	Single phase MOSFET/IGBT based PWM inverter.	2 hours/L3
7	Speed control of universal motor using AC voltage controller.	2 hours/L3
8	Speed control of a separately excited D.C. Motor using an IGBT or MOSFET chopper.	2 hours/L3
9	Simulation of semi-converter and full controlled converter with R and R-L load.	2 hours/L2
10	Simulation of single phase bridge inverter.	2 hours/L2

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO52.1	Understand the working and characteristics of power diodes, power MOSFETs, IGBTs and SCRs.
CO52.2	Understand thyristor triggering methods, commutation techniques and protection methods of thyristor.
CO52.3	Analyse the operation of controlled rectifier circuits connected to different types of loads.
CO52.4	Discuss the operation of step-down, step-up chopper, buck converter, boost converter and cycloconverter.
CO52.5	Analyse the operation of single phase and three phase AC voltage controllers and single-phase inverters.

Textbooks:

1. Power Electronics: Circuits Devices and Applications Mohammad H Rashid, Pearson 4th Edition, 2014.
2. Power electronics, M.D Singh, K.B Khanchandani, Tata McGraw Hill, 2nd Edition, 2006

Reference books:

1. Power Electronics P.S. Bimbhra Khanna Publishers 5th Edition, 2012.
2. Power Electronics: Converters, Applications and Design Ned Mohan et al Wiley 3rd Edition, 2014.
3. Elements of Power Electronics: Indian Edition, Philip T. Krein, Oxford University Press; Second edition (2017)
4. Power Electronics, P.C Sen, McGraw Hill Education; 2nd edition (2017)
5. Power Electronics by Daniel Hart, McGraw Hill India (2011)

E-Books / Web References

1. https://freevideolectures.com/course/2351/power-electronics/1
2. http://site.iugaza.edu.ps/malramlawi/files/RASHID_Power_Electronics_Handbook.pdf
3. https://atakarihome.files.wordpress.com/2018/09/m-d-singh-k-b-khanchandani-power-electronics.pdf

MOOCs

1. https://www.coursera.org/learn/power-electronics?specialization=power-electronics
2. https://onlinecourses.nptel.ac.in/noc22_ee03/preview

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester. Typical Evaluation pattern for integrated courses is shown in the Table below

3. **Table: Distribution of weightage for CIE & SEE of Integrated courses**

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO52.1	3	2	-	2	-	-	-	2	2	2	-	-	-	-	2
CO52.2	3	2	-	2	-	1	-	2	2	2	-	-	-	-	2
CO52.3	3	2	-	2	3	-	-	2	2	2	-	2	-	-	3
CO52.4	3	2	-	2	-	-	-	2	2	2	-	2	1	-	3
CO52.5	3	2	-	2	3	-	-	2	2	2	-	2	1	-	3
22EEE52	**3**	**2**	**-**	**2**	**3**	**1**	**-**	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**3**

SEMESTER – V

Course: Power System II

Subject Code	22EEE53	CIE Marks	50
Hours/Week (L:T)	2:2:0	SEE Marks	50
Credits	3	Examination Hours	03

Course Learning Objectives: At the end of the course the student should be able to:

CLO1	Understand one line diagram, impedance diagram/reactance diagram, per unit system, modelling of Power System Components
CLO2	Understand short circuit analysis on a synchronous machine and to select appropriate circuit breakers and current limiting reactors.
CLO3	Calculate sequence impedances of power system components and draw sequence network of a given system.
CLO4	Calculate the currents, voltages and power of a LG/LL and LLG on an unbalanced alternator and unsymmetrical faults on a power system with and without fault impedance.
CLO5	Understand steady state and transient stability , application of equal area criteria and methods of improving stability.

Content	No. of Hrs/ RBT levels
MODULE I – Per Unit Representation & Modeling of Power System Components Per unit quantities-single phase and three phase-selection of base quantities -advantages of per unit system –changing the base of per unit quantities Modelling of power system components - Steady State Model of Synchronous Machine, Power Transformer, Transmission Lines Representation of Loads. Single Line Diagram, Impedance and Reactance diagrams and their importance.	08 Hours/ L1, L2
MODULE II – Symmetrical Fault Analysis Introduction, Transients on a Transmission Line, Short Circuit Analysis of a Synchronous Machine – Unloaded and Loaded, Short Circuit MVA, Current limiting reactors, Selection of Circuit Breakers. Simple problems on fault current calculation.	08 Hours/ L1, L2
MODULE III – Symmetrical Components Introduction, Symmetrical Component Transformation, Phase Shift in Star-Delta Transformers, Sequence Impedances of Transmission Lines, Sequence Impedances and Sequence Network of Power System, Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances of Transmission Lines, Sequence Impedances and Networks of Transformers, Construction of Sequence Networks of a Power System	08 Hours/ L1, L2
MODULE IV – Unsymmetrical Fault Analysis Introduction, Symmetrical Component Analysis of Unsymmetrical Faults, Single Line-To-Ground (LG) Fault, Line-To-Line (LL) Fault, Double Line-To-Ground (LLG) Fault, Open Conductor Faults	8 Hours/ L1, L2
MODULE V – Power System Stability Steady state, dynamic and transients stability , Dynamics of a Synchronous Machine, Swing Equation, Equal Area Criterion, critical clearing angle, Multi machine stability studies, Numerical Solution of Swing Equation by Point by Point method, Runge Kutta, Modified Euler's Method. Methods of Improving transient stability.	8 hours L1,L2
Total Hours	**40 Hours**

Course Outcomes: The students will be able to:

CO53.1	Understand one line diagram, impedance diagram/reactance diagram, per unit system, modelling of Power System Components
CO53.2	Understand short circuit analysis on a synchronous machine and to select appropriate circuit breakers and current limiting reactors.
CO53.3	Calculate sequence impedances of power system components and draw sequence network of a given system.
CO53.4	Calculate the currents, voltages and power of a LG/LL and LLG on an unbalanced alternator and unsymmetrical faults on a power system with and without fault impedance.
CO53.5	Understand steady state and transient stability, application of equal area criteria and methods of improving stability.

TEXTBOOKS:

1. D P Kothari, I J Nagarath, Power System Engineering , Mc Graw Hill Education, Second Editiion, 2008
2. William D. Stevenson Jr , Elements of Power System Analysis, McGraw Hill Education; 4th edition , 2017

REFERENCES:

1. J.Duncan Glover et al, Power System Analysis and Design, Cengage, 4th Edition, 2008
2. Hadi Sadat, Power System Analysis Mc Graw Hill Education, 1st Edition, 2002

WEB LINKS:

1. https://nptel.ac.in/courses/108105067
2. https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/
3. https://www.classcentral.com/course/swayam-power-system-analysis-14243
4. https://onlinecourses.nptel.ac.in/noc22_ee17
5. https://www.udemy.com/course/electrical-power-engineering

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO53.1	3	2	2	-	-	-	1	-	-	-	-	2	1	2	-
CO53.2	3	2	2	-	-	-	1	-	-	-	-	2	1	2	-
CO53.3	3	2	2	-	-	-	1	-	-	-	-	2	1	2	-
CO53.4	3	2	2	-	-	-	1	-	-	-	-	2	1	2	-
CO53.5	3	-	2	-	-	-	1	-	-	-	-	2	1	2	-

SEMESTER – IV

Course: Auto CAD

Course Code	22EEEL54	CIE Marks	50
Hours/Week (L: T: P)	1: 0: 2	SEE marks	50
No. of Credits	2	Examination Hours	03

Prerequisites: Electrical Machines-I and II, Power Systems-I and II.

Course Objectives:

CLO1	To discuss the terminology of DC and AC armature windings.
CLO2	To discuss design and procedure to draw armature winding diagrams for DC and AC machines.
CLO3	To discuss the substation equipment, their location in a substation and development of a layout for substation.
CLO4	To discuss different sectional views of transformers, DC machine, its parts and alternator and its parts.
CLO5	To explain development of sectional views of Transformers, DC machine and alternators using the design data, and sketches

Content	No. of Hours/ RBT levels
Module 1: Winding Diagrams **Winding Diagrams:** (a). Developed Winding Diagrams of D.C. Machines: Simplex Double Layer Lap and Wave Windings. (b). Developed Winding Diagrams of A.C. Machines: (c). Integral and Fractional Slot Double Layer Three Phase Lap and Wave Windings.	8 hours L3
Module 2: Single Line Diagrams **Single Line Diagrams:** Single Line Diagrams of Generating Stations and Substations Covering Incoming Circuits, Outgoing Circuits, Busbar Arrangements (Single, Sectionalised Single, Main and Transfer, Double Bus Double Breaker, Sectionalised Double Bus, One and a Half Circuit Breaker Arrangement, Ring Main),Power Transformers, Circuit Breakers, Isolators,Earthing Switches,Instrument Transformers, Surge or Lightning Arresters, Communication Devices (PowerLine Carrier) and Line Trap	8 hours L3
Module 3: Electrical Machine Assembly Drawings Using Design Data, Sketches or Both Electrical Machine Assembly Drawings Using Design Data, Sketches or Both: Transformers – Sectional Views Of Single And Three Phase Core And Shell Type Transformers	8 hours L3
Module 4: Electrical Machine Assembly Drawings Using Design Data, Sketches or Both Electrical Machine Assembly Drawings Using Design Data, Sketches or Both: D.C. Machine – Sectional Views of Yoke with Poles, Armature and Commutator dealt separately	8 hours L3
Module 5: Electrical Machine Assembly Drawings Using Design Data, Sketches or Both Electrical Machine Assembly Drawings Using Design Data, Sketches or Both: Alternator – Sectional Views of Stator and Rotor dealt separately.	8 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO54.1	Discuss the terminology and types of DC and AC armature windings.
CO54.2	Develop armature winding diagram for DC and AC machines
CO54.3	Develop a layout for substation using the standard symbols for substation equipment. .
CO54.4	Draw sectional views of core and shell types transformers using the design data.
CO54.5	Draw sectional views of assembled DC machine and alternator or its parts using the design data or the sketches.

Textbooks:

1. Performance & Design of Alternating Current machines, M. G. Say, CBS publishers,3rd Edition,2002.
2. The Performance & Design of DC machines A.E Clayton & N.N.Hancock CBS Publication,3rd Edition,2004.

Reference books:

1. A course in Electrical Machine design A. K. Sawhney DhanpatRai 6th Edition, 2013
2. Electrical Engineering Drawing K. L. Narang SatyaPrakashan 2014

E-Books / Web References

1. https://images.autodesk.com/adsk/files/autocad_aca_user_guide_english.pdf
2. https://static.sdcpublications.com/pdfsample/978-1-63057-339-3-1-cw77gw9lwo.pdf
3. https://iastate.pressbooks.pub/visualgraphiccomm/chapter/chapter-1/

MOOCs

https://www.my-mooc.com/en/video/autocad-complete-tutorial-for-beginners-part-1/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO54.1	2	2	-	-	3	-	-	-	-	-	-	-	3	3	-
CO54.2	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-
CO54.3	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-
CO54.4	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-
CO54.5	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-
22EEEL54	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-

SEMESTER – V

Course: Object Oriented Programming Using C++ (Program Elective)

Course Code	22EEE55A	CIE Marks	50
Hours/Week (L: T: P)	4:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Basic knowledge of C programming

Course Objectives:

CLO1	Solve the problem with object-oriented approach.
CLO2	Analyze the problem statement and build object-oriented system model
CLO3	Describe the characters and behavior of the objects that comprise a system
CLO4	Explain function overloading, operator overloading and virtual functions.
CLO5	Define encapsulation, inheritance and polymorphism

Content	No. of Hours/ RBT levels
Module 1: Beginning with C++ and its Features Applications of C++, structure of C++ program, Variables, Different Operators, expressions, C++ statements, basic data types, derived data types, user defined data types, storage classes, dynamic initialization of variables, memory management operators, manipulators, type cast operator, implicit conversions, control structures in C++ , functions	8 hours L2
Module 2: Function overloading , Classes and Objects Function overloading, inline functions ,recursive functions Specifying a class, C++ program with a class, arrays within a class, memory allocation to objects, array of objects, objects as function arguments ,returning objects, static data members, static member functions, nested class	8 hours L3
Module 3: Constructors, Destructors and Operator Overloading Constructors, parameterized constructors, multiple constructors in a class, Dynamic initialization of objects, copy constructor, constructing two dimensional arrays, Destructors, operator overloading, Overloading Unary and binary operators, Manipulation of strings using operators	8 hours L3
Module 4: Inheritance, Pointers, Virtual Functions, Polymorphism Derived Classes, Single inheritance, multilevel inheritance, multiple inheritance, hierarchical inheritance, hybrid inheritance, virtual base classes ,abstract classes, constructors in derived classes, pointers to objects, this pointer, Virtual and pure virtual functions	8 hours L3
Module 5: Streams and Working with Files C++ streams and stream classes, formatted and unformatted I/O operations, managing output with manipulators, Classes for file stream operations, opening and closing a file, Detecting End of File, File modes, sequential input and output operations, updating a file.	8 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO55A.1	Build the basic knowledge of object-oriented programming.
CO55A.2	Introduce the concept of classes, objects and their significance in real world.
CO55A.3	Apply the concept of constructors, destructors and operator overloading in programs
CO55A.4	Apply the concept of data hiding, inheritance, virtual functions.
CO55A.5	Utilize I/O operations and file streams in programs.

Textbooks:

1 Object Oriented Programming with C++ E.Balaguruswamy TMH 6th Edition, 2013

Reference books:

1. Object Oriented Programming with C++ Robert Lafore Galgotia publication 2010
2. Object Oriented Programming with C++ Sourav Sahay Oxford University 2006

E-Books / Web References

https://www.educative.io/courses/

https://www.pdfdrive.com/title-of-the-subject-object-oriented-programming-using-c-e17429149.html

MOOCs
1 http://udemy.com
2.http://coursera.com

Scheme of Examination:
Semester End Examination (SEE):
SEE **Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50.** There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**
Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.
CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO55A.1	3	2	2	-	1	-	-	-	-	-	-	3			3
CO55A.2	3	2	2	-	1	-	-	-	-	-	-	3			3
CO55A.3	3	2	2	-	1	-	-	-	-	-	-	3			3
CO55A.4	3	2	2	-	1	-	-	-	-	-	-	3			3
CO55A.5	3	2	2	-	1	-	-	-	-	-	-	3			3
Average	3	2	2		1							3			3

SEMESTER – V

Course: Embedded System (Professional Elective Course – I)

Course Code	22EEE55B	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Basic Knowledge of C Programming

Course Objectives:

CLO1	Learn the architecture and features of 8-bit 8051 microcontroller.
CLO2	Develop the embedded C programs for the given applications using 8051 microcontrollers.
CLO3	Understand 32-bit ARM controller
CLO4	Describe different blocks of Embedded System.
CLO5	Know the current trends and applications of embedded systems in industry

Content	No. of Hours/ RBT levels
Module 1:8051 Microcontrollers Introduction to Embedded system, Microcontroller, Comparison of Microprocessor and Microcontroller, Intel MCS 51 family, Architecture and Pin Functions of 8051 Microcontroller, CPU Organization, Program Counter, Internal and external Memory Organization, Registers, Stack operation Data types available in embedded C, time delay functions in 8051C	8 hours L2
Module 2: 8051 Microcontroller Based System Design Input/Output Ports, I/O Port Programming in 8051C, Logic operations in 8051 C, Data conversion program in 8051 C, Data serialization using 8051C, Timers and counters, modes of operation of timers, Programming timers in 8051C.	8 hours L3
Module 3: 8051 interrupts and ARM-32bit Microcontroller Serial communication, serial port programming in 8051 C, Interrupt Service Routines Programming in C, Interfacing DAC, stepper motor interfacing, DC motor interfacing and PWM. **Architecture of ARM Cortex M3** –General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Register. Advanced Programming Features.	8 hours L3
Module 4: Typical Embedded System Definition, Embedded systems vs. General Computing Systems, Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components, PCB and Passive Components.	8 hours L3
Module 5: Trends in the Embedded Industry Processor trends in embedded system, Embedded OS trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks. Embedded Systems-Application and Domain Specific: Washing Machine-application specific Embedded System, Automotive- Domain Specific Example of Embedded Systems Design Case Studies: Digital camera, Embedded Systems in Automobile, Smart Card Reader, Automated Meter Reading System.	8 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO55B.1	Describe the architecture and features of 8-bit 8051 microcontroller.
CO55B.2	Apply the knowledge of embedded C for writing the programs using 8051 microcontroller.
CO55B.3	Explain 32-bit ARM controller and its features
CO55B.4	Describe different blocks of Embedded System
CO55B.5	Understand domain specific applications of embedded systems through case studies

Textbooks:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C, Muhammad Ali Mazadi, Pearson, 2 nd Edition, 2008
2. Shibu K V, " to Embedded Systems", First Edition, Tata McGraw Hill Education Private Limited, 2009
3. Joseph Yiu,"The Definitive Guide to the ARM Cortex-M3", Second Edition, Newnes, (Elsevier), 2008

Reference books:

1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design", edition, Mc Graw Hill, 2012
2. James K Peckol "Embedded Systems – A contemporary Design Tool", edition, John Weily, 2008

E-Books / Web References

1. https://onlinecourses.nptel.ac.in/noc20_cs15/course

MOOCs

1 https://nptel.ac.in/course/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO55B.1	3	3	1	-	3	-	-	-	-	-	-	3	-	-	3
CO55B.2	3	3	1	-	3	-	-	-	-	-	-	3	-	-	3
CO55B.3	3	3	1	-	3	-	-	-	-	-	-	3	-	-	3
CO55B.4	3	3	1	-	3	-	-	-	-	-	-	3	-	-	3
CO55B.5	3	3	1	-	3	-	-	-	-	-	-	3	-	-	3
Average	3	3	1	-	3	-	-	-	-	-	-	3	-	-	3

SEMESTER – V

Course: Digital System Design using Verilog HDL

Course Code	22EEE55C	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Digital system design

Course Objectives:

CLO1	Learn different modelling concepts in Verilog HDL
CLO2	Verilog based modeling of digital circuits using Gate Level and Data flow styles
CLO3	Understand Behavioral modeling, Tasks and Functions in Verilog
CLO4	Developing the Digital Circuit Applications
CLO5	Logic Synthesis and its effects in Verification of digital circuits.

Content	No. of Hours/ RBT levels
Module 1: Overview of Digital Design with Verilog HDL and Hierarchical Modeling Concepts Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, trends in HDLs. Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. Basic Concepts: Lexical conventions, data types, system tasks, compiler directives. Modules and Ports: Module definition, port declaration, connecting ports. Hierarchical Names.	08 Hours/ L1, L2
Module 2: Gate level and dataflow modeling Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types.	08 Hours/ L1, L2,L3
Module 3: Behavioral Modeling, Tasks and Functions Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements, delay control, Timing Control, conditional statements, Multiway branching, loops. Tasks and Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions.	08Hours/ L1, L2,L3
Module 4: Design examples and State Machine Charts BCD to 7 segment Display Decoder, Traffic Light Controller, Synchronization and Debouncing, Shift and Add Multiplier, Binary Divider State Machine Charts: SM Charts, Derivation of SM Charts, Realization of SM Charts. Implementation of Dice Game.	8 Hours/ L1, L2, L3
Module 5: Useful Modeling Techniques and Logic Synthesis with Verilog Useful Modeling Techniques: Procedural Continuous Assignments, Overriding Parameters, Conditional Compilation and Execution, Useful System Tasks. Logic Synthesis with Verilog: Logic Synthesis, Impact of Logic Synthesis, Verilog HDL Synthesis, Synthesis Design Flow and Verification of Gate Level Netlist.	8 hours L1,L2,L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO55C.1	Analyze the Verilog programs using different abstract levels.
CO55C.2	Design and Verify the functionality using test benches.
CO55C.3	Develop a Verilog program with tasks and functions.
CO55C.4	Apply the SM Charts to realize the digital circuits.
CO55C.5	Interpret the verification of digital circuit using logic synthesis

Textbooks:

1.Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition.
2.Charls H. Roth Jr, Lizy K, John and Byeong K. Lee, Digital Systems Design Using Verilog, 1
St Edition, Cengage Learning, 2016.

Reference books:

1. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL" Pearson (Prentice Hall), Second edition.
2. Peter J. Ashenden, Digital Design: An Embedded Systems Approach using Verilog,1 st Edition, Elsevier, 2015
3. Stephen Brown and Zvonkoc Vranesic, Fundamentals of Digital Logic with Verilog Design, 1st Edition, Mc-Graw-Hill Publication, 2003.

E-Books /Web References:

1.https://www.mitzon.com/mooc/digital-design-using-verilog-hdl-programming-with- practical/
2.https://www.coursera.org/learn/fpga-hardware-description-languages

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping																
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO55C.1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO55C.2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO55C.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO55C.4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO55C.5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
Average	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-

SEMESTER V

Course: Electromagnetic Field Theory

Course Code	22EEE55D	CIE Marks	50
Hours/Week (L: T: P)	2:2:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Engineering Mathematics, Fundamentals of Electrical Engineering

Course Objectives:

CLO1	Understand different coordinate systems for understanding the concept of gradient,divergence and curl of a vector.
CLO2	Understand the application of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations.
CLO3	Evaluate the energy and potential due to a system of charges.
CLO4	Explain the behavior of electric field across a boundary between a conductor and dielectricand between two different dielectrics.
CLO5	Understand the time varying fields and Maxwell`s equations.

Content	No. of Hours/ RBT levels
Module 1: Vector Analysis and Electrostatics **Vector Analysis:** Scalars and Vectors, Vector algebra, Cartesian co-ordinate system, Vector components and unit vectors. Scalar field and Vector field. Dot product and Cross product, Gradient of a scalar field. Divergence and Curl of a vector field. Co – ordinate systems: cylindrical and spherical, relation between different coordinate systems. Expression for gradient, divergence, and curl in rectangular, cylindrical and spherical co-ordinate systems. Problems. **Electrostatics:** Coulomb's Law and electric field intensity: Experimental law of Coulomb, Electric field intensity, Types of charge distributions. Field due to variouscharge distributions-Line charges, Surface charge, Volume charge. Fields due to infinite line charge, charged circular ring, infinite sheet charge. **Electric flux density, Gauss' law, and divergence:** Electric flux and flux density, Fluxdensity for various charge distributions-Line charge, surface charge, volume charge. Gauss' law, Divergence, Maxwell's First equation (Electrostatics), vector operator and divergence theorem.	8 hours L1, L2, L3
Module 2: Energy, potential, Conductors and Dielectrics **Energy and potential:** Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and Potential, The potential field of a point charge and system of charges, Potential gradient, Energydensity in an electrostatic field. Conductors and dielectrics: Current and current density, Continuity of current, metallic conductors, Conductor properties and boundary conditions, boundary conditions for perfect Dielectrics.	10 Hours L2, L3, L4 etc.
Module 3: Poisson`s and Laplace`s equation and Steady magnetic fields Poisson's and Laplace's equations: Derivations of Poisson's and Laplace's Equations. Examples of the solutions of Laplace's and Poisson's equations. Steady magnetic fields: Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and Vector magnetic potentials.	8 hours L1, L2, L3
Module 4: Magnetic Forces and Materials Magnetic forces and materials: Force on a moving charge and differential current element, Force between differential current elements, Force and torque on a closed circuit. Magnetic materials: Magnetization and permeability, Magnetic boundary conditions, Magnetic circuit, Potential energy and forces on magnetic materials.	8 hours L1, L2, L3, L4
Module 5: Time Varying fields and Maxwell`s equations Time varying fields and Maxwell's equations: Faraday's law, displacement current, General field relations for time varying Electric and Magnetic fields. Maxwell's equation in point and Integral form.	8 hours L1, L2, L3, L4

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO55D.1	Understand different coordinate systems, Coulomb's Law and Gauss Law for differentcharge configurations.
CO55D.2	Calculate the energy and potential due to a system of charges with boundaryconditions.
CO55D.3	Explain the Poisson's, Laplace equations and behaviour of steady magnetic fields.
CO55D.4	Explain the behaviour of magnetic fields and magnetic materials.
CO55D.5	Apply Maxwell`s equations for time varying fields.

Textbooks:

1. Engineering Electromagnetics, William H Hayt Jr. and John A Buck, Tata McGraw-Hill, 7thedition, 2006.
2. Elements of electromagnetics, Matthew NO Sadiku Oxford university press, 3rd edition,2007.

Reference books:

1. Electromagnetics with Applications, John Krauss and Daniel A Fleisch, McGraw-Hill, 5th edition, 1999.
2. Electromagnetic Waves And Radiating Systems, Edward C. Jordan and Keith G Balmain,Prentice – Hallof India / Pearson Education, 2nd edition, 1968.Reprint 2002.
3. Field and Wave Electromagnetics , David K Cheng, Pearson Education Asia, 2nd edition, - 1989, Indian Reprint – 2001.
4. Electromagnetics, J A Edminister Tata McGrawhill, Schaum' s outlines, IInd Edition 2006

E-Books / Web References

1. https://ocw.mit.edu/resources/res-6-002-electromagnetic-field-theory-a-problem-solving-approach-spring-2008/textbook-contents/
2. https://physics.bgu.ac.il/~gedalin/Teaching/Mater/EMFT_Book.pdf
3. https://vtechworks.lib.vt.edu/handle/10919/84164
4. https://engineering.purdue.edu/wcchew/ece604f19/EMFTAll20191204.pdf

MOOCs

1. https://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/2. https://nptel.ac.in/courses/108/106/108106073/
3. https://www.coursera.org/learn/electrodynamics-electric-magnetic-fields
4. https://www.edx.org/course/electricity-and-magnetism-maxwells-equations

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO55D.1	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-
CO55D.2	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO55D.3	3	2	-	-	-	-	-	-	-	-	-	-	3	3	-
CO55D.4	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
CO55D.5	3	2	-	-	-	-	-	-	-	-	-	1	3	3	-
Average	3	2	-	-	-	-	-	-	-	-	-	1	3	3	-

SEMESTER –VI

COURSE: MINI PROJECT

Course Code	22EEEP56	CIE Marks	50
Hours/Week (L: T: P)	0:0:4	SEE Marks	50
No. of Credits	2	Examination Hours	03

Mini-project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-Project:

a. Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

b. Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college. The CIE marks awarded for the Mini- Project shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-Project:

a. Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

b. Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong.

Typical Evaluation pattern for regular courses is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	50	50
	Review-2		
SEE	Semester End Examination	50	50
Grand Total			100

SEMESTER – V

Course: Research Methodology and IPR

Course Code	22RMIK57	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Course Objectives: To enable students to apply the knowledge of Research Methodology in broad domain of Electrical and Electronics engineering by making them to learn:

CLO1	To make the student understand the foundations of Research and problem solution
CLO2	Knowledge in Research design, Qualitative and Quantitative Research
CLO3	Knowledge to formulate and derive static and dynamic aero elastic equations of motion.
CL04	To understand the different types of IPR

Content	No. of Hours/ RBT levels
Module 1 **RESEARCH METHODOLOGY:** Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. **DEFINING THE RESEARCH PROBLEM:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration	08 Hours/ L3
Module 2 **REVIEWING THE LITERATURE:** Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, broadening knowledge base in research area, enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, developing a conceptual framework, writing about the literature reviewed. **RESEARCH DESIGN:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs	08 Hours/ L3
Module 3 **DESIGN OF SAMPLE SURVEYS:** Design of Sampling: Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. **MEASUREMENT AND SCALING:** Qualitative and Quantitative Data, **DATA COLLECTION:** Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.	08 Hours/ L3
Module 4 **TESTING OF HYPOTHESES:** Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. **INTERPRETATION AND REPORT WRITING:** Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	08 Hours/ L3

Module 5	
INTELLECTUAL PROPERTY: Principles of IPR, Kinds of IPR, Patent- Concepts, Novelty, Utility Inventiveness/Non-obviousness, Procedure for granting and obtaining patents; Copyright- conditions for grant of copyright, Copyright in Literary, Dramatic and Musical ,Works, Sound Recording, Cinematograph Films, Copyright in Computer Programme, Author Special Rights, Right of Broadcasting and performers, Trademark Law and Practices - Procedure of registration of trademark; Emerging Issues and Challenges; Few Future Aspects of Intellectual Property Rights;	**08 Hours/ L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand the research problem by literature review to solve problems
CO2	Develop skills in qualitative and quantitative data analysis and presentation.
CO3	Develop advanced critical thinking skills.
CO4	Understand to write the report writing and awareness about IPR

Textbooks:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
4. Lionel Bently., Brad Sherman-Intellectual Property Law, 3rd Edition

Reference books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
4. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for **100 marks and the marks scored will be proportionately reduced to 50.** There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

SEMESTER – V

Course: Environmental Studies

Course Code	22CIVK58	CIE Marks	50
Hours/Week (L: T: P)	2:0:0	SEE Marks	50
No. of Credits	2	Examination Hours	3

Prerequisites:

Course **Objectives:** Students will be taught:

CLO1	To understand ecosystem functions and 17 SDG's for sustainable development
CLO2	To understand advanced energy systems and natural resource management.
CLO3	To understand about pollution and waste management solutions and laws
CLO4	To understand global environmental issues, related policies and solutions through case studies
CLO5	To understand key environmental legislation related to water, air, waste and environmental protection.

Content	No. of Hours/ RBT levels
Module 1 – Ecosystem and Sustainability Ecosystems (Structure and Function): Forest, Desert, Wetlands, River, Oceanic and Lake. Sustainability: 17 SDGs-History, targets, implementation, Capacity Development	6 Hours L2
Module 2 - Natural Resource Management Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind. Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining - case studies and Carbon Trading	6 Hours L2
Module 3 – Environmental Pollution & Waste Management Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution. Waste Management: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge	6 Hours L2
Module 4 - Global Environmental Issues Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology	6 Hours L2
Module 5 – Environmental Legislation Environmental Legislation: Water Act 1974, Air Act 1981, Environmental Protection Act 1984, Solid Waste Management Rules-2016, E- Waste management Rule - 2022, Biomedical Waste management- 2016	6 Hours L2

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

22CIVK58.1	**Analyze** ecosystem dynamics to formulate strategies for addressing sustainability challenges and implementing the SDGs.
22CIVK58.2	**Evaluate** energy technologies to design effective resource management strategies.
22CIVK58.3	**Evaluate** the impacts of pollution to develop effective waste management strategies.
22CIVK58.4	**Evaluate** global environmental issues to design solutions for sustainable management.
22CIVK58.5	**Interpret** environmental laws and regulations for sustainable management practices.

Textbooks:

1. Environmental studies, Benny Joseph, Tata Mcgraw-Hill 2nd edition 2012
2. Environmental studies, S M Prakash, pristine publishing house, Mangalore 3rd edition-2018

References:

1. Benny Joseph, Environmental studies, Tata Mcgraw-Hill 2nd edition 2009
2. M.Ayi Reddy Textbook of environmental science and Technology, BS publications 2007
3. Dr. B.S Chauhan, Environmental studies, university of science press 1st edition

Web Reference:

https://www.hzu.edu.in/bed/E%20V%20S.pdf
https://onlinecourses.nptel.ac.in/noc23_hs155/preview
https://onlinecourses.swayam2.ac.in/cec19_bt03/preview

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of three test marks will be added to test component. CIE is executed by way of two quizzes/Alternate Assessment Tools(AAT's), some possible AAT's: Seminar/ assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**100**	**50**
Grand Total			**100**

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
22CIVK58.1	2					1	1	1							3
22CIVK58.2	2	2	2			1	3	1							3
22CIVK58.3		2	2	2		1	3	1							2
22CIVK58.4		2	2	2		1	3	1							2
22CIVK58.5	1	2	2	2		1	2	1							2
Average	**1.67**	**2**	**2**	**2**		**1**	**2.4**	**1**							**2.4**

SCHEME

VI Semester 2022
Scheme and Syllabus

Electrical & Electronics Engineering

Autonomous Institute Affiliated to VTU, Belagavi
Approved by AICTE and Accredited by NAAC with A grade
NBA Accredited CS, E&C, E&E, CIV, MECH and IS branches) Ideal Homes Township,

Department of Electrical and Electronics Engineering

Global Academy of Technology
HOD, EEE
Bangalore-98

Global Academy of Technology

(An Autonomous Institution, affiliated to VTU, Belagavi, recognized by Karnataka and Approved by AICTE, New Delhi.)

B.E. in Electrical & Electronics Engineering Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22EEE61	Internet of Things and its Applications	TD:EEE PSB:EEE	2	2	2		03	50	50	100	4
2	PCC	22EEE62	Power Systems III	TD:EEE PSB:EEE	3	2	0		03	50	50	100	4
3	PEC	22EEE63X	Professional Elective - II	TD:EEE PSB:EEE	3	0	0		03	50	50	100	3
4	OEC	22EEE64X	Open Elective -I	TD:EEE PSB:EEE	3	0	0		03	50	50	100	3
5	PROJ	22EEEP65	Major Project Phase - I	TD:EEE PSB:EEE	0	0	4		03	100	--	100	2
6	PCCL	22EEEL66	Power System Simulation Lab	TD:EEE PSB:EEE	0	0	2		03	50	50	100	1
7	AEC/ SDC	22EEE67X	Ability Enhancement Course/ SkillDevelopment Course - III	TD & PSB: EEE	If the course is offered as a Theory: 1	0	0		01	50	50	100	1
					If course is offered as a practical: 0	0	2						
8	MC	22NSK68	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		22PEK68	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YOK68	Yoga	Yoga Teacher									
9	IKS	22IKSK69	Indian Knowledge System		1	0	0		01	50	50	100	0
10	MC	22UHV69	Universal Human Values	Any Department	1	0	0		01	50	50	100	0
									Total	**600**	**400**	**1000**	**18**

H.C. Rajashekar Theas
Dean Academic
Global Academy of Technology,
Rajarajeshwarinagar, Bengaluru-98

HOD, EEE

Professional Elective Course			
22EEE63A	**Artificial Intelligence**	22EEE63C	**VLSI Design**
22EEE63B	**Micro grids**	22EEE63D	**Industrial Drives and its Applications**
Open Elective Course			
22EEE64A	Electric Vehicles	22EEE64C	Utilization of Electrical Power
22EEE64B	Industrial Automation	22EEE64D	Technologies of Renewable Energy Sources
Ability Enhancement Course / Skill Enhancement Course - III			
22EEE67A	Embedded Systems Lab	22EEE67C	Energy Audit Project
22EEE67B	Simulation of Control of Power Electronic Circuits	22EEE67D	Project on Renewable Energy Sources

PCC: Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course (Non-credit), **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ:** Project /Mini Project. **PEC:** Professional Elective Course. **PROJ:** Project Phase -I, **OEC:** Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulationgoverning the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

SEMESTER – VI

Course: Internet of Things and its Applications

Course Code	22EEE61	CIE Marks	50
Hours/Week (L: T: P)	2:2:2	SEE Marks	50
No. of Credits	4	Examination Hours	03

Prerequisites: Python programming

Course Objectives:

CLO1	Understand the basics and necessity of IoT.
CLO2	Explain the system management protocols and design methodology in IoT
CLO3	Use Raspberry Pi for interfacing applications
CLO4	Understand the basics of cloud computing and execute the programs using cloud
CLO5	Discuss the cloud application design methodologies

Content	No. of Hours/ RBT levels
Module 1: Introduction to Internet of Things (IoT) Introduction, Physical design of IoT, Logical design of IoT, IoT Enabling Technologies, IoT Levels & Deployment Templates. Domain Specific IoTs: Home automation, smart parking, weather monitoring, smart vending machines, remote vehicle diagnostics, machine diagnosis and prognosis, wearable electronics IoT and M2M, Difference between IoT and M2M, SDN and NFV for IoT, software defined networking, network function virtualization.	8 / L3
Module 2: IoT system management and Platform Design methodology Need for IoT systems management, simple network management protocol (SNMP), limitations of SNMP, network operator requirements, NETCONF, YANG, IoT systems management with NETCONF-YANG, NETOPEER IoT Design Methodology, Case study on IoT system for weather monitoring	8 / L3
Module 3: IoT Physical Devices Basic building blocks of an IoT device, Raspberry Pi board, Raspberry Pi interfaces-serial, SPI, I2C, Programming Raspberry Pi with Python-controlling LED with Raspberry Pi, interfacing an LED and switch with Raspberry Pi, Interfacing a light sensor (LDR) with Raspberry Pi, other IoT Devices	8 / L3
Module 4: Cloud computing Introduction to cloud computing, characteristics of cloud computing, cloud models, cloud services examples, cloud-based services and applications, cloud concepts and technologies-virtualization, load balancing, scalability and elasticity, deployment, replication, monitoring, software defined networking network function virtualization, MapReduce, identity and access management, service level agreements, billing	8 / L3
Module 5: Cloud application design methodologies Introduction, design considerations for cloud applications- scalability, reliability and availability, security, maintenance and upgradation, performance, Reference architectures for cloud applications, Cloud application design methodologies-service oriented architecture, cloud component mode, IaaS, PaaS and SaaS services for cloud applications, model view controller, RESTful web services, Data storage approaches-Relational (SQL) approach, Non-relational (non-SQL) approach	8 / L3

Sl. No.	Experiments	No. of Hours/

		RBT levels
1	Write a program to interface RGB LED to ESP32 and execute to test the output	2 hours/ L3
2	Write a program to interface IR/LDR with ESP32 and to turn on LED after sensor detection.	2 hours/ L3
3	Write a program to interface DC Motor to ESP32 and control the direction of rotation.	2 hours/ L3
4	Write a program for turning on LED using Bluetooth and ESP32.	2 hours/ L3
5	Demonstrate, reading the ultrasonic sensor data to smartphone using Bluetooth, which is interfaced to ESP32.	2 hours/ L3
6	Write a program for reading Temperature and Humidity using DTH sensor interface to ESP32, display the data on serial monitor.	2 hours/ L3
7	Write a Program for displaying the "Hello World" on OLED using ESP32.	2 hours/ L3
8	Write a program for reading Temperature and Humidity using DTH11 sensor, interfaced to SP32, display the data on OLED.	2 hours/ L3
9	Demonstrate, reading Temperature and Humidity using DTH11 sensor, interfaced to ESP32, display the data on Things Speak cloud.	2 hours / L3
10	Write a program to interface RGB LED to Raspberry Pi Pico and execute to test the output	2 hours / L3
11	Write a program to interface Pushbutton with an LED for Raspberry Pi Pico and execute to test the output.	2 hours/ L3
12	Write a program to interface Relay for Raspberry Pi Pico and execute to test the output.	2 hours / L3
13	Write a program on Raspberry Pi to publish temperature data to MQTT broker.	2 hours / L3
14	Write a program to create TCP server on Raspberry Pi and respond with humidity data to TCP client when requested.	2 hours / L3
15	Write a program to create UDP server on Raspberry Pi and respond with humidity data to UDP client when requested.	2 hours / L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO61.1	Understand the fundamentals and applications of IoT.
CO61.2	Describe the system management and design methodology in IoT
CO61.3	Use Raspberry Pi and ESP32 for interfacing applications
CO61.4	Explain the basics of cloud computing and execute the programs with cloud
CO61.5	Discuss the cloud application design methodologies

TEXTBOOKS:

1. Arshdeep Bahga, "Internet of Things - A hands on approach", 2018,universities press.
2. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-on Approach", 2013 universities press.

REFERENCE BOOKS:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
2. Interconnecting Smart Objects with IP- J. P Vasseur, Adam Dunkels, 2010
3. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, "Internet ofThings: Architectures, Protocols and Standards", ISBN: 978-1-119-35967.

E Books: IoT-From Research and Innovation to Market Deployment_IERC

MOOCs: Introduction to Arduino Uno by IIT Kharagpur
https://www.youtube.com/watch?v=NkZdosZH6Wo

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

1.

2. **Table: Distribution of weightage for CIE & SEE of Integrated courses**

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO61.1	3	1	1	-	3	-	-	3	3	3	-	2	-	-	2
CO61.2	3	1	1	-	3	-	-	3	3	3	-	2	-	-	2
CO61.3	3	1	1	-	3	-	-	3	3	3	-	2	-	-	2
CO61.4	3	1	1	-	3	-	-	3	3	3	-	2	-	-	2
CO61.5	3	1	1	-	3	-	-	3	3	3	-	2	-	-	2
22EEE61	3	1	1	-	3	-	-	3	3	3	-	2	-	-	2

VI SEMESTER

Course: Power System III

Subject Code	22EEE62	CIE Marks	50
Hours/Week (L:T:P)	3:2:0	SEE Marks	50
Credits	4	Examination Hours	03

Prerequisites:

Course Learning Objectives: At the end of the course the student should be able to:

CLO1	Discuss performance of protective relays, components of protection scheme and relay terminology.
CLO2	Discuss construction, operating principles and performance of various distance and differential relays.
CLO3	Explain the principle of circuit interruption and different types of circuit Breakers and fuses
CLO4	Discuss generation of high voltages and currents and their measurement
CLO5	Understand Non-Destructive Testing of Materials and Electrical Apparatus

Content	No. of Hrs/ RBT levels
MODULE I – Introduction to Power System Protection Need for protective schemes, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection, Performance of Protective Relaying, Classification of Protective Relays, Electromechanical Relays, Static Relays – Merits and Demerits of Static Relays, Numerical Relays, Comparison between Electromechanical Relays and Numerical Relays. **Overcurrent Protection:** Introduction, Time – current Characteristics, Current Setting, Time Setting. Overcurrent Protective Schemes, Reverse Power or Directional Relay, Protection of Parallel Feeders, Protection of Ring Mains, Earth Fault and Phase Fault Protection, Phase Fault Protective Scheme, Directional Earth Fault Relay.	08 Hours/ L3
MODULE II – Distance & Differential Protection **Distance Protection:** Impedance Relay, Reactance Relay, Mho Relay, Reach of Distance Relays. **Differential Protection**: Differential Relays, Simple Differential Protection, Percentage or Biased Differential Relay, Differential Protection of 3 Phase Circuits, Balanced (Opposed) Voltage Differential Protection. Protection of Generators, Transformer Protection, Bus zone Protection, Frame Leakage Protection.	08 Hours/ L3
MODULE III – Circuit Breakers & Fuses Introduction, Fault Clearing Time of a Circuit Breaker, Arc Voltage, Arc Interruption, Restriking Voltage and Recovery Voltage, Current Chopping, Interruption of Capacitive Current, Classification of Circuit Breakers, Air – Break Circuit Breakers, Oil Circuit Breakers, Air – Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers, High Voltage Direct Current Circuit Breakers, Rating of Circuit Breakers, Testing of Circuit Breakers. Types of Fuses, Applications of HRC Fuses, Selection of Fuse.	08 Hours/ L3
MODULE IV – Generation of High Voltage & Current and their Measurement Generation of High Voltages and Currents: Generation of High Direct Current Voltages, Generation of High Alternating Voltages, Generation of Impulse Voltages, Generation of Impulse Currents, Tripping and Control of Impulse Generators. Measurement of High Voltages and Currents: Measurement of High Direct Current Voltages, Measurement of High AC and Impulse Voltages, Measurement of High Currents – Direct, Alternating and Impulse, Cathode Ray Oscillographs for Impulse Voltage and Current Measurements. Sphere gap for measurement of high voltages. Effect of atmospheric conditions on measurements using sphere gap.	8 Hours/ L3
MODULE V – Non-Destructive Testing of Materials and Electrical Apparatus Introduction, Measurement of Dielectric Constant and Loss Factor, Partial Discharge Measurements. High Voltage Testing of Electrical Apparatus: Testing of Insulators and Bushings, Testing of Isolators and Circuit Breakers, Testing of Cables, Testing of Transformers, Testing of Surge Arrestors, Radio Interference Measurements, Testing of HVDC Valves and Equipment	8 hours L3
Total Hours	**40 Hours**

	Content	No. of Hours/ RBT levels
1.	IDMT characteristics of electromechanical type over-current relay.	2 hours/L3
2.	Operating characteristics of electromechanical type over-voltage relay.	2 hours/L3
3.	Operating characteristics of microprocessor based (numeric) over-current relay for feeder protection.	2 hours/L3
4.	Operating characteristics of microprocessor based over/under voltage relay.	2 hours/L3
5.	Operating characteristics of Microprocessor based overcurrent relay.	2 hours/L3
6.	Overload protection, high set over current protection. Earth fault protection of motor using microprocessor-based relay SPAM 150C.	2 hours/L3
7.	Measurement of HVAC and HVDC using Standard Spheres.	2 hours/L3
8.	Spark-over characteristics of air insulation subjected to (HVDC & HVAC) with spar-over characteristics corrected to STP for uniform and non-uniform field configuration.	2 hours/L3
9.	Generation Protection using Merz Prize Protection.	2 hours/L2
10.	Breakdown strength of transformer oil using oil-testing kit.	2 hours/L2

Course Outcomes: The students will be able to:

CO62.1	Understand the performance of protective relays, components of protection scheme and relay terminology over current protection.
CO62.2	Apply distance and differential relays for the protection of generators & transformers.
CO62.3	Explain the construction and operation of different types of circuit breakers and fuses.
CO62.4	Summarize generation of high voltages & currents and their measurements.
CO62.5	Understand non-destructive testing of materials and electric apparatus, high-voltage testing of electric apparatus.

TEXTBOOKS:

1. Badri Ram, D.N.Vishwakarma, Power System Protection and Switchgear , Mc Graw Hill Education, Second Editiion, 2008
2. M.S. Naidu, Kamaraju , High Voltage Engineering, McGraw Hill Education; 5th edition , 2013

REFERENCES:

1. N. Veerappan S.R.Krishnamurthy, Power System Switchgear and Protection, S Chnd, First Edi. 2009
2. E. Kuffel, W.S. Zaengl, J. Kuffel, High Voltage Engineering Fundamentals, Newnes, 2nd Edition, 2000
3. Wadhwa C.L, High Voltage Engineering, New Age International, 3rd Edition 2012

WEBLINKS;

1. https://nptel.ac.in/courses/108107167
2. -https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring- 2011/

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

3. Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO/PSO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO62.1	3	2	-	1	-	1	1	2	2	2	-	2	-	3	2
CO62.2	3	2	-	1	-	1	1	2	2	2	-	2	1	3	2
CO62.3	3	2	-	1	-	1	1	2	2	2	-	2	-	3	2
CO62.4	3	2	-	1	-	1	1	2	2	2	-	2	-	3	2
CO62.5	3	2	-	1	-	1	1	2	2	2	-	2	-	3	2
22EEE62	3	2	-	1	-	1	1	2	2	2	-	2	1	3	2

SEMESTER – VI

Course: Artificial Intelligence (Professional Elective)

Course Code	22EEE63	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	03	Examination Hours	03

Prerequisites: Python programming

Course Objectives:

CLO1	Understand the significance of Artificial Intelligence (AI) along with basic principles, techniques and its applications
CLO2	Define the principles involved in various searching algorithms
CLO3	Recognize the complexity involved in searching process under certain unfavorable conditions
CLO4	Explain the principles involved in adversarial search problems
CLO5	Categorize the information based on level of uncertainty involved

Content	No. of Hours/ RBT levels
Module 1: Fundamental concepts of AI: Artificial Intelligence – Introduction to AI - Foundations of Artificial Intelligence - History of Artificial Intelligence - State of the Art - Risks and Benefits of AI Intelligent Agents - Agents and Environments - Concept of Rationality - Nature of Environments - Structure of Agents.	8 hours L3
Module 2: Searching algorithms and strategies: Solving Problems by Searching - Problem-Solving Agents - Search Algorithms - Uninformed Search Strategies - Informed (Heuristic) Search Strategies.	8 hours L3
Module 3: Searching in complex environments: Search in Complex Environments - Local Search and Optimization Problems - Local Search in Continuous Spaces - Search with Nondeterministic Actions - Search in Partially Observable Environments - Online Search Agents and Unknown Environments.	8 hours L3
Module 4: Adversarial Search and Games: Game Theory - Optimal Decisions in Games - Heuristic Alpha--Beta Tree Search - Monte Carlo Tree Search Constraint Satisfaction Problems - Defining Constraint Satisfaction Problems - Constraint Propagation: Inference in CSPs - Backtracking Search for CSPs.	8 hours L3
Module 5: Uncertainty and knowledge base: Uncertain knowledge and decision - Acting under Uncertainty - Basic Probability Notation - Bayes' Rule and Its Use - Naive Bayes Models - Sequential Decision Problems - Algorithms for Markov Decision Processes.	8 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO63A.1	Understand the fundamental aspects involved in AI and its applications
CO63A.2	Apply basic principles involved in formulating searching strategies
CO63A.3	Understand the various searching techniques in complex environments
CO63A.4	Explain constraint propagation methods in adversarial search environments
CO63A.5	Describe the decision-making philosophy in uncertain environments

Textbooks:

1. Artificial Intelligence: A Modern Approach (3rd edition) by Stuart Russell and Peter Norvig.
2. Winston, Patrick Henry. Artificial Intelligence. 3rd ed. Addison-Wesley, 1992. ISBN: 9780201533774.

Reference books:

1. Artificial Intelligence and Intelligent Systems, OXFORD University Press, New Delhi, 2005-N. P. Padhay.
2. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.

3. Elaine Rich and Kevin Knight, "Artificial Intelligence", 2nd Edition, Tata McGraw-Hill, 2003.
4. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", Pearson Education / PHI, 2002

E-Books / Web References

1. https://medium.com/machine-learning-in-practice/my-curated-list-of-ai-and-machine-learning-resources-from-around-the-web-9a97823b8524
2. https://github.com/norvig/paip-lisp
3. https://www.ximilar.com/the-best-resources-on-artificial-intelligence-and-machine-learning/
4. https://www.business2community.com/business-innovation/6-online-resources-that-will- help-you-understand-artificial-intelligence-better-02065673

MOOCs

1. https://www.edx.org/course/artificial-intelligence-ai
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/
3. https://www.udacity.com/course/intro-to-artificial-intelligence--cs271
4. https://online-learning.harvard.edu/course/cs50s-introduction-artificial-intelligence-python?delta=0
5. https://course.elementsofai.com/

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50(Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO63A.1	3	3	3	-	-	-	-	-	-	-	-	3	-	-	2
CO63A.2	3	3	3	-	-	-	-	-	-	-	-	3	-	-	2
CO63A.3	3	3	3	-	-	-	-	-	-	-	-	3	-	-	2
CO63A.4	3	3	3	-	-	-	-	-	-	-	-	3	-	-	2
CO63A.5	3	3	3	-	-	-	-	-	-	-	-	3	-	-	2
22EEE63A	3	3	3	-	-	-	-	-	-	-	-	3	-	-	2

SEMESTER – VI

Course: Micro Grids (Professional Elective)

Course Code	22EEE63B	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	03	Examination Hours	03

Prerequisites: PS-I & PS-II

Course Objectives:

CLO1	Understand the operation and control of microgrid
CLO2	Analyze the centralized and decentralized operation of micro grids
CLO3	Understand the different types of intelligent controllers of microgrids
CLO4	Understand the different types of protection techniques of microgrids
CLO5	Investigate the operation of multi micro grids

Content	No. of Hours/ RBT levels
Module 1 **Concept of Microgrids:** Introduction to the concept of microgrid, Operation and Control of Microgrids, Market Models for Microgrids, Status Quo and Outlook of Microgrid Applications, Microgrid Control Architecture, Centralized and Decentralized Control, Forecasting.	07 Hours/ L3
Module 2 **Centralized and Decentralized control:** Centralized Control: Economic Operation, Participation in Energy Markets Mathematical Formulation, Solution Methodology. Decentralized Control: Multi-Agent System Theory, Agent Communication and Development, Agent Communication Language, Agent Ontology and Data Modeling, Coordination Algorithms for Microgrid Control, Game Theory and Market Based Algorithms, Scalability and Advanced Architecture and State Estimation	08 Hours/ L4
Module 3 **Intelligent Local Controllers:** Introduction, Inverter Control Issues in the Formation of Microgrids, Control Strategies for Multiple Inverters, Implications of Line Parameters on Frequency and Voltage Droop Concepts and Development and Evaluation of Innovative Local Controls to Improve Stability	08 Hours/ L3
Module 4 **Microgrid protection:** Introduction, Challenges for Microgrid Protection, Adaptive Protection for Microgrids, Adaptive Protection Based on Pre-Calculated Settings, Microgrid with DER Switched off, in Grid-Connected Mode, Microgrid with Synchronous DERs Switched on in Grid, Connected and Islanded Modes, Adaptive Protection System Based on Real-Time Calculated Settings, Communication Architectures and Protocols for Adaptive Protection.	09 Hours/ L3
Module 5 **Operation of Multi-Microgrids:** Introduction, Multi-Microgrid Control and Management Architecture, Coordinated Voltage/var Support, Coordinated Frequency Control, Emergency Functions (Black Start), Dynamic Equivalents	08 hours L4

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO63B.1	Explain the concept of microgrids
CO63B.2	Analyze the centralized and decentralized control strategies of microgrids
CO63B.3	Apply the different intelligent controllers for microgrids
CO63B.4	Apply the different protection techniques for microgrid control
CO63B.5	Analyze the operation of multi-Microgrids

Textbooks:

1. Microgrids Architecture and control, N. D. Hatziargyriou, IEEE Press Series, John Wiley & Sons Inc, 2013, 1st Edition.

Reference books:

1. Microgrid Dynamics and Control, H. Bevrani, B. François, and T. Ise, John Wiley & Sons, 2017, 1st Edition.
2. Cooperative Synchronization in Distributed Microgrid Control, Bidram, V. Nasirian, A. Davoudi, F. L. Lewis, Springer, 2017, 1st Edition.

E-Books / Web References

1. https://onlinecourses.nptel.ac.in/noc20_ee84/preview
2. http://nitttrc.edu.in/nptel/courses/video/108107143/L01.html

MOOCs

1. https://nptel.ac.in/courses/108107143

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 50 marks each. Marks scored in each test is reduced to 20 and added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests.

Two quizzes are to be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses.

	Component	Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Quiz /AAT	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO63B.1	3	2	2	-	-	-	-	-	-	-	-	1	3	1	-
CO63B.2	3	2	2	-	-	-	-	-	-	-	-	1	3	1	-
CO63B.3	3	2	2	-	-	-	-	-	-	-	-	1	3	1	-
CO63B.4	3	2	2	-	-	-	-	-	-	-	-	1	3	1	-
CO63B.5	3	2	2	-	-	-	-	-	-	-	-	1	3	1	-
22EEE63B	3	2	2	-	-	-	-	-	-	-	-	1	3	1	-

SEMESTER – VI

Course: VLSI Design (Professional Elective)

Course Code	22EEE63C	Course Code	50
Hours/Week (L: T: P)	3:0:0	Hours/Week (L: T: P)	50
No. of Credits	3	No. of Credits	03

Prerequisites: Analog Electronics, Digital System Design

Course Objectives:

CLO1	Impart knowledge of MOS transistor theory and CMOS technologies
CLO2	Learn the operation principles and analysis of inverter circuits.
CLO3	Design Combinational, sequential and dynamic logic circuits as per the requirements
CLO4	Infer the operation of Semiconductors Memory circuits.
CLO5	Demonstrate the concepts of CMOS testing

Content	No. of Hours/ RBT levels
Module 1: Introduction to VLSI **Introduction:** A Brief History, MOS Transistors, CMOS Logic, MOS Transistor Theory: Introduction, Long-channel I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics	8 / L3
Module 2: Fabrication **Fabrication:** CMOS Fabrication and Layout, VLSI Design Flow, Introduction, CMOS Technologies, Layout Design Rules, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances	8 /L3
Module 3: Delay **Delay:** Introduction, Transient Response, RC Delay Model, Linear Delay Model, Logical Efforts of Paths, Combinational Circuit Design: Introduction, Circuit families	9 / L3
Module 4: Sequential Circuit Design and Logic Circuits **Sequential Circuit Design:** Introduction, Circuit Design for Latches and Flip-Flops, Dynamic **Logic Circuits:** Introduction, Basic Principles of Pass Transistor Circuits, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques	7 / L3
Module 5: Semiconductor Memories, Testing and Verification **Semiconductor Memories:** Introduction, Dynamic Random Access Memory (DRAM) and Static Random Access Memory (SRAM) **Testing and Verification:** Introduction, Logic Verification Principles, Manufacturing Test Principles, Design for testability	8 /L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO63C.1	Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
CO63C.2	Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects.
CO63C.3	Demonstrate ability to design Combinational, sequential and dynamic logic circuits as per the requirements
CO63C.4	Interpret Memory elements along with timing considerations
CO63C.5	Interpret testing and testability issues in VLSI Design

TEXTBOOKS:

1. "CMOS Digital Integrated Circuits: Analysis and Design" - Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill.
2. "CMOS VLSI Design- A Circuits and Systems Perspective"- Neil H. E. Weste, and David Money Harris4th Edition, Pearson Education.

REFERENCE BOOKS:

1. Adel Sedra and K. C. Smith, "Microelectronics Circuits Theory and Applications", 6th or 7th Edition, Oxford

University Press, International Version, 2009.
2. Douglas A Pucknell & Kamran Eshragian, "Basic VLSI Design", PHI 3rd Edition, (original Edition – 1994).
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", TMH, 2007.

E-Books /Web References:

1. https://link.springer.com/chapter/10.1007/978-1-4613-1985-6_2

MOOCs:

1. https://nptel.ac.in/courses/117101058
2. E-learning: www.vtu.ac.in

Scheme of Examination:

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO63C.1	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO63C.2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO63C.3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO63C.4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO63C.5	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
22EEE63C	3	2	2	-	-	-	-	-	-	-	-	-	-	-	2

VI SEMESTER

Course: Industrial Drives and Applications (Professional Elective)

Course Code	22EEE63D	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Electric Machines-I, Electric Machines-II, Power Electronics

Course Objectives:

CLO1	Discuss dynamics and modes of operation of electrical drives.
CLO2	Determine power rating of electric motors for continuous, intermittent and short time duty.
CLO3	Explain the operation of dc, induction and synchronous motors under normal, transient and faulty conditions.
CLO4	Understand the speed control methods to control the speed of Dc and Induction motors
CLO5	Understand the types and speed control methods of synchronous and stepper motor drive.

Content	No. of Hours/RBT levels
Module 1: Introduction: Electrical Drives, Advantages of Electrical Drives. Parts of Electrical Drives, Choice of Electrical Drives, Status of dc and ac Drives. Dynamics of Electrical Drives: Fundamental Torque Equations, Speed Torque Conventions and Multi-quadrant Operation. Equivalent Values of Drive Parameters, Components of Load Torques, Nature and Classification of Load Torques, Calculation of Time in Transient Operations, SteadyState Stability. Thermal Model of Motor for Heating and Cooling, Classes of Motor Duty, Determination of Motor Rating.	8 hours/ L3
Module 2: Direct Current Motor Drives Controlled Rectifier Fed DC Drives, Single Phase Fully Controlled Rectifier Control of DC Separately Excited Motor, Single Phase Half Controlled Rectifier Control of DC Separately Excited Motor, Multi-quadrant Operation of DC Separately Excited Motor Fed From Fully Controlled Rectifier, Rectifier Control of DC Series Motor, Chopper Control of Separately Excited DC Motor, Chopper Control of Series Motor.	8 hours/ L3
Module 3: Induction Motor Drives Analysis and Performance of Three Phase Induction Motors, Operation with Unbalanced Source Voltage and Single Phasing, Operation with Unbalanced Rotor Impedances, Analysis of Induction Motor Fed From Non-Sinusoidal Voltage Supply, Starting, Braking, Methods of starting and braking.	8 hours/ L3
Module 4: Induction Motor Drives (continued) Speed Control Techniques-Stator Voltage Control, Variable Voltage Frequency Control from Voltage Sources. Voltage Source Inverter (VSI) Control, Variable Frequency Control from a Current Source, Current Source (CSI) Control, current regulated voltage source inverter control.	8 hours/ L4
Module 5: Synchronous Motor, Brushless DC Motor and Stepper Motor Drives Operation from fixed frequency supply-starting, Self-controlled synchronous motor drive employing load commutated thyristor inverter, Starting Large Synchronous Machines Brushless dc Motor Drives for servo applications. Stepper Motor Drives: Variable Reluctance, Permanent Magnet, Important Features of Stepper Motors, Torque Versus Stepping rate Characteristics, Drive Circuits for Stepper Motor.	8 hours/ L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO63D.1	Understand dynamics and modes of operation of electrical drives.
CO63D.2	Determine power rating of electric motors for continuous, intermittent and short time duty.
CO63D.3	Analyse behavior of dc, induction and synchronous motors under normal, transient and faulty conditions.
CO63D.4	Apply appropriate method to control DC and induction motor drive.
CO63D.5	Understand the control methods with reference to synchronous and stepper motor drives.

Textbooks:

1. Fundamentals of Electrical Drives by Gopal K. Dubey, Narosa Publishing House, 2nd Edition, 2001.

Reference books:

1. Electrical Drives: Concepts and Applications, Vedum Subrahmanyam, McGraw Hill, 2nd Edition, 2011.
2. Electric Drives, N.K De, P.K. Sen, PHI Learning, 1st Edition, 2009

E-Books / Web References

1. https://www.google.co.in/books/edition/Fundamentals_of_Industrial_Drives/l8McyPSJ0qMC?hl=en&gbpv=1

MOOCs

1. https://nptel.ac.in/courses/108108077
2. https://www.coursera.org/learn/motors-circuits-design

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO63D.1	3	3	-	-	-	1	-	-	-	-	-	-	2	-	-
CO63D.2	3	3	-	-	-	2	-	-	-	-	-	-	2	-	-
CO63D.3	3	3	-	-	-	1	-	-	-	-	-	2	2	-	3
CO63D.4	3	3	-	-	-	1	-	-	-	-	-	2	2	-	3
CO63D.5	3	2	-	-	-	1	-	-	-	-	-	2	2	-	3
22EEE63D	3	3	-	-	-	1	-	-	-	-	-	2	2	-	3

SEMESTER – VI

Course: Electric Vehicles (Open Elective)

Course Code	22EEE64A	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites:

Course Objectives:

CLO1	Understand Vehicle Fundamentals
CLO2	Explain electric, hybrid electric and plug in hybrid electric vehicle, their architecture and technology
CLO3	Explain the use of power electronics converters and various electric drives suitable for electric vehicles
CLO4	Discuss different energy storage technologies used for hybrid electric vehicles and their control and battery management systems
CLO5	Demonstrate different configurations of electric vehicle charging techniques

Content	No. of Hours/ RBT levels
Module 1: Vehicle Fundamentals: Vehicle Basics, Roadway Fundamentals, Laws of motion, vehicle kinetics, Dynamics of Vehicle Motion, Propulsion Power, Velocity & Acceleration, EV Powertrain Component Sizing.	8 hours L3
Module 2: Basics of EV Technology: Economic and environment impact of electrical vehicle. Basics of the EV, HEV configurations – Series hybrid, parallel hybrid, series parallel hybrid, complex hybrid systems. Power Flow control in HEV configurations. Basics of Plug-In Hybrid Electric Vehicle (PHEV) and its architecture.	8 hours L3
Module 3: Power Electronics in Electric Vehicles: Power Electronics in Electric Vehicles: Power electronics circuits used for control and distribution of electric power in DC-DC, AC-DC, DC-AC converters used for HEV. **Electric Machines and Drives in Electric Vehicles:** Fundamental of Drives and Control of EV Using DC motor, Induction Motor, Permanent Magnet Synchronous Motor, Switched Reluctance Motor, BLDC motor with their advantages and disadvantages.	8 hours L3
Module 4: Energy Storage in EVs: Batteries – and their types, Fuel Cells - and their types, basics of Fuel Cell Vehicles (FCEVs,) Ultra Capacitors and Ultra high speed Flywheels, their features and design. Hybridization of Energy Sources. Battery Management Systems- block diagram and functions.	8 hours L3
Module 5: EV Charging Technologies: EV Charging Technologies: Classification of different charging technology for EV charging station, introduction to Grid-to-Vehicle, Vehicle to Grid (V2G) or Vehicle to Buildings (V2B) or Vehicle to Home (V2H) operations, bi-directional EV charging systems, energy management strategies used in hybrid and electric vehicle, Wireless power transfer (WPT) technique for EV charging.	8 hours L3

Course Outcomes: **The students will be able to:**

CO64A.1	Understand Vehicle Fundamentals
CO64A.2	Understand the architecture and technology of electric, hybrid electric and plug in hybrid electric vehicle
CO64A.3	Analyze the use of different power electronics converters and electrical machines in hybrid electric vehicles
CO64A.4	Explain the use of different energy storage systems used for electric vehicles
CO64A.5	Understand the control and configurations of EV charging stations

TEXTBOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, Third Edition, CRC Press 2021

REFERENCES:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 2003
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd. , 2011

WEBLINKS:

1. https://nptel.ac.in/courses/108106170
2. cw.mit.edu/courses/16-682-technology-in-transportation-spring-2011

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO64A.1	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2
CO64A.2	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2
CO64A.3	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2
CO64A.4	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2
CO64A.5	3	-	2	1	-	-	1	-	-	-	-	2	1	2	2
22EEE64A	3	2	2	1	-	-	1	-	-	-	-	2	1	2	2

SEMESTER – VI

Course: Industrial Automation (Open Elective)

Course Code	22EEE64B	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites:

Course Objectives:

CLO1	To give an overview of the automation technologies such as PLCs, SCADA and DCS used in Industries.
CLO2	To provide a fundamental understanding of Programmable Logic Controllers and develop PLC programs for industrial sequential applications
CLO3	To understand the architecture of Distributed Control Systems
CLO4	To provide an insight to SCADA and its industrial applications
CLO5	Understand basic industrial robots with their control, design and application in automation Industries.

Content	No. of Hours/ RBT levels
Module 1: Automation Overview: Introduction: Automation overview, Need and Benefits of automation systems, Architecture of Industrial Automation system, Types of Automation Systems; Fixed, Programmable and Flexible, Different Systems- PLC, HMI, SCADA, DCS	8 hours L3
Module 2: Programmable Logic Controllers: Programmable controllers, Programmable logic controllers, Analog-digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries	8 hours L3
Module 3: Distributed Control System: Computers in Process Automation, Process Automation Networks, Protocols, Distributed Control Systems, Hardware Units of DCS, Communications in DCS Architecture. Operation, Monitoring, Control and Data Acquisition in DCS	8 hours L3
Module 4: Supervisory Control and Data Acquisition: Evolution of SCADA, SCADA Architecture, Functions- Data Acquisition, Data Communication, Elements- MTU, RTU. SCADA Security, Application of SCADA, Basic overview of Industrial Internet of things IIoT	8 hours L3
Module 5: Robotics in Industrial Automation: Definitions, Types of Robots, , Degrees of Freedom, Robot classification on the basis of – Co-ordinate Systems, Power Source, Methods of Control, Programming method, AI in Robotics : Applications in manufacturing and material management, defence, medical, industries, etc.	8 hours L3

Course Outcomes: The students will be able to:

CO64B.1	Understand basics of automation technologies such as PLCs, SCADA and DCS used in Industries.
CO64B.2	Understand Programmable Logic Controllers and develop PLC programs for industrial sequential applications
CO64B.3	Explain the architecture of Distributed Control Systems
CO64B.4	Understand SCADA and its industrial applications
CO64B.5	Understand basic industrial robots with their control, design and application in automation Industries.

TEXTBOOKS:

1 Chanchal Dey & Sunit Kumar Sen, Industrial Automation Technologies, CRC Press , 2003
2. Mikell P Groover, Industrial Robotics, Technology, Programming & Applications, Mc Graw Hill Education, 2012

REFERENCES:

3. Frank Petruzella, Programmable Logic Controllers, Mc Graw Hill Education, Fifth Edition 2017
4. Stamatios Manesis , George Nikolakopolous, Introduction to Industrial Automation, CRC Press , 2018

WEBLINKS:

1. https://onlinecourses.nptel.ac.in/noc20_me39/preview

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO64B.1	3	2	2	1	2	-	1	-	-	-	-	2	1	1	2
CO64B.2	3	2	2	1	2	-	1	-	-	-	-	2	1	1	2
CO64B.3	3	2	2	1	2	-	1	-	-	-	-	2	1	1	2
CO64B.4	3	2	2	1	2	-	1	-	-	-	-	2	1	1	2
CO64B.5	3	-	2	1	2	-	1	-	-	-	-	2	1	1	2
Average	3	2	2	1	2	-	1	-	-	-	-	2	1	1	2

SEMESTER – VI

Course: Utilization of Electrical Power (Open Elective)

Course Code	22EEE64C	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Power System I (23EEE44)

Course Objectives:

CLO1	Describe electric heating and different methods of electric heating.
CLO2	Discuss electric welding and different methods of electric welding and their applications.
CLO3	Illustrate the laws of illumination and design methods for various type of lighting.
CLO4	Explain the motors used and their control in electric traction.
CLO5	Discuss power supply arrangement in electric traction

Content	No. of Hours/ RBT levels
Module 1: Electric Heating: Introduction, Advantages of Electrical Heating, Heating Methods, Resistance Heating, Direct Resistance Heating, Indirect Resistance Heating, Radiating Heating, Electric Arc Furnace, Indirect Arc Furnace, Electron Bombardment Heating, High Frequency Heating, Induction Heating, Dielectric Heating.	08 Hours/L3
Module 2: Electric Welding: Introduction, Classification, Electric Arc Welding, Weld Metal Deposition, Coated Electrodes, Types of Joints and Applicable Welds, Requirements of Good Weld, Atomic Hydrogen Welding, Inert Gas Metal Arc Welding, Carbon Arc Welding, Electric Supply for Arc Welding, Resistance Welding, Spot Welding, Projection Welding, Butt Welding, Electron Beam Welding, Electro Slag Welding, Plasma Arc Welding, Laser Welding, Ultrasonic Welding, Power Supply for Resistance Welding.	08 Hours/L3
Module 3: Illumination: Introduction, Nature of Light, Definitions, Polar Curve, Laws of Illumination, Sources of Light, Requirements of Good Lighting, Diffusing and Reflecting Surfaces, Types of Light Fittings, Methods of Lighting Calculation, Factory Lighting, Street Lighting, Flood Lighting, Photometry, Integrating Sphere.	08 Hours/L3
Module 4: Electric Traction: Introduction, Systems of Traction, Systems of Electric Traction, Speed-Time Curvesfor Train Movements, Mechanics of Train Movement, Train Resistance, Adhesive Weight, Coefficient of Adhesion. Motors – Significant Features of Traction Drives, Desirable Properties of Traction Motors, Traction Motors, D.C. Series Motors – Characteristics of D.C. Motors, Suitability of Series Motor for Traction Duty, Series Motors-Parallel Operation with Unequal Wheel Diameters, Series Motors-Series Operation with Unequal Diameters, Tractive Effort and Horse Power, A.C. Series Motor, Three Phase Induction Motor. Electronic Control – Speed Relations of D.C. Motors, Thyristor Control of D.C. Motors, D.C. Motor Supplied by three phase thyristor rectifiers, Field Excitation of D.C. Motor and generator from rectifier, Chopper Control of D.C. Motors, Closedloop System for automatic speed control of D.C. Motor, Automatic Control.	08 Hours/L3
Module 5: Power Supply Arrangement and Braking of Electric Traction: Braking – Introduction, Advantages and Disadvantages of Electrical Braking over Mechanical Braking, Requirements of a Braking System, Types of Braking, Electric Braking Plugging, Rheostatic, Regenerative Braking, Energy Saving in egenerative Braking. Electric Traction – System of Electric Traction, A.C. Electrification, Transmission Lines to Sub-stations, Sub-stations, Feeding & Distributing System on A.C. Traction, Feeding & Distribution System for D C Tramways, Electrolysis by Currents through Earth, Negative Booster, System of Current Collection, Trolley Wires.	08 Hours/L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO64C.1	Explain different types of electric heating.
CO64C.2	Classify various methods of electric welding and their applications.
CO64C.3	Design lighting scheme for different application.
CO64C.4	Analyze systems of electric traction, speed time curves and mechanics of train movement.
CO64C.5	Discuss the motors used for electric traction, their control & braking and power supply system used for electric traction

Textbooks:

1. A Text Book on Power System Engineering A. Chakrabarti et al Dhanpat Rai and Co 2nd Edition, 2010
2. Modern Utilization of Electric Power, Pradip Kumar Sadhu Soumya Das, CBS Publishers & Distributors Pvt Ltd

Reference books:

1. Utilization, Generation and Conservation of Electrical Energy Sunil S Rao Khanna Publishers1st Edition, 2011
2. Utilization of Electric Power and Electric Traction G.C. Garg Khanna Publishers 9th Edition, 2014

E-Books / Web References

1. https://easyengineering.net/utilisation-of-electrical-power-by-rajput/
2. https://book.jobscaptain.com/utilisation-of-electrical-power/
3. https://irieen.indianrailways.gov.in/uploads/files/1302522976022-PSI%20FINAL.pdf

MOOCs

1 **https://nptel.ac.in/courses/108105060**
2. E-learning: www.vtu.ac.in
3. https://www.youtube.com/watch?v=4pkREvVx5A0
4. https://nptel.ac.in/courses/108105060

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO64C.1	3	2	-	-	-	1	-	-	-	-	-	-	-	2	-
CO64C.2	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO64C.3	3	2	2	-	-	-	-	1	-	-	-	1	-	2	-
CO64C.4	3	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO64C.5	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Average	3	2	2	-	-	1	-	1	-	-	-	1	-	2	-

SEMESTER –VI

COURSE: Technologies of Renewable Energy Sources

Course Code	22EEE64D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

(1) To discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.
(2) To explain sun – earth geometric relationship, Earth – Sun Angles and their Relationships.
(3) To discuss about solar energy reaching the Earth's surface and solar thermal energyapplications.To discuss types of solar collectors, their configurations and their applications.
(4) To explain the components of a solar cell system, equivalent circuit of a solar cell, its characteristicsand applications.
(5) To discuss benefits of hydrogen energy, production of hydrogen energy, storage its advantages anddisadvantages.
(6) To discuss wind turbines, wind resources, site selection for wind turbine.
(7) To discuss geothermal systems, their classification and geothermal based electric power generation (9To discuss waste recovery management systems, advantages and disadvantages.
(8) To discuss biomass composition, production, types of biomass gasifiers, properties of producer gasbenefits.
(9) To discuss tidal energy resources, energy availability, power generation.
(10) To explain motion in the sea wave, power associated with sea wave and energy availability and the devicesfor harnessing wave energy.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various courseoutcomes.

1 Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2 Use of Video/Animation to explain functioning of various concepts.
3 Encourage collaborative (Group Learning) Learning in the class.
4 Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5 Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6 Introduce Topics in manifold representations.
7 Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8 Discuss how every concept can be applied to the real world - and when that's possible, it helps improve thestudents' understanding.

Module-1

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy ResourceDevelopment, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

Energy from Sun: Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles andtheir Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications.

Module-2

Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond.

Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic panels (series and parallelarrays).

Module-3

Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy.

Wind Energy: Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection.

Geothermal Energy: Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects. Solid waste and Agricultural Refuse: Waste is Wealth, Key Issues, Waste Recovery Management Scheme, Advantages and Disadvantages of Waste Recycling, Sources and Types of Waste, Recycling
of Plastics.

Module-4

Biomass Energy: Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier, Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers.

Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefitsof Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant, Biogas Plant Feeds and theirCharacteristics.

Tidal Energy: Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability in Tides, Tidal

Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy.

Module-5

Sea Wave Energy: Introduction, Motion in the sea Waves, Power Associated with Sea Waves, Wave Energy Availability, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Wave Power.

Ocean Thermal Energy: Introduction, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Carnot Cycle, Application of OTEC in Addition to Produce Electricity, Advantages,

Disadvantages and Benefits of OTEC.

Course outcome (Course Skill Set)

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

1. Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy. Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
2. Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
3. Explain generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
4. Discuss production of energy from biomass, biogas.
5. Summarize tidal energy resources, sea wave energy and ocean thermal energy.

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Textbook

1. Nonconventional Energy Resources, Shobh Nath Singh, Pearson, 1st Edition, 2015.

Reference Books

1. Nonconventional Energy Resources, B.H. Khan, McGraw Hill, 3rd Edition.
2. Renewable Energy; Power for a sustainable Future, Godfrey Boyle, Oxford, 3rd Edition, 2012.
3. Renewable Energy Sources: Their Impact on global Warming and Pollution, Tasneem Abbasi S.A. Abbasi, PHI,1st Edition, 2011.

SEMESTER –VI

COURSE: MAJOR PROJECT PHASE-I

Course Code	22EEEP65	CIE Marks	50
Hours/Week (L: T: P)	0:0:4	SEE Marks	-
No. of Credits	2	Examination Hours	-

Content	No. of Hours/RBT levels
Project work phase - 1: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6. **CIE procedure for Project Work Phase - 1:** **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology) using Rubrics, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the Project report shall be the same for all the batch mates. **Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates as per Rubrics covering all Program Outcomes.	**04 Hours**

Individual student performance are evaluated based on the following COs:

CO1	Able to make comprehensive use of the technical knowledge gained from previous courses
CO2	Able to understand technologies concerned with the project
CO3	Able to apply project management skills (scheduling work, procuring parts and documenting expenditures and working within the confines of a deadline).
CO4	Able to analyze, develop and demonstrate the proposed work
CO5	Able to communicate technical information by means of ethical writing and presentation.

Table 1: Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	100	100
	Review-2		--
SEE	Semester End Examination	--	100
Grand Total			

CO/PO Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

SEMESTER –VI

COURSE: Power System Simulation Lab

Course Code	22EEEL66	CIE Marks	50
Hours/Week (L: T: P)	0:0:2	SEE Marks	50
No. of Credits	1	Examination Hours	03

CLO1	To explain formulation of network models, bus admittance matrix for solving load flow problems and bus impedance matrix for the use in short circuit studies in power systems.
CLO2	To explain load flow analysis using different methods and compare them
CLO3	Solve issues of economic load dispatch and unit commitment problems.
CLO4	To explain basic generator control loops, functions of Automatic generation control, speed governors and mathematical models of Automatic Load Frequency Control
CLO5	To explain voltage and reactive power control in an interconnected power system.

S.no.	Experiments	
1	ABCD parameters: Formation for symmetric Π/T configuration. Verification of AD-BC=1and determination of efficiency and regulation.	L3 /L4 2 hours
2.	Determination of Power angle diagrams, reluctance power, excitation, emf and regulation for Salient and Non salient pole synchronous machines	L3 /L4 2 hours
3.	To obtain swing curve and to determine critical clearing time and regulation for a single machine connected to infinite bus.	L3 /L4 2 hours
4.	Formation of Y-Bus with and without mutual coupling by (i) Inspection method and (ii) Singular transformation method.	L3 /L4 2 hours
5.	Determination of bus currents, bus power and line flow for a specified system voltage (Bus) profile.	L3 /L4 2 hours
6	Formation of Z-bus using Z bus building algorithm (without mutual coupling)	L3 /L4 2 hours
7	Formation of Jacobian for a system of 4 buses in polar co-ordinates (No PV buses)	L3 /L4 2 hours
8	Determination of fault currents and voltages in a single transmission line for SLGF and DLG	L3 /L4 2 hours
9	LFA using G-S, N-R and FDLF method, both PQ and PV buses	L3 /L4 2 hours
10	Optimal Generator scheduling for Thermal power plants	L3 /L4 2 hours

Course Outcomes: The students will be able to:

CO66.1	Calculate bus impedance and bus admittance matrices for power system.
CO66.2	Analyse load flow analysis using Gause-Seidal, Newton Raphson and fast decoupled method.
CO66.3	Solve issues of economic load dispatch and unit commitment problems.
CO66.4	Explain basic generator control loops, functions of Automatic generation control, speed governors and mathematical models of Automatic Load Frequency Control
CO66.5	Understand voltage and reactive power control in an interconnected power system

TEXTBOOKS:

3. D P Kothari, I J Nagarath, Power System Engineering , Mc Graw Hill Education, Second Editiion, 2008
4. William D. Stevenson Jr , Elements of Power System Analysis, McGraw Hill Education; 4th edition , 2017

REFERENCES:

4. J. Duncan Glover et al, Power System Analysis and Design, Cengage, 4th Edition, 2008
5. Hadi Sadat, Power System Analysis Mc Graw Hill Education, 1st Edition, 2002

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-athon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO66.1	2	2	-	-	3	-	-	-	-	-	-	-	3	3	-
CO66.2	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-
CO66.3	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-
CO66.4	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-
CO66.5	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-
Average	2	2	2	-	3	-	-	-	-	-	-	-	3	3	-

SEMESTER – VI

Course: Embedded Systems Lab (AEC)

Course Code	22EEE67A	CIE Marks	50
Hours/Week (L: T: P)	1:0:0	SEE Marks	50
No. of Credits	1	Examination Hours	01

CLO1	Learn the architecture and features of 8-bit 8051 microcontroller.
CLO2	Develop the embedded C programs for the given applications using 8051 microcontrollers.
CLO3	Understand 32-bit ARM controller
CLO4	Describe different blocks of Embedded System.
CLO5	Know the current trends and applications of embedded systems in industry

Sl. No.	Experiments	No. of Hours/ RBT levels
PART A: Conduct the following experiments by writing C Program using Keil Micro vision simulator		
1	Write an 8051 C program to send the data to the I/O ports with some delay.	2 hours L3
2	Write an 8051 C program to find the sum of first 10 integer numbers	
3	Write an 8051 C program to Shifting the bits right or left.	
4	Write an 8051 C program to add an array of 16-bit numbers and store the 32-bit result in internal RAM	2 hours L3
5	Write an 8051 C program to find the square of a number (1 to 10)	
6	Write an 8051 C program to get a byte of data from P0. If it is less than 100, send it to P1, otherwise send it to P2.	
7	Write an 8051 C program to count the number of ones and zeros in two consecutive memory locations	2 hours L3
8	Write an 8051 C program to display "Hello World" message	
9	Write an 8051 C program to convert the hexadecimal data 0xCFh to decimal and display the digits on ports P0, P1 and P2	2 hours L3
10	Write an 8051 C program to toggle the bits of port P0, P1 with the given delay	
	PART B: Interfacing Programs	
1.	Interface DAC to 8051 microcontrollers to generate different wave forms 1. Sine wave 2. square wave 3. Triangular wave 4. Ramp wave 5. Staircase wave	2 hours L3
2.	Stepper motor interface to 8051 microcontrollers	2 hours L3
3.	DC motor interface to 8051 microcontrollers	
4	Elevator interface to 8051 microcontrollers	2 hours L3

COURSE **OUTCOMES:**

Upon completion of this course, student will be able to:

CO67A.1	Describe the architecture and features of 8-bit 8051 microcontroller.
CO67A.2	Write the embedded C programs for the given applications using 8051 microcontroller.
CO67A.3	Explain 32-bit ARM controller and its features
CO67A.4	Describe different blocks of Embedded System and conduct the experiments
CO67A.5	Understand the current trends in embedded industry and analyze different application and domain specific examples of embedded systems through case studies.

Textbooks:

2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, Muhammad Ali Mazadi, Pearson, 2 nd Edition, 2008
3. Shibu K V, " to Embedded Systems", First Edition, Tata McGraw Hill Education Private Limited, 2009

4. Joseph Yiu,"The Definitive Guide to the ARM Cortex-M3", Second Edition, Newnes, (Elsevier), 2008

Reference books:

3. Raj Kamal, "Embedded Systems – Architecture, Programming and Design", edition, Mc Graw Hill, 2012
4. James K Peckol "Embedded Systems – A contemporary Design Tool", edition, John Weily, 2008

E-Books / Web References

1. https://onlinecourses.nptel.ac.in/noc20_cs15/course

MOOCs

1 https://nptel.ac.in/course/

CO/PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO67A.1	3	3	1		3			3	3	3		3			2
CO67A.2	3	3	1		3			3	3	3		3			2
CO67A.3	3	3	1		3			3	3	3		3			2
CO67A.4	3	3	1		3			3	3	3		3			2
CO67A.5	3	3	1		3			3	3	3		3			2
Average	3	3	1		3			3	3	3		3			2

SEMESTER – VI

Course: Simulation and Control of Power Electronics Circuits

Course Code	22EEE67B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0-0-1	SEE Marks	50
Credits	01	Exam Hours	100
Examination type (SEE)	practical/Viva-Voce		

Course objectives:

- To be able to simulate any DC-DC converter and observe the performance under various test conditions
- To be able to simulate single phase and three phase DC –AC converters and observe the performance under various test conditions
- To be able to simulate uncontrolled, half controlled and fully controlled AC-DC converters and observe the performance under various test conditions

Sl.NO	Experiments
1	(a) Simulate a single phase half wave diode bridge rectifier. Input 100V, 50 Hz. AC supply. At the out put, resistance of 50 ohms. (b) Simulate a single phase full wave diode bridge rectifier. Input 100V, 50 Hz. AC supply. At the out put, resistance of 50 ohms.
2	(a) Simulate a single phase half controlled full wave rectifier. Input 100V, 50 Hz. AC supply. At the output, resistance of 50 ohms. (b) Simulate a single phase fully controlled full wave rectifier. Input 100V, 50 Hz. AC supply. At the out put, resistance of 50 ohms.
3	Simulate a buck converter with 20 V DC input, and regulate the output at 10 V by implementing a PI controller for closed loop operation. The out put power to vary from 10 W to 20 W. Ensure that voltageripple is limited to 1%.
4	Simulate a boost converter with 20 V DC input, and regulate the output at 35 V by implementing a PI controller for closed loop operation. The out put power to vary from 30W to 60 W. Ensure that voltageripple is limited to 1%
5	Simulate a single phase AC voltage controller using a triac with 100V ,50 Hz. AC supply for an RL load of10 oms and 2 mH.
6	Simulate a three phase inverter with 180 degree conduction mode with DC input of 100V and a starconnected balanced resistive of 40 ohms each. Use IGBT for inverter.
7	Simulate a single phase SPWM inverter with 50V DC input with modulation indices of 0.5, 0.6 and 0.8.connect a resistance of 25 ohms at the output of inverter. Use power Mosfets for inverter.
8	Simulate a three phase inverter with 120 degree mode of conduction. Take input DC voltage of 100V andthree phase star connected balanced resistive load of 50 ohms each.
	Demonstration Experiments (For CIE)
9	In expt. 8. connect suitable LC filter at the output to obtain a sinusoidal output with THD of less than 8 %.
10	Simulate a three phase SPWM inverter with 50V DC input with modulation indices of 0.5, 0.6 and 0.8. connect a star connected resistances of 25 ohms each at the output of the inverter. Use power Mosfets forinverter.
11	Simulate a three phase, 5 level, neutral point clamped (NPC) inverter. Input DC voltage is 100V. Theinverter output is connected to a balanced 3 phase resistive load of 40 Ohms each.
12	Simulate a forward converter with input DC voltage of 30 V. Take transformer ratio of 1.5:1. Observe the output voltages for duty cycles of 0.4, 0.6 and 0.8. Ensure that the output voltage ripple is less than 0.5 V.The load resistance is 10 Ohms.

Course outcomes (Course Skill Set):

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

- Simulate any given power electronic circuit and evaluate its performance under different test conditionsand also observe the performance for different values of passive filtering elements used in the converter.

Suggested Learning Resources:

https://in.mathworks.com/solutions/electrification/power-electronics-simulation.html

- - This provides design examples for power electronics simulation using MATLAB

SEMESTER – VI

Course: Energy Audit Project

Course Code	22EEE67C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)		SEE Marks	50
Credits	01	Exam Hours	03
Examination type (SEE)	Practical		

Course objectives:

- Along with prescribed hours of teaching –learning process, provide opportunity to perform the experiments/programmes at their own time, at their own pace, at any place as per their convenience and repeat any number of times to understand the concept.
- Provide unhindered access to perform whenever the students wish.
- Vary different parameters to study the behaviour of the circuit without the risk of damaging equipment / device or injuring themselves.
- To carryout Energy Audit for an industry, business establishment, organization and its computation using
- Scilab Software and proposing possible remedial measures to reduce the energy consumption.

Students shall select real time project/audit with the approval of the guide. The following shall be considered by the students and guide while auditing.

(1) Building and Utility Data Analysis: The main purpose of this step is to evaluate the characteristics of the energy systems and the patterns of energy use for the premises considered. The premises characteristics can be collected from the architectural/ mechanical/electrical drawings and/or from consultation/discussions with premises operators. The energy use patterns can be obtained from a compilation of utility bills over a period.

(2) Walk-Through Survey: This step should identify potential energy savings measures. The results of this stepare important since they determine if the building warrants any further energy auditing work. Some of the tasks involved in this step are • Identify the customer's concerns and needs • Check the current operating and maintenance procedures • Determine the existing operating conditions of major energy use equipment (lighting,HVAC systems, motors, etc.) • Estimate the occupancy, equipment, and lighting (energyuse density and hours of operation).

(3)Baseline for Building Energy Use: The main purpose of this step is to develop a base-case model that represents the existing energy use and operating conditions for the building. This model will be used as a reference to estimate the energy savings due to appropriately selected energy conservation measures.

Evaluation of Energy-Saving Measures: In this step, a list of cost-effective energy conservation measures is determined using both energy savings and economic analysis.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project under ability enhancement can be assigned to an individual student or to a group havingnot more than 4 students.

Assessment Details (both CIE and SEE)

CIE procedure for project ability enhancement course:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concernedDepartment and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project reportshall be the same for all the batch mates.

Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college.

The CIE marks awarded for the project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the projectreport shall be thesame for all the batch mates.

SEE for project:

(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

The SEE marks awarded for the project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be thesame for all the batch mates.

Course outcomes (Course Skill Set):

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

- Analyze the data collected for energy audit of a building or industry or organization.
- Perform comparative analysis with and without energy audit.
- Analyze the energy saving measures to be considered with economy considerations.
- Analyse in a systematic way, think better, and perform better

SEMESTER – VI

Course: Project on Renewable Energy Sources

Course Code	22EEE67D	Semester	VI
Teaching Hours/Week (L:T:P: S)	0:0:2:0	CIE Marks	50
Credits	01	SEE Marks	50
Examination type (SEE)	Practical	Exam Hours	03

Course objectives:

- Along with prescribed hours of teaching –learning process, provide opportunity to perform the experiments/programmes at their own time, at their own pace, at any place as per their convenienceand repeat any number of times to understand the concept.
- Provide unhindered access to perform whenever the students wish.
- Vary different parameters to study the behavior of the circuit without the risk of damaging equipment/ deviceor injuring themselves.

Students can select appropriate projects with the approval of the guide. The projects be applicationoriented and can be considering any of the following or any other.

Automatic solar tracking system.
Solar based small traffic control system.Solar mobile charger.
Vertical axis wind turbine system. Solar powered Smart irrigation system.
Renewable energy based home automation system.Domestic illumination using solar.
Solar grass cutter.Solar UPS.

Course outcomes (Course Skill Set):

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

(1) Analyse in a systematic way, think better, and perform better.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project under ability enhancement can be assigned to an individual student or to a group havingnot more than 4 students.

Assessment Details (both CIE and SEE)

CIE procedure for project ability enhancement course:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college.

The CIE marks awarded for the project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be thesame for all the batch mates.

SEE for project:

(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to. The SEE marks awarded for the project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEMESTER – VI

Course: Indian Knowledge System

Course Code	22IKSK69	CIE Marks	100
Hours/Week (L: T: P)	1:0:0	SEE Marks	-
No. of Credits	0	Examination Hours	01

Course Objectives:

CLO1	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system
CLO2	To make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life.

Content
Module 1 (05 hours)
Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.
Module 2 (05 hours)
Traditional Knowledge in Humanities and Sciences: Lingistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology
Module 3 (05 hours)
Traditional Knowledge in Professional domain: Town planning and architecture. Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.

Reference Books:

1. Introduction to Indian Knowledge System- concepts and applications, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93- 91818-21-0
2. Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN- 13: 978-8126912230,
3. Knowledge Traditions and Practices of India, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO 1	Provide an overview of the concept of the Indian Knowledge System and its importance.
CO 2	Appreciate the need and importance of protecting traditional knowledge.
CO 3	Recognize the relevance of Traditional knowledge in different domains.
CO 4	Establish the significance of Indian Knowledge systems in the contemporary world

Scheme of Examination:

Semester End Examination (SEE):

SEE paper shall be set for 50 questions, each of the 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignments	10	
SEE	Semester End Examination	50	50
Grand Total			100

CO/PO	PO6
CO 1	3
CO 2	3
CO 3	3
CO 4	3
Average	3

SEMESTER – VI

Course: Universal Human Values

Course Code	22UHV69	CIE Marks	50
Hours/Week (L: T: P)	1:0:0	SEE Marks	50
No. of Credits	0	Examination Hours	01

Course **Objectives:**

CLO1	To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
CLO2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
CLO3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
CLO4	To provide a much-needed orientation input in value education to the young enquiring minds.

Content
Module 1 (03 hours)
Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations
Module 2 (03 hours)
Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Module 3 (03 hours)
Harmony in the Family and Society : Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Module 4 (03 hours)
Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Module 5 (03 hours)
Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Reference Books:

1. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978- 93-87034- 47-1
2. The Teacher"s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

COURSE OUTCOMES:

Upon completion of this course, student would:

CO 1	Become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO 2	Have better critical ability
CO 3	Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO 4	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

Scheme of Examination:

Semester End Examination (SEE):

SEE paper shall be set for 50 questions, each of the 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Typical Evaluation pattern for regular courses is shown in Table 2.

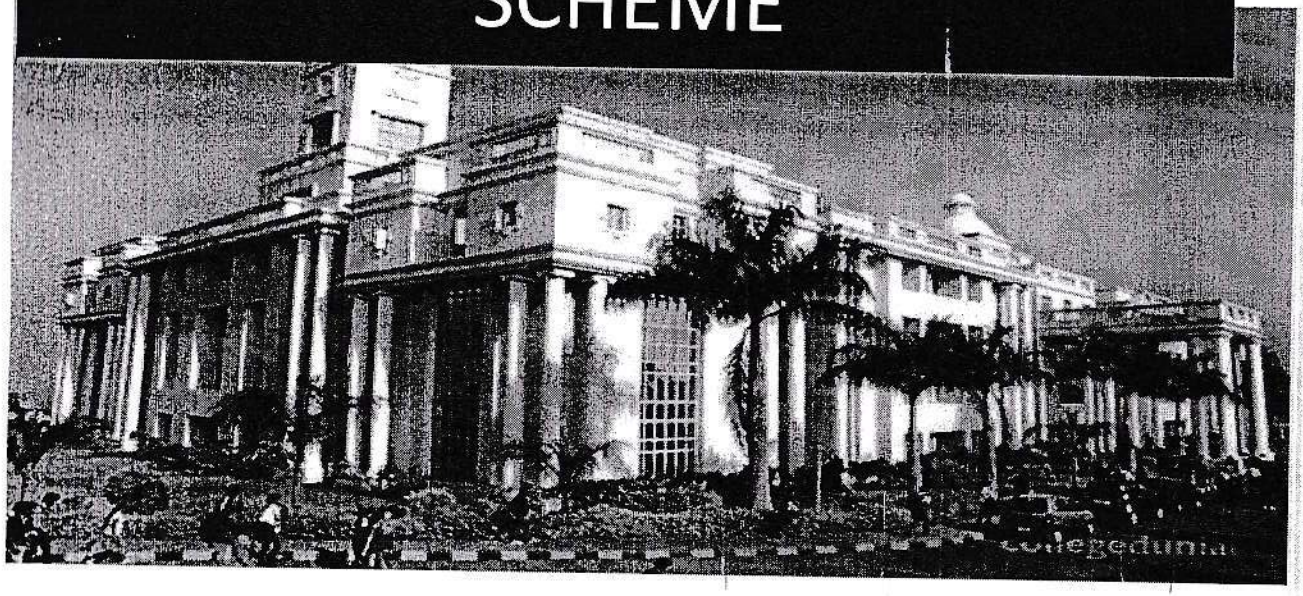
Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignments	10	
SEE	Semester End Examination	50	50
Grand Total			100

CO/PO	PO6
CO 1	3
CO 2	3
CO 3	3
CO 4	3
Average	3

Low-1: Medium-2: High-3

SCHEME



VII Semester 2022
Scheme and Syllabus

Electrical & Electronics Engineering

GLOBAL ACADEMY OF TECHNOLOGY

(Autonomous Institution affiliated to VTU, Belagavi,

Re-accredited by NAAC with A grade

NBA Accredited CS, E&C, E&E, MECH and IS branches)Ideal Homes Township,

Department of Electrical and Electronics Engineering

Global Academy of Technology
HOD, EEE

Global Academy of Technology

(An Autonomous Institution, affiliated to VTU, Belagavi, recognized by Karnataka and Approved by AICTE, New Delhi.)

B.E. in Electrical & Electronics Engineering Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

Scheme A- VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22EEE71	Power Systems IV	TD: EEE PSB:	3	0	2		03	50	50	100	4
2	IPCC	22EEE72	Electric Vehicles	TD: PSB:EEE	3	0	2		03	50	50	100	4
3	PCC	22EEE73	Digital Signal Processing	TD:, PSB:EEE	3	2	0		03	50	50	100	4
4	PEC	22EEE74X	Professional Elective-III	TD:EEE PSB:EEE	3	0	0		03	50	50	100	3
5	OEC	22EEE75X	Open Elective- II	TD:EEE PSB:EEE	3	0	0		01	50	50	100	3
6	PROJ	22EEEP76	Major Project Phase-II		0	0	12		03	100	100	200	6
									Total	**400**	**300**	**700**	**24**

Professional Elective Course

22EEE74A	Machine Learning	22EEE74C	Switched Mode Power Converters
22EEE74B	Robotics and Automation	22EEE74D	FACTS & HVDC

Open Elective Course

22EEE75A	Smart Grid Technology	22EEE75C	Smart Internet of Things
22EEE75B	Electrical Energy Conservation and Auditing	22EEE75D	Energy Storage System

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L**: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD**- Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI

H.C. Rajeshwarinagar

Dean Academic
Global Academy of Technology,
Rajarajeshwarinagar, Benga 98

HOD, EEE

semester.

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

PROJECT WORK (21MEP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To install responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve ingroup discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

SEMESTER VII

Course: Power System IV

Subject Code	22EEE71	CIE Marks	50
Hours/Week (L:T)	3:0:2	SEE Marks	50
Credits	4	Examination Hours	03

Prerequisites:

Course Learning Objectives: At the end of the course the student should be able to:

CLO1	To explain formulation of network models, bus admittance matrix for solving load flow problems and bus impedance matrix for the use in short circuit studies in power systems.
CLO2	To explain load flow analysis using different methods and compare them
CLO3	Solve issues of economic load dispatch and unit commitment problems.
CLO4	To explain basic generator control loops, functions of Automatic generation control, speed governors and mathematical models of Automatic Load Frequency Control
CLO5	To explain voltage and reactive power control in an interconnected power system.

Content	No. of Hrs/ RBT levels
MODULE I – Network Topology Introduction and basic definitions of Elementary graph theory Tree, cut-set, loop analysis. Formation of Incidence Matrices. Primitive network- Impedance form and admittance form, Formation of Y Bus by Singular Transformation. Ybus by Inspection Method. Z Bus Formulation by Step by step building algorithm without mutual coupling between the elements by addition of link and addition of branch. Z bus Algorithm for Short Circuit Studies.	08 Hours/ L3
MODULE II – Load Flow Studies Classification of buses. Power flow equation, Operating Constraints, Data for Load flow, Gauss Seidal iterative method. Newton-Raphson method derivation in Polar form, Fast decoupled load flow method, Flow charts of LFS methods. Comparison of Load Flow Methods	08 Hours/ L4
MODULE III – Economic Operation of Power System Introduction and Performance curves Economic generation scheduling neglecting losses and generator limits Economic generation scheduling including generator limits and neglecting losses Economic dispatch including transmission losses Derivation of transmission loss. Unit Commitment: Introduction, Constraints and unit commitment solution by priorty list method and dynamic forward DP approach (Flow chart and Algorithm only).	08 Hours/ L3
MODULE IV – Automatic Generation Control Introduction, Schematic diagram of load frequency and excitation voltage regulators of turbo generators, Load frequency control (Single area case), Turbine speed governing system, Model of speed governing system, Turbine model, Generator load model, Complete block diagram of representation of load frequency control of an isolated power system, Steady state analysis, Control area concept, Proportional plus Integral Controller Two area load frequency control,	8 Hours/ L3
MODULE V – Control of Voltage and Reactive Power: Introduction, Generation and absorption of reactive power, Relation between voltage, power and reactive power at a node, Methods of voltage control: (i) Injection of reactive power, Shunt capacitors and reactors, Series capacitors, Synchronous compensators, Series injection. (ii) Tap changing transformers. Combined use of tap changing transformers and reactive power injection, Hybrid Booster transformers, Phase shift transformers, Voltage collapse.	8 hours L3
Total Hours	**40 Hours**

S.no.	Experiments
1	ABCD parameters: Formation for symmetric Π/T configuration. Verification of AD-BC=1and determination of efficiency and regulation.
2.	Determination of Power angle diagrams, reluctance power, excitation, emf and regulation for Salient and Non salient pole synchronous machines
3.	To obtain swing curve and to determine critical clearing time and regulation for a single machine connected to infinite bus.
4.	Formation of Y-Bus with and without mutual coupling by (i) Inspection method and (ii) Singular transformation method.
5.	Determination of bus currents, bus power and line flow for a specified system voltage (Bus) profile.
6	Formation of Z-bus using Z bus building algorithm (without mutual coupling)
7	Formation of Jacobian for a system of 4 buses in polar co-ordinates (No PV buses)
8	Determination of fault currents and voltages in a single transmission line for SLGF and DLG
9	LFA using G-S, N-R and FDLF method, both PQ and PV buses
10	Optimal Generator scheduling for Thermal power plants

Course Outcomes: The students will be able to:

CO71.1	Calculate bus impedance and bus admittance matrices for power system.
CO71.2	Analyse load flow analysis using Gause-Seidal, Newton Raphson and fast decoupled method.
CO71.3	Solve issues of economic load dispatch and unit commitment problems.
CO71.4	Explain basic generator control loops, functions of Automatic generation control, speed governors and mathematical models of Automatic Load Frequency Control
CO71.5	Understand voltage and reactive power control in an interconnected power system

TEXTBOOKS:

1. D P Kothari, I J Nagarath, Power System Engineering , Mc Graw Hill Education, Second Editiion, 2008
2. William D. Stevenson Jr , Elements of Power System Analysis, McGraw Hill Education; 4th edition , 2017

REFERENCES:

1. J. Duncan Glover et al, Power System Analysis and Design, Cengage, 4th Edition, 2008
2. Hadi Sadat, Power System Analysis Mc Graw Hill Education, 1st Edition, 2002

WEBLINKS:

1. https://onlinecourses.nptel.ac.in/noc22_ee17
2. https://www.udemy.com/course/electrical-power-engineering
3. https://nptel.ac.in/courses/108105067
4. https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/
5. https://www.classcentral.com/course/swayam-power-system-analysis-14243

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

1.

2. Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO/PSO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO71.1	3	2	2	1	3	-	1	2	2	2	-	2	1	3	1
CO71.2	3	2	2	1	3	-	1	2	2	2	-	2	1	3	1
CO71.3	3	2	2	1	-	-	1	2	2	2	-	2	1	3	1
CO71.4	3	2	2	1	3	-	1	2	2	2	-	2	1	3	1
CO71.5	3	-	2	1	-	-	1	2	2	2	-	2	1	3	1
Average	3	2	2	1	3	-	1	2	2	2	-	2	1	3	1

SEMESTER VII

Course: Electric Vehicles

Course Code	22EEE72	CIE Marks	50
Hours/Week (L: T: P)	3:0:2	SEE Marks	50
No. of Credits	4	Examination Hours	03

Prerequisites: Power Electronics/ Electric Machines

Course Objectives:

CLO1	Understand Vehicle Fundamentals
CLO2	Explain electric, hybrid electric and plug in hybrid electric vehicle, their architecture and technology
CLO3	Understand electric propulsion unit and its control for application to electric vehicles.
CLO4	Discuss different energy storage technologies and their control, used for hybrid electric vehicles and functions of battery management systems
CLO5	Demonstrate different configurations of electric vehicle charging techniques

Content	No. of Hours/ RBT levels
Module 1: Vehicle Fundamentals Vehicle Basics, Roadway Fundamentals, Laws of motion, vehicle kinetics, Dynamics of Vehicle Motion, Propulsion Power, Velocity & Acceleration, EV Powertrain Component Sizing.	8 hours L3
Module 2: Basics of EV Technology Economic and environment impact of electrical vehicle. Basics of the EV, HEV configurations – Series hybrid, parallel hybrid, series parallel hybrid, complex hybrid systems. Power Flow control in HEV configurations. Basics of Plug-In Hybrid Electric Vehicle (PHEV) and its architecture.	8 hours L3
Module 3: Electric Propulsion Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	8 hours L3
Module 4: Energy Storage in EVs Batteries – and their types, Fuel Cells - and their types, basics of Fuel Cell Vehicles (FCEVs,) Ultra Capacitors and Ultra high speed Flywheels, their features and design. Hybridization of Energy Sources. Battery Management Systems-block diagram and functions.	8 hours L3
Module 5: EV Charging Technologies EV Charging Technologies: Classification of different charging technology for EV charging station, introduction to Grid-to-Vehicle, Vehicle to Grid (V2G) or Vehicle to Buildings (V2B) or Vehicle to Home (V2H) operations, bi-directional EV charging systems, energy management strategies used in hybrid and electric vehicle, Wireless power transfer (WPT) technique for EV charging. ISO standards for EV charging.	8 hours L3

Sl. No.	Experiments	No. of Hours/ RBT levels
1	Modelling and Simulation of an Electric Vehicle using MATLAB/Simulink	2 hours (L3)
2	Simulate a Battery Pack Model for an Electric Vehicle.	2 hours (L3)
3	Simulation of Buck Boost Converters using MATLAB.	2 hours (L3)
4	Simulation of AC/DC three phase PWM converters, to understand the concept of charging from grid	2 hours (L3)
5	Observe the performance of various sensors used in Electric Vehicles	2 hours (L3)
6	To plot the Speed torque characteristics of a BLDC motor	2 hours (L3)
7	Study the Performance of Electric Vehicle Powered with Solar and Li Ion Battery	2 hours (L3)
8	To plot the charging discharging characteristics of lead acid and lithium ion batteries	2 hours (L3)
9	Study of Running, reversing and braking in BLDC Hub motor	2 hours (L3)
10	To observe the charging of Battery using Regenerative Braking	2 hours (L3)

Course Outcomes: **The students will be able to:**

CO72.1	Understand Vehicle Fundamentals
CO72.2	Understand the architecture and technology of electric, hybrid electric and plug in hybrid electric vehicle
CO72.3	Develop the electric propulsion unit and its control for application to electric vehicles.
CO72.4	Explain the use of different energy storage systems used for electric vehicles
CO72.5	Understand the control and configurations of various EV charging technologies

TEXTBOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, Third Edition, CRC Press 2021

REFERENCES:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 2003
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd. , 2011

WEBLINKS:

1. https://nptel.ac.in/courses/108106170
2. cw.mit.edu/courses/16-682-technology-in-transportation-spring-2011

Scheme of Evaluation: **(Integrated courses)**

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

3. **Table: Distribution of weightage for CIE & SEE of Integrated courses**

	Component	Marks	Total Marks
CIE	CIE Test-1	30	50
	CIE Test-2	30	
	CIE Test-3	30	
	Laboratory	20	
SEE	Semester End Examination	100	50
		Grand Total	100

CO/PO/PSO Mapping

Co/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO72.1	3	2	2	1	-		1	3	3	3	-	2	1	2	2
CO72.2	3	2	2	1	-	-	1	3	3	3	-	2	1	2	2
CO72.3	3	2	2	1	-	-	1	3	3	3	-	2	1	2	2
CO72.4	3	2	2	1	-	-	1	3	3	3	-	2	1	2	2
CO72.5	3	-	2	1	-	-	1	3	3	3	-	2	1	2	2

SEMESTER VII

Course: Digital Signal Processing

Course Code	22EEE73	CIE Marks	50
Hours/Week (L: T: P)	3:2:0	SEE Marks	50
No. of Credits	4	Examination Hours	03

Prerequisites: Mathematics for EEE stream

Course Objectives:

CLO1	Explain basic signals, their classification, basic operations on signals, and the properties of the systems.
CLO2	Explain computation of convolution of signals in continuous and discrete time domain and the properties of impulse response representation.
CLO3	Compute discrete Fourier Transform of a sequence by direct method, Linear transformation Method and using Fast Fourier Transformation Algorithms.
CLO4	Design IIR all pole analog filters and transform them into digital filter using Impulse Invariant and Bilinear Transformation Techniques.
CLO5	Design FIR filters using Window Method and Frequency Sampling Method.

Content	No. of Hours/RBT levels
Module 1: Discrete Fourier Transforms (DFT) Introduction to DFT, Properties of DFT, multiplication of two DFTs- the circular convolution, additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method	8/ L3
Module 2: Fast-Fourier-Transform (FFT) algorithms Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms). Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and Decimation-in-frequency algorithms.	8/ L3
Module 3: Design of Infinite Impulse Response (IIR) Filters Characteristics of commonly used analog IIR filters – Butterworth and Chebyshev Type - I filter, Analog to analog frequency transformations. Design of Digital IIR filters from analog filters (Butterworth and Chebyshev) - Impulse invariance method. Mapping of transfer functions: Bilinear transformation method.	8/ L3
Module 4: Design of Finite Impulse Response (FIR) Filters Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Hanning and Kaiser window techniques, FIR filter design using frequency sampling Technique.	8/ L3
Module 5: Digital Filter Realization and Applications of DSP Implementation of discrete-time systems: Structures for IIR Systems - direct form I and direct form II, cascade and parallel structures. Structures for FIR systems-direct form, cascade and Linear Phase Form. Applications of DSP: Voice Processing, Image processing	8/ L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO73.1	Compute Discrete Fourier Transform of a sequence and the convolution of two sequences.
CO73.2	Compute Discrete Fourier Transform of a sequence by using fast methods
CO73.3	Design Butterworth and Chebyshev IIR digital filters using impulse variance and bilinear transformation methods.
CO73.4	Design FIR filters using window techniques and frequency sampling methods.
CO73.5	Implement IIR and FIR filter using different forms.

TEXTBOOKS:

1. Digital Signal Processing: Principles, Algorithms and Applications, Jhon G Proakis, Dimitris K Manolakis, Printice Hall, 4th Edition.
2. Digital Signal Processing by S. Salivahanan, 4th Edition, 2019.
3. Digital Signal Processing, A Nagoor Kani, Tata McGraw-Hill, 2nd Edition, 2017.

REFERENCE BOOKS:

1. Digital Signal Processing, Anand Kumar, Prentice Hall India Learning Private Limited, 2nd Edition, 2015.
2. Digital Signal Processing: A computer Based Approach with DSP Laboratory Using MATLAB, Sanjit K Mitra, McGraw-Hill, 2001

E-Books / Web References

1. http://www.freebookcentre.net/Electronics/DSP-Books
2. https://www.electronicsforu.com/special/cool-stuff-misc/8-free-digital-signal-processing-ebooks

MOOCs

1. https://nptel.ac.in/courses/117102060
2. https://onlinecourses.nptel.ac.in/noc21_ee20/preview

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper **is to be set for 100 marks and the marks scored will be proportionately reduced to 50.** There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO73.1	3	2	2	-	2	-	-	-	-	-	-	1	-	-	2
CO73.2	3	2	2	-	2	-	-	-	-	-	-	1	-	-	2
CO73.3	3	2	2	-	2	-	-	-	-	-	-	1	-	-	2
CO73.4	3	2	2	-	2	-	-	1	-	-	-	1	-	-	2
CO73.5	3	2	2	-	2	-	-	1	-	-	-	1	-	-	2
Average	3	2	2	-	2	-	-	1	-	-	-	1	-	-	2

SEMESTER VII

Course: Machine Learning (Professional Elective)

Course Code	22EEE74A	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: AI

Course Learning Objectives:

CLO1	Define machine learning and problems relevant to machine learning.
CLO2	Differentiate supervised, unsupervised and reinforcement learning.
CLO3	Apply neural networks, Bayes classifier and k nearest neighbor, for problems appear in machine learning.
CLO4	Apply Bayesian learning techniques for problems appear in machine learning.
CLO5	Apply Instance based and reinforcement learning techniques for problems appear in machine learning.

Content	No. of Hours/ RBT levels
Module 1: Concept Learning and General-to-Specific Ordering Well-posed learning problems, designing a learning system, Perspectives and issues in machine learning, Concept learning task, Concept learning as search, FIND-S, Version spaces and candidate elimination algorithm, Inductive bias.	07 Hours/ L3
Module 2: Decision Tree Learning and Kernel Machines Decision Tree Learning: Decision tree representation, Problems for decision tree learning, Decision tree learning algorithm, Hypothesis space search, Inductive bias in decision tree learning, Issues in decision tree learning. Kernel Machines: Support vector machines – SVMs for regression, SVMs for classification, Choosing C, A probabilistic interpretation of SVMs	08 Hours/ L3
Module 3: Artificial Neural Networks Neural network representations, Appropriate problems for neural network learning, Perceptron's, Multilayer networks and Backpropagation algorithm, Convergence and local minima, Representational power of feedforward networks, Hypothesis space search and inductive bias, Hidden layer representations, Generalization, Overfitting, Stopping criterion, An Example - Face Recognition.	08 Hours/ L3
Module 4: Bayesian Learning Bayes theorem and concept learning, Maximum likelihood and least-squared error hypothesis, Maximum likelihood hypotheses for predicting probabilities, Minimum Description Length principle, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier, An Example – Learning to classify text; Bayesian belief networks, EM Algorithm.	09 Hours/ L3
Module 5: Instance Based Learning and Reinforcement Learning Instance Based Learning: k-Nearest Neighbor learning, Locally weighted regression, Radial basis functions, Case-based reasoning. Reinforcement Learning: The learning task, Q-learning, Nondeterministic rewards and actions, Temporal difference learning, Generalizing from examples, Relationship to dynamic programming	08 hours/ L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO74A.1	Understand the concept learning algorithms to automatically infer a general description for a given learning problem.
CO74A.2	Analyze the underlying mathematical models within machine learning algorithms and learning tasks.
CO74A.3	Apply suitable machine learning algorithms for various types of learning tasks.
CO74A.4	Design efficient neural architectures to model patterns for a given learning problem.
CO74A.5	Apply machine learning algorithms to solve societal problems such as face recognition, text classification

Textbooks:

1. Tom M. Mitchell, Machine Learning, McGraw Hill, 2013.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

Reference books:

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 4th Edition, 2020.
2. Shai Shalev Shwartz, Shai Ben David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.

E-Books / Web References

https://swayam.gov.in/nd1_noc19_cs52/preview
https://www.udemy.com/course/machinelearning/

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO74A.1	3	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO74A.2	2	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO74A.3	2	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO74A.4	3	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO74A.5	2	3	2	1	-	-	-	-	-	-	-	-	-	2	-
Average	3	3	2	1	-	-	-	-	-	-	-	-	-	2	-

SEMESTER VII

Course: Robotics & Automation (Professional Elective)

Course Code	22EE74B	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Programming in a high-level language, Sensor and Transducers

Course Objectives:

CLO1	To identify robots and its peripherals for satisfactory operation
CLO2	To introduce the concepts of Robotic system, its components and instrumentation and control related to robotics.
CLO3	To develop skills in performing spatial transformations associated with rigid body motions.
CLO4	To provide knowledge of the singularity issues associated with the operation of robotic systems.
CLO5	To Control robots for industrial and non-industrial applications.

Content	No. of Hours/ RBT levels
Module 1: Robot basics and Elements **ROBOT BASICS:** Robot-Basic concepts, Need, Law, History, Anatomy, specifications. Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot. **ROBOT ELEMENTS:** End effectors-Classification, Types of Mechanical actuation, Gripper design, Robot drive system Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation.	08 Hours/ L3
Module 2: Industrial Robotics Robotic configuration, robot anatomy and related attributes, robot control systems, end effectors, sensors in robotics, industrial robot applications, robot accuracy and repeatability, different types of robotics, various generations of robots, degrees of freedom – Asimov's laws of robotics dynamic stabilization of robots.	08 Hours/ L3
Module 3: Spatial descriptions and transformations Positions, orientations, and frames. Mappings: Changing descriptions from frame to frame. Operators: translations, rotations and transformations, transformation arithmetic transform equations, transformation of free vectors computational considerations, manipulator Kinematics, link description, link-connection description, actuator space joint space and Cartesian space.	08 Hours/ L3
Module 4: Robot programming Introduction, levels of robot programming, requirements of robot programming language, problems pertaining to robot programming languages, offline programming systems, central issues in OLP systems, automating subtasks in OLP systems, simple programs on robot applications	8 Hours/ L3
Module 5: Robot Applications ROBOT APPLICATIONS Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Applications, Micro and Nanorobots, Future Applications.	8 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO74B.1	Interpret the various parts of robots and fields of robotics.
CO74B.2	List and explain the basic elements of industrial robots.
CO74B.3	Illustrate the various kinematics and inverse kinematics of robots.
CO74B.4	Explain the levels of robotic programming.
CO74B.5	Explain the control of robots for some specific applications.

Textbooks:

1. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, "Industrial Robotics Technology, Programming and Applications", Tata –McGraw Hill Pub. Co., 2008.
2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012

Reference books:

1. Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Company Limited, 2010.
2. Klafter.R.D, Chmielewski.T.A, and Noggin's., "Robot Engineering: An Integrated Approach"', Prentice Hall of India Pvt. Ltd., 1994.
3. Fu.K.S, Gonzalez.R.C&Lee.C.S.G, "Robotics control, sensing, vision and intelligence", Tata- McGraw Hill Pub. Co., 2008.
4. Robotics for Engineers –YoramKoren, McGraw Hill International, 1st edition, 1985.

E-Books /Web References:

1. https://spectrum.ieee.org/topic/robotics/
2. http://www.robot.bmstu.ru/files/books/(Ebook%20-%20English)%20Mcgraw-Hil,%20Pic%20Robotics%20--%20A%20Beginner'S%20Guide%20To%20Robotic.pdf

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_me76/preview
2. https://nptel.ac.in/courses/112105249
3. E-learning: www.vtu.ac.in

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping																
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO74B.1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO74B.2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO74B.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO74B.4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO74B.5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-
Average	3	2	1	-	-	-	-	-	-	-	-	-	-	-	2	-

SEMESTER VII

Course: Switched Mode Power Converters (Professional Elective)

Course Code	22EEE74C	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Power Electronics

Course Objectives:

CLO1	Understand the working of buck converter and boost converter under continuous and discontinuous conduction mode.
CLO2	Illustrate the working of CUK converter and Buck-boost converter.
CLO3	Understand the working of flyback converter, forward converter and push pull converter with reference to switched mode power supplies.
CLO4	Analyze switched mode Dc to AC single phase and three phase inverters with different switching schemes.
CLO5	Illustrate the techniques for zero-voltage and zero-current switching of resonant pulse inverters.

Content	No. of Hours/ RBT levels
Switched Mode DC-to-DC Converter Introduction, control of DC-DC converters, buck converters, boost Converter, Continuous Conduction mode, boundary between continuous and discontinuous conduction – critical values of inductance/load resistance - discontinuous conduction mode with constant output voltage - Output voltage ripple.	8 hours/ L4
Switched Mode DC-to-DC Converter Buck-boost converter, Continuous Conduction mode, boundary between continuous and discontinuous conduction – critical values of inductance/load resistance - discontinuous conduction mode with constant output voltage, Cuk converter – Full-ridge dc-dc Converter – PWM with bipolar voltage and unipolar voltage switching –comparison of dc-dc converters	8 hours/ L4
Switched Mode Power Supplies Linear Power Supply – disadvantages of linear power supply – switched mode power supply – dc-dc converters with electrical isolation. Fly back converter – continuous & discontinuous conduction mode, double ended fly back converter – forward converters – basic forward converter – practical forward converter – continuous conduction mode only - double ended forward converter – push pull converter.	8 hours/ L3
Switched Mode DC to AC converter Introduction, pulse width modulated switching scheme, square wave switching scheme, 1-phase square wave full-bridge inverter PWM switching scheme – PWM with bipolar & unipolar voltage switching, harmonic analysis of output voltage, output control by voltage cancellation, single phase push-pull inverter. Pulse width modulated 3-phase voltage source inverter	8 hours/ L4
Resonant Converters Basic resonant circuit concepts – series resonant circuit – parallel resonant circuit – load resonant converter - ZCS resonant converter - L type & M type - ZVS resonant converter – comparison of ZCS & ZVS Resonant Converters	8 hours/ L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO74C.1	Analyze buck converter and boost converter under continuous and discontinuous conduction mode.
CO74C.2	Illustrate the working of CUK converter and Buck-boost converter.
CO74C.3	Analyze flyback converter, forward converter and push pull converter.
CO74C.4	Analyze switched mode Dc to AC single phase and three phase inverters with different switching schemes.
CO74C.5	Explain the techniques for zero-voltage and zero-current switching of resonant pulse inverters.

Textbooks:

1. Power Electronics Converters, Applications and Design (For Module 5: Chapters 16 and 17), Ned Mohan et al. Wiley, 3rd Edition, 2014.
2. Power Electronics: Circuits Devices and Applications, Mohammad H Rashid, Pearson education, 4th Edition, 2014.

Reference books:

1. Power Electronics, Daniel W Hart, McGraw Hill 1st Edition, 2011
2. Switch-Mode Power Converters: Design and Analysis, Keng C. Wu, Academic Press Inc (1 December 2005)

E-Books / Web References

- https://ee.iisc.ac.in/wp-content/uploads/2023/01/SMPC_VRamnarayanan.pdf

MOOCs

- https://nptel.ac.in/courses/108105180
- https://www.coursera.org/learn/converter-circuits?specialization=power-electronics

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO74C.1	3	2	-	-	-	-	-	-	-	-	-	2	-	-	3
CO74C.2	3	2	-	-	-	-	-	-	-	-	-	2	-	-	3
CO74C.3	3	1	-	-	-	-	-	-	-	-	-	2	-	-	3
CO74C.4	3	2	-	-	-	-	-	-	-	-	-	2	-	-	3
CO74C.5	3	2	-	-	-	-	-	-	-	-	-	2	-	-	3
Average	3	2	-	-	-	-	-	-	-	-	-	2	-	-	3

SEMESTER – VII

Course: FACTS & HVDC (Professional Elective)

Course Code	22EEE74D	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: PS-I & PS-II

Course Objectives:

CLO1	To explain the basic concepts, definitions of flexible ac transmission systems and benefits from FACTS technology.
CLO2	To describe shunt controllers, Static Var Compensator and Static Compensator for injecting reactive power in the transmission system in enhancing the controllability and power transfer capability
CLO3	To describe series Controllers Thyristor -Controlled Series Capacitor (TCSC) and the Static Synchronous Series Compensator (SSSC) for control of the transmission line current.
CLO4	To explain advantages of HVDC power transmission, overview and organization of HVDC system.
CLO5	To describe the basic components of a converter, the methods for compensating the reactive power demanded by the converter

Content	No. of Hours/ RBT levels
Module 1 FACTS Concept and General System Considerations: FACTS concept and General system considerations – Transmission Interconnections, Flow of power in an AC system, Loading capability, Power flow and dynamic stability considerations of a transmission interconnection, basic types of FACTS controllers, IEEE definitions, FACTS devices in India and abroad, Checklist of Possible Benefits from FACTS Technology, In Perspective: HVDC or FACTS.	07 Hours/ L3
Module 2 Static Shunt Compensators: Objectives of Shunt Compensation - Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, Improvement of Transient Stability. Methods of Controllable Var Generation –Thyristor controlled Reactor (TCR) and Thyristor Switched Reactor (TSR), Thyristor Switched Capacitor (TSC), Switching Converter Type Var Generators, Basic Operating Principles, Basic Control Approaches. Static VAR Compensators: SVC and STATCOM, the Regulation Slope. Comparison between STATCOM and SVC, V –I and V – Q Characteristics, Transient stability, Response Time	08 Hours/ L4
Module 3 Static Series Compensators: Objectives of Series Compensation, Concept of Series Capacitive Compensation. Voltage Stability, Improvement of Transient Stability, variable impedance type series compensators: GTO Thyristor-Controlled Series Capacitor, Thyristor-Switched Series Capacitor, Thyristor-Controlled Series Capacitor (GCSC, TSSC, TCSC), Static synchronous Series Compensator (SSSC), Transmitted Power Versus Transmission Angle Characteristics.	08 Hours/ L4
Module 4 Introduction to HVDC System Basic Concepts Necessity of HVDC systems, Economics and Terminal equipment of HVDC transmission systems, Types of HVDC Links, Apparatus required for HVDC Systems, Comparison of AC and DC Transmission, Application of DC Transmission System, Planning and Modern trends in D.C. Transmission. Analysis of HVDC Converters: Choice of Converter Configuration, Analysis of Graetz circuit, Characteristics of 6 Pulse and 12 Pulse converters.	09 Hours/ L3
Module 5 Converter and HVDC System Control Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control	08 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO74D.1	Explain transmission interconnections, flow of Power in an AC System, limits of the loading capability, dynamic stability considerations of a transmission interconnection and controllable parameters and benefits from FACTS technology.
CO74D.2	Analyze shunt controllers, Static Var Compensator and Static Compensator for injecting reactive power in the transmission system in enhancing the controllability and power transfer capability.
CO74D.3	Analyze series Controllers Thyristor-Controlled Series Capacitor (TCSC) and the Static Synchronous Series Compensator (SSSC) for control of the transmission line current.
CO74D.4	Explain advantages of HVDC power transmission, overview and organization of HVDC system.
CO74D.5	Describe the basic components of a converter, the control techniques used for converter control.

Textbooks:

1. Hingorani, Narain G., and Laszlo Gyugyi. Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems. New York: IEEE Press, 2000.
2. K. R. Padiyar, HVDC Power Transmission Systems: Technology and system Interactions, New Age International(P) Limited, and Publishers, 1990.

Reference books:

E-Books / Web References

1. https://onlinecourses.nptel.ac.in/noc20_ee84/preview
2. http://nitttrc.edu.in/nptel/courses/video/108107143/L01.html

MOOCs

1. https://nptel.ac.in/courses/108107143

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 50 marks each. Marks scored in each test is reduced to 20 and added to test component.

CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests.

Two quizzes are to be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	20	50
	CIE Test-2	20	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	Semester End Examination	50	50
Grand Total			100

SEMESTER – VII

Course: Smart Grid Technology (Open Elective)

Course Code	22EEE75A	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	03	Examination Hours	03

Prerequisites: PS-I, PS-II, PS-III & PS-IV

Course Objectives:

CLO1	Understand the operation of Smart Grid technologies
CLO2	Understand the Smart Grid Architecture
CLO3	Understand the different types of Tools and Techniques for Smart Grid
CLO4	Understand the different types of Communication Technologies in Smart Grid
CLO5	Understand the smart meters and advanced metering infrastructure

Content	No. of Hours/ RBT levels
Module 1 Introduction to Smart Grid: Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India.	07 Hours/ L3
Module 2 Smart Grid Architecture: Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system, advanced metering infrastructure. The fundamental components of Smart Grid designs, Transmission Automation, Distribution Automation, Renewable Integration	08 Hours/ L3
Module 3 Tools and Techniques for Smart Grid: Computational Techniques – Static and Dynamic Optimization Techniques for power applications such as Economic load dispatch – Computational Intelligence Techniques – Evolutionary Algorithms in power system – Artificial Intelligence techniques and applications in power system	08 Hours/ L3
Module 4 Communication Technologies in Smart Grid: Introduction to Communication Technology, Two Way Digital Communications Paradigm, Synchro-Phasor Measurement Units (PMUs) – Wide Area Measurement Systems (WAMS)- Introduction to Internet of things (IoT)- Applications of IoT in Smart Grid.	09 Hours/ L3
Module 5 Smart Meters and Advanced Metering Infrastructure Introduction to Smart Meters, Advanced Metering infrastructure (AMI)drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED)&their application for monitoring & protection	08 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO75A.1	Understand the features of Smart Grid
CO75A.2	Assess the role of automation and digitization in Transmission and Distribution
CO75A.3	Analyze Smart grids with evolutionary algorithms
CO75A.4	Analyze Communication Technologies used in smart grid
CO75A.5	Understand the operation of smart meters and the importance of Advanced Metering Infrastructure

Textbooks:

1. Smart Grids, Infrastructure, Technology and Solutions, S. Borlase, CRC Press, 2013, 1st Edition.
2. Renewable and Efficient Electric Power System, G. Masters, Wiley–IEEE Press, 2013, 2nd Edition.

Reference books:

1. Synchronized Phasor Measurements and their Applications, A.G. Phadke and J.S. Thorp, Springer, 2017, 2nd Edition.

2. Wind Power in Power Systems, T. Ackermann, Hoboken, N J, USA, John Wiley, 2012, 2nd Edition.

E-Books / Web References

3. https://ieeexplore.ieee.org/book/9509795
4. https://www.elsevier.com/books/advances-in-smart-grid-power-system/tomar/978-0-12-824337-4

NPTEL/MOOCs

1 https://nptel.ac.in/courses/108107113

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50.

There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 50 marks each. Marks scored in each test is reduced to 20 and added to test component.

CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests.
Two quizzes are to be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.
All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.
Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Quiz /AAT	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO75A.1	3	2	2	2	2	2	-	-	-	-	-	-	1	3	1	-
CO75A.2	1	2	3	3	1	2	-	-	-	-	-	-	1	3	1	-
CO75A.3	2	2	3	2	2	2	-	-	-	-	-	-	1	3	1	-
CO75A.4	3	2	3	2	2	3	-	-	-	-	-	-	1	3	1	-
CO75A.5	2	2	3	2	2	2	-	-	-	-	-	-	1	3	1	-
Average	2	2	3	2	2	2	-	-	-	-	-	-	1	3	1	-

SEMESTER VII

Course: Energy Conservation and Auditing (Open Elective)

Course Code	22EEE75B	CIE Marks	50
Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	3	Examination Hours	3

Prerequisites:

Course Learning Objectives:

CLO 1	To explain fundamentals of energy, the current energy scenario, energy management and energy conservation.
CLO 2	To explain the importance of Energy audit, concept of energy audit, the energy conservation act and its features.
CLO 3	To explain energy audit of fans, power plants.
CLO 4	To explain energy of lighting systems and electric motors.
CLO 5	To explain Energy-Saving Measure in existing as well as new buildings

Content	No. of Hours/ RBT levels
Module 1: Fundamentals of Energy and Energy Scenario: Fundamentals of Energy, Various Types of Energy, Commercial and Non-commercial Energy, Grades of Energy, Energy Demand and Supply in India, Energy Scenario in India, Energy Security in India, Future Energy Strategy. **Energy Management and Energy Conservation Opportunities:** Energy Management, Tariff, Energy Conservation.	08 hours/ L3
Module 2: Electrical Energy Management: Maximum Demand Basics, Improvement of Power Factor, Capacitor Locations, Pump, Fan Systems. **Energy Audit:** Concept of Energy Audit, Type of Energy Audit, Collecting Data Strategy, Technical and Economic Feasibility, Types of Energy Conservation Measures, Understanding Energy Costs, Benchmarking and Energy Performance, Plant Energy Performance, Fuel and Energy Substitution.	08 hours/ L3
Module 3: Energy Audit (Continued): The Energy Conservation Act, 2001 and Its Features, Responsibilities and Duties to be Assigned Under the Energy Conservation Act, 2001. **Energy Audit of Fans:** Classification of Fans, Fan Laws and Curves, Power Consumption by a Fan, Energy-Saving Potential in Fans.	08 hours/ L3
Module 4: Energy Audit of a Power Plant: Indian Power-Plant Scenario, How is Energy Audit of Power Plants Helpful?, Types of Power Plants, Energy Audit of Power Plant. **Energy Audit of Motors**: Classification of Motors, Parameters Related to Motors, Efficiency of Motors, Energy Conservation in Motors.	08 hours/ L3
Module 5: Energy Audit of Lighting Systems: Fundamentals of Lighting, Different Lighting Systems, Ballasts, Fixtures, Reflectors, Lenses and Louvers, Lighting Control Systems, Lighting System Audit, Energy-Saving Opportunities. **Energy Audit Applied to Buildings**: Energy-Saving Measures in New Buildings, Water Audit, How to Audit Your Home? General Energy-saving Tips Applicable to New as Well as Existing Buildings.	08 hours/ L3

Course Outcomes

Upon completion of this course, student will be able to:

CO75B. 1	Discuss the fundamentals of energy, the current energy scenario. energy management and energy conservation.
CO75B. 2	Explain the importance of Energy audit, concept of energy audit, the energy conservation act and its features.
CO75B. 3	Conduct energy audit of fans, power plants.
CO75B. 4	Conduct energy audit of motors and lighting systems
CO75B. 5	Explain energy saving measures in existing as well as new buildings.

Textbooks:

1. Energy Management Conservation and Audits, Anil Kumar, Om Prakash, Prashant Singh Chauhan, Samsher First edition 2020, CRC Press.
2. Handbook of Energy Audit, Sonal Desai, 2015, McGraw Hill Education (India) Private Limited

Reference books:

1. Energy Management Handbook, W.C. Turner, John Wiley and Sons
2. Energy Efficient Electric Motors and Applications, H.E. Jordan, Plenum Pub. Corp

E-Books / Web References

3. http://sites.google.com>venusict.org>ntpl-video-link

MOOCs

3. https://nptel.ac.in/courses/112105221
4. https://nptel.ac.in/courses/105102175

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO – PO Mapping With Strengths															
CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO75B. 1	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO75B. 2	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO75B. 3	3	1	-	1	-	-	-	1	-	-	1	-	-	1	-
CO75B. 4	3	1	-	1	-	-	-	1	1	-	1	-	-	1	-
CO75B. 5	3	1	-	1	-	-	-	1	1	-	1	-	-	1	-
Average	3	1	-	1	-	-	-	1	1	-	1	-	-	1	-

SEMESTER – VII

Course: Smart Internet of Things (Open Elective)

Course Code	22EEE75C	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Course Objectives:

CLO1	To understand the application areas of Internet of things.
CLO2	To understand the working and interfacing of sensors to the microcontroller
CLO3	To develop the basic skills necessary to pursue research in the field of Internet of things.

Content	No. of Hours/ RBT levels
Module 1: Introduction: Relevance of IOT for the future, IOT in everyday life, Internet of Everything, IOT and Individual Privacy, Challenges in IOT implementation, Big Data Management, Connectivity challenges, Mission critical applications.	8 hours L2
Module 2: Sensor & Actuators: Overview of Sensors working, Analog and Digital Sensors, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino /ESP32, Interfacing of Actuators with Arduino /ESP32, interfacing of Relay Switch and Servo Motor with Arduino/ESP32 Laboratory Sessions/ Experimental learning: Demonstration of light control, temperature and humidity sensors, ultrasonic sensor	8 hours L3
Module 3: IoT for Smart Home Appliances: Understanding smart appliances, Operation, Monitoring, Energy saving, Maintenance, Smart Appliances, Automating the home, Steps to a smart home, smart lighting, smart security systems Laboratory Sessions/ Experimental learning: Automated system using smart sensors.	8 hours L3
Module 4: IoT for Transportation: Transportation and transports, Challenges, IoT architecture for transportation, IoT use-case for transportation: Connected cars, Connected fleet, Infrastructure and mass transit	8 hours L3
Module 5: IOT for smart cities: IoT strategy for smart cities, Smart city IoT architecture, Smart city Security architecture, Smart city use-case examples: Connected Street lighting, Smart Parking, Smart traffic control, Smart water management, Connected environment.	8 hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO75C.1	Understand general concepts of Internet of Things and recognize various devices, sensors and applications
CO75C.2	Understand IoT solutions for smart home appliances
CO75C.3	Explain the applications of IoT for transportation
CO75C.4	Explain the applications of IoT for smart cities

Textbooks:

1. Michael Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World", QUE, 2015.
2. Shriram K Vasudevan, Abhishek S Nagarajan and RMD Sundaram, "Internet of Things", Wiley, Ist Edition, 2019.
3. David Hanes, Gonzalo Salgueiro, "IoT fundamentals: Networking technologies, Protocols, and use cases for the Internet of Things", Pearson, 2018

Reference books:

1. Andrew Minteer: Analytics for the Internet of Things (IoT) Intelligent Analytics for Your Intelligent Devices, Packt Publishing, 2017
2. Michael Stanley and Jongmin Lee: Sensor Analysis for the Internet of Things, Morgan & Claypool Publishers, 2018.
3. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-on Approach", University Press, 2014.

E-Books / Web References

Link to NPTEL course contents: Internet of Things

https://nptel.ac.in/courses/106/105/106105166/

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO75C.1	3	3	2	-	3	-	-	3	3	2	-	3
CO75C.2	3	3	2	-	3	-	-	3	3	2	-	3
CO75C.3	3	3	2	-	3	-	-	3	3	2	-	3
CO75C.4	3	3	2	-	3	-	-	3	3	2	-	3
Average	**3**	**3**	**2**	-	**3**	-	-	**3**	**3**	**2**	-	**3**

SEMESTER – VII

Course: Energy Storage Systems (Open Elective)

Course Code	22EEE75D	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites:

Course Objectives:

CLO1	Understand the need of Energy storage systems
CLO2	Acquire knowledge pertaining to various ways to store energy
CLO3	Explain the various applications of Energy Storage

Content	No. of Hours/ RBT levels
Module 1: Introduction to Energy Systems Energy Storage Systems Issues & Opportunities, Need for energy storage; Different modes of energy storage; Utilization of energy storage devices, specific areas of applications of energy storage system.	08 hours/ L3
Module 2: Thermal Energy Storage Necessity, latent heat storage system, Phase Change Materials (PCMs) and classifications, properties of the PCM's for different temperature range, selection criteria of PCMs for heating and cooling in buildings, PCM's use in Solar dryer, water heating system, Latent heat thermal energy storage (LHTES) systems in refrigeration and air-conditioning applications; Energy storage-super-capacitors, Magnetic Energy storage-Superconducting systems	08 hours/ L3
Module 3: Mechanical Energy Storage Methods Pumped Hydro Energy Storage Systems (PHESSs); KE and Compressed Air Energy Storage Systems (CAESSs); Flywheels, Thermo-chemical energy storage, Fuel cell (FC) as energy storage systems and Applications (PEMF, SOFC, Microbial Fuel Cell, etc), Hydrogen storage methods and types (Metal hydrides, metallic alloy hydrides).	08 hours/ L3
Module 4: Electrochemical Energy Storage Reaction Mechanism in Electrochemical Cell, determination of voltage and capacities of Electrochemical cells, Lead Acid and Lithium Ion Batteries, Battery System Models, applications	08 hours/ L3
Module 5: Design and Applications of Energy Storage Renewable energy storage-Battery sizing and stand-alone applications, stationary (Power Grid application), Small scale application-Portable storage systems and medical devices, Mobile storage Applications- Electric vehicles (EVs), types of EVs, batteries and fuel cells, future technologies, hybrid systems for energy storage.	08 hours/ L3

Course Outcomes: The students will be able to:

CO75D.1	Understand the need of energy storage systems
CO75D.2	Acquire knowledge of Thermal Energy Storage Systems
CO75D.3	Understand various mechanical energy storage systems.
CO75D.4	Understand the fundamentals of Electrochemical Energy Storage.
CO75D.5	Understand the various applications of Energy storage

TEXTBOOKS:

1. Kalaiselvam, S., and R. Parameshwaran. Thermal Energy Storage Technologies for Sustainability: Systems Design, Assessment and Applications. Elsevier.
4. Robert A Huggins, Energy Storage, Springer Publications , 2010

REFERENCES:

1. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech

2. Christopher D. Rahn and Chao-Yang Wang, Battery Systems Engineering, Wiley, 2013

WEBLINKS

1. https://energystorage.org
2. https://www.smart-energy.com/storage/the-different-types-of-energy-storage-and-their-opportunities/
3. https://onlinecourses.nptel.ac.in/noc21_mm34

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO – PO Mapping With Strengths															
CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO75D.1	3	2	2	1	-	-	2	-	-	-	-	2	-	2	2
CO75D.2	3	2	2	1	-	-	2	-	-	-	-	2	-	2	2
CO75D.3	3	2	2	1	-	-	2	-	-	-	-	2	-	2	2
CO75D.4	3	2	2	1	-	-	2	-	-	-	-	2	-	2	2
CO75D.5	3	-	2	1	-	-	2	-	-	-	-	2	-	2	2
Average	3	2	2	1	-	-	2	-	-	-	-	2	-	2	2

SEMESTER –VIII

COURSE: MAJOR PROJECT PHASE-II

Course Code	22EEEP76	CIE Marks	100
Hours/Week (L:T: P)	0:0:12	SEE Marks	100
No. of Credits	6	Examination Hours	03

Content	No. of Hours/RBT levels
CIE procedure for Project Work Phase - II: **a. Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates using Rubrics. **b. Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates as per Rubrics covering all Program Outcomes. **SEE for Project Work Phase - II:** **a. Single discipline:** Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department. **b. Interdisciplinary:** Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong.	

Individual student performance are evaluated based on the following COs:

CO22706.1	Able to make comprehensive use of the technical knowledge gained from previous courses
CO22706.2	Able to understand technologies concerned with the project
CO22706.3	Able to apply project management skills (scheduling work, procuring parts and documenting expenditures and working within the confines of a deadline).
CO22706.4	Able to analyze, develop and demonstrate the proposed work
CO22706.5	Able to communicate technical information by means of ethical writing and presentation.

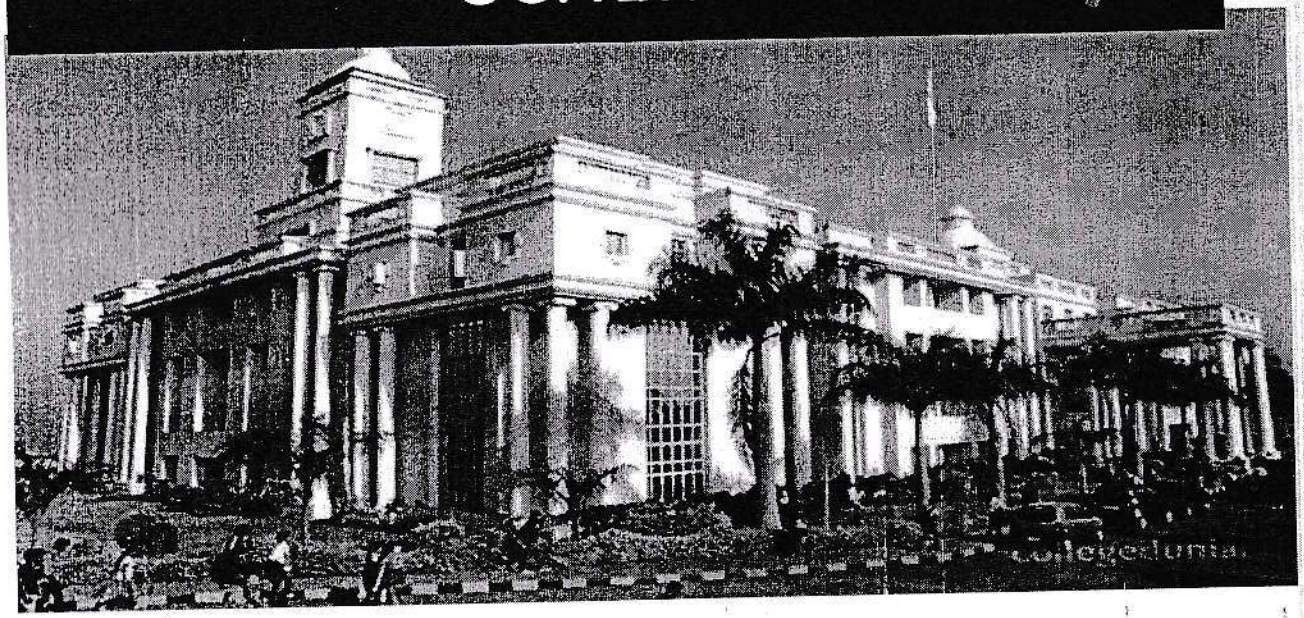
Table 1: Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**100**	**100**
	Review-2		
SEE	Semester End Examination	**100**	**100**
Grand Total			**200**

CO/PO Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

SCHEME



VIII Semester 2022
Scheme and Syllabus

Electrical & Electronics Engineering

GLOBAL ACADEMY OF TECHNOLOGY

(Autonomous Institution affiliated to VTU, Belagavi,
Accredited by NAAC with 'A' grade
NBA Accredited CS, E&C, E&E, MECH and IS branches)Ideal Homes Township,

Department of Electrical and Electronics Engineering

Global Academy of Technology
HOD, EEE

Global Academy of Technology

(An Autonomous Institution, affiliated to VTU, Belagavi, recognized by Karnataka and Approved by AICTE, New Delhi.)

B.E. in Electrical & Electronics Engineering Scheme of Teaching and Examinations 2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

Scheme A- VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	22EEE81X	**Professional Elective -IV (Online Courses)**	TD: EEE PSB:EEE	3	0	0		03	50	50	100	3
2	OEC	22EEE82X	**Open Elective - III (Online Courses)**	TD: EEE PSB:EEE	3	0	0		03	50	50	100	3
3	INT	22EEEI83	**Internship (Industry/Research) (14 - 20 weeks)**	TD: EEE	0	0	12		03	100	100	200	10
									Total	**200**	**200**	**400**	**16**

Professional Elective Course (Online Courses)

22EEE81A	Smart Grid	22EEE81C	Image processing
22EEE81B	Electrical Power Quality	22EEE81D	Energy Conservation & Auditing

Open Elective Courses (Online Courses)

22EEE82A	MOOCs (Online)	22EEE82C	MOOCs (Online)
22EEE82B	MOOCs (Online)	22EEE82D	MOOCs (Online)

L: Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **TD-** Teaching Department, **PSB:** Paper Setting department, **OEC:** Open Elective Course, **PEC:** Professional Elective Course. **PROJ:** Project work, **INT:** Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program

Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester.
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

Dean Academic
Global Academy of Technology,
Rajarajeshwarinagar, Bengaluru-98

HOD, EEE

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, centre of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.

List of MOOCs Courses	
Cyber Security and Privacy	Data Science for Engineers
Sustainable Transportation System	Introduction to Deep Learning
Cloud Computing	Fabrication Techniques for MEMs based sensors
Programming in Java	Introduction to Biomedical Imaging Systems
Enclosure Design of electronics Equipment	Introduction to Industry 4.0 and Industrial Internet of Things
Introduction to Aerospace Engineering	Data Science Using Python

SEMESTER VIII

Course: Smart Grid (Professional Elective)

Course Code	22EEE81A	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: PS-I, PS-II, PS-III & PS-IV

Course Objectives:

CLO1	Understand the operation of Smart Grid technologies
CLO2	Understand the Smart Grid Architecture
CLO3	Understand the different types of Tools and Techniques for Smart Grid
CLO4	Understand the different types of Communication Technologies in Smart Grid
CLO5	Understand the smart meters and advanced metering infrastructure

Content	No. of Hours/ RBT levels
Module 1 Introduction to Smart Grid: Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India.	08 hours/ L3
Module 2 Smart Grid Architecture: Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system, advanced metering infrastructure. The fundamental components of Smart Grid designs, Transmission Automation, Distribution Automation, Renewable Integration	08 hours/ L3
Module 3 Tools and Techniques for Smart Grid: Computational Techniques – Static and Dynamic Optimization Techniques for power applications such as Economic load dispatch – Computational Intelligence Techniques – Evolutionary Algorithms in power system – Artificial Intelligence techniques and applications in power system	08 hours/ L3
Module 4 Communication Technologies in Smart Grid: Introduction to Communication Technology, Two Way Digital Communications Paradigm, Synchro- Phasor Measurement Units (PMUs) – Wide Area Measurement Systems (WAMS)- Introduction to Internet of things (IoT)- Applications of IoT in Smart Grid.	08 hours/ L3
Module 5 Smart Meters and Advanced Metering Infrastructure Introduction to Smart Meters, Advanced Metering infrastructure (AMI)drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED)&their application for monitoring & protection	08 hours/ L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO81A.1	Understand the features of Smart Grid
CO81A.2	Assess the role of automation and digitization in Transmission and Distribution
CO81A.3	Analyze Smart grids with evolutionary algorithms
CO81A.4	Analyze Communication Technologies used in smart grid
CO81A.5	Understand the operation of smart meters and the importance of Advanced Metering Infrastructure

Textbooks:

1. Smart Grids, Infrastructure, Technology and Solutions, S. Borlase, CRC Press, 2013, 1st Edition.
2. 2. Renewable and Efficient Electric Power System, G. Masters, Wiley–IEEE Press, 2013, 2nd Edition.

Reference books:

1. Synchronized Phasor Measurements and their Applications, A.G. Phadke and J.S. Thorp, Springer, 2017, 2nd Edition.
2. Wind Power in Power Systems, T. Ackermann, Hoboken, N J, USA, John Wiley, 2012, 2nd Edition.

E-Books / Web References

1. https://ieeexplore.ieee.org/book/9509795
2. https://www.elsevier.com/books/advances-in-smart-grid-power-system/tomar/978-0-12-824337-4

NPTEL/MOOCs

1 https://nptel.ac.in/courses/108107113

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 50 marks each. Marks scored in each test is reduced to 20 and added to test component.

CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests.

Two quizzes are to be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Quiz /AAT	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO81A.1	3	2	2	2	2	2	-	-	-	-	-	-	1	3	1	-
CO81A.2	1	2	3	3	1	2	-	-	-	-	-	-	1	3	1	-
CO81A.3	2	2	3	2	2	2	-	-	-	-	-	-	1	3	1	-
CO81A.4	3	2	3	2	2	3	-	-	-	-	-	-	1	3	1	-
CO81A.5	2	2	3	2	2	2	-	-	-	-	-	-	1	3	1	-
Average	2	2	3	2	2	2	-	-	-	-	-	-	1	3	1	-

SEMESTER VIII

Course: Electrical Power Quality (Professional Elective)

Course Code	22EEE81B	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Electrical Power Systems

Course Objectives:

CLO1	Familiarize with the power quality terminologies and power quality problems.
CLO2	Analyze various sources of harmonic generation.
CLO3	Explain the working of various custom power devices.
CLO4	Apply DSTATCOM to improve power quality.
CLO5	Understand the working of power quality measurement devices.

Content	No. of Hours/ RBT levels
Module 1: Introduction to Power Quality Introduction to Electrical Power Quality, Impacts of power quality problems on end users, power quality standards, power quality terminologies – total harmonic distortions, transients, voltage fluctuations, short duration and long duration voltage variations, voltage imbalance. Power Quality problems - Poor load power factor, Harmonic contents in loads, Notching, DC offset, Supply voltage distortion, Voltage sag/ swell, flicker.	8 hours/ L4
Module 2: Harmonics Harmonics: Definition of harmonics, Odd and even order harmonics, causes of voltage and current harmonics, individual and total harmonic distortions, Harmonic current generating loads – fluorescent lighting, adjustable speed drive. Effect of harmonics on power system devices – transformer, AC motors, capacitor bank, Guidelines for harmonic voltage and current limitations, Harmonic current mitigation by harmonic current cancellation and harmonic filters.	8 hours/ L4
Module 3: Custom Power Devices Custom Power Devices: Introduction to custom power devices, Network reconfiguring devices, load compensation using DSTATCOM, voltage regulation using DSTATCOM, protecting sensitive loads using DVR, Unified power quality conditioner (UPQC). Applications of custom power devices.	8 hours/ L3
Module 4: Load Compensation using DSTATCOM Load Compensation using DSTATCOM: Compensating Single-Phase Loads, Ideal Three-Phase Shunt Compensator Structure, Instantaneous PQ theory, Generating Reference Currents using Instantaneous PQ Theory.	8 hours/ L3
Module 5: Control of DSTATCOM and Power Quality Measurement Devices Control of DSTATCOM: DSTATCOM structure, Control of DSTATCOM Connected to a Stiff Source, DSTATCOM Structure for Weak Supply Point Connection Power Quality Measurement Devices: Harmonic Analyzer, transient disturbance analyzer, true RMS meters	8 hours/ L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO81B.1	Analyze the power quality issues with reference to electrical power systems.
CO81B.2	Analyze various sources of harmonic generation and their mitigation techniques.
CO81B.3	Explain various custom power devices and their working.
CO81B.4	Use DSTATCOM to compensate load and improve power quality
CO81B.5	Explain control algorithm of DSTATCOM and working of power quality measurement devices.

Textbooks:

1. Power Quality Enhancement Using Custom Power Devices, Arindam Ghosh, Gerard Ledwich, Springer (1 January 2009).
2. Electric power quality problems –M.H.J. Bollen IEEE series-Wiley India publications,2011.

Reference books:

1. R.C.Duggan Electric Power Systems Quality, Tata MC Graw Hill Publishers, Third Edition, 2012.
2. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & Mitigation Techniques" Wiley, 2015.

E-Books / Web References

- https://www.intechopen.com/books/62
- https://www.svec.education/wp-content/uploads/2020/01/power-quality-course-material.pdf
- https://www.academia.edu/27079425/Power_Quality_pdf

MOOCs

- https://onlinecourses.nptel.ac.in/noc21_ee103/preview
- https://onlinecourses.nptel.ac.in/noc20_ee10/preview

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.

CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO/PO/PSO Mapping															
CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO81B.1	3	-	-	-	-	-	-	-	-	-	-	2	-	2	-
CO81B.2	3	2	1	-	-	-	-	-	-	-	-	2	-	2	2
CO81B.3	3	1	-	-	-	-	-	-	-	-	-	2	-	2	2
CO81B.4	3	2	1	-	-	-	-	-	-	-	-	2	-	2	2
CO81B.5	3	2	-	-	-	-	-	-	-	-	-	2	-	2	2
Average	3	2	1	-	-	-	-	-	-	-	-	2	-	2	2

SEMESTER –VIII

Course: Image processing (Professional Elective)

Course Code	22EEE81C	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Prerequisites: Digital Signal Processing

Course Objectives: This course will enable students to

CLO1	Understand the fundamentals of digital image Processing
CLO2	Explain the image transforms used in digital image processing
CLO3	Use the image enhancement techniques in Digital image processing.
CLO4	Apply the image restoration techniques and methods in digital image processing.
CLO5	Apply the morphological operations in digital image processing

Content	No. of Hours/ RBT levels
Module 1 Introduction, Origins of Digital Image Processing Examples of fields that use Digital image processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, An introduction to mathematical tools used in digital image processing	8 Hours L3
Module 2 Image Sampling and Quantization Some Basic Relationships Between Pixels, Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.	8 Hours L3
Module 3 Filtering in the Frequency Domain: Basics of Filtering in the Frequency Domain, image smoothing using frequency domain filters, Image Sharpening Using Frequency Domain Filters, Selective Filtering. Image Segmentation: Fundamentals, point line and edge detection, Thresholding,	8 Hours L3
Module 4 Image Restoration and Reconstruction: A model of image degradation and restoration process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant degradations, Estimating the Degradation Function, inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.	8 Hours L4
Module 4 Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing.	8 Hours L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO81C.1	Illustrate image digitization and basic relationships between pixels using fundamental principles of Digital image processing.
CO81C.2	Apply image processing techniques in both the spatial domains.
CO81C.3	Use image processing techniques in both the frequency domains.
CO81C.4	Analyze image restoration techniques in both spatial and frequency domains.
CO81C.5	Explain the concept of colour image processing and morphological image processing.

Textbook:

Digital Image Processing- Rafel C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010.

Reference Books:

1. Digital Image Processing- S.Jayaraman, S. Esakkirajan,T. Veerakumar, TataMcGrawHill2014.
2. Fundamentals of Digital Image Processing- A K. Jain, Pearson 2004.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **onefull question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is addedto test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and threetests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproductionof research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	CIE Test-3	40	
	Assignments	10	
SEE	Semester End Examination	50	50
Grand Total			100

CO-PO and PSO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO81C.1	1	-	-	-	-	-	-	-	-	-	-	2	-	-	3
CO81C.2	1	-	-	-	-	-	-	-	-	-	-	2	-	-	3
CO81C.3	3	-	2	-	2	-	-	-	-	-	-	2	-	-	3
CO81C.4	2	-	1	-	2	-	-	-	-	-	-	2	-	-	3
CO81C.5	2	-	2	-	1	-	-	-	-	-	-	2	-	-	3
Average	2	-	2	-	2	-	-	-	-	-	-	2	-	-	3

SEMESTER VIII

Course: Energy Conservation and Auditing (Professional Elective)

Course Code	22EEE81D	CIE Marks	50
Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	3	Examination Hours	3

Prerequisites:

Course Learning Objectives:

CLO 1	To explain fundamentals of energy, the current energy scenario, energy management and energy conservation.
CLO 2	To explain the importance of Energy audit, concept of energy audit, the energy conservation act and its features.
CLO 3	To explain energy audit of fans, power plants.
CLO 4	To explain energy of lighting systems and electric motors.
CLO 5	To explain Energy-Saving Measure in existing as well as new buildings

Content	No. of Hours/ RBT levels
Module 1: Fundamentals of Energy and Energy Scenario: Fundamentals of Energy, Various Types of Energy, Commercial and Non-commercial Energy, Grades of Energy, Energy Demand and Supply in India, Energy Scenario in India, Energy Security in India, Future Energy Strategy. **Energy Management and Energy Conservation Opportunities**: Energy Management, Tariff, Energy Conservation.	08 hours/ L3
Module 2: Electrical Energy Management: Maximum Demand Basics, Improvement of Power Factor, Capacitor Locations, Pump, Fan Systems. **Energy Audit:** Concept of Energy Audit, Type of Energy Audit, Collecting Data Strategy, Technical and Economic Feasibility, Types of Energy Conservation Measures, Understanding Energy Costs, Benchmarking and Energy Performance, Plant Energy Performance, Fuel and Energy Substitution.	08 hours/ L3
Module 3: Energy Audit (Continued): The Energy Conservation Act, 2001 and Its Features, Responsibilities and Duties to be Assigned Under the Energy Conservation Act, 2001. **Energy Audit of Fans:** Classification of Fans, Fan Laws and Curves, Power Consumption by a Fan, Energy-Saving Potential in Fans.	08 hours/ L3
Module 4: Energy Audit of a Power Plant: Indian Power-Plant Scenario, How is Energy Audit of Power Plants Helpful?, Types of Power Plants, Energy Audit of Power Plant. **Energy Audit of Motors**: Classification of Motors, Parameters Related to Motors, Efficiency of Motors, Energy Conservation in Motors.	08 hours/ L3
Module 5: Energy Audit of Lighting Systems: Fundamentals of Lighting, Different Lighting Systems, Ballasts, Fixtures, Reflectors, Lenses and Louvers, Lighting Control Systems, Lighting System Audit, Energy-Saving Opportunities. **Energy Audit Applied to Buildings**: Energy-Saving Measures in New Buildings, Water Audit, How to Audit Your Home? General Energy-saving Tips Applicable to New as Well as Existing Buildings.	08 hours/ L3

Course Outcomes

Upon completion of this course, student will be able to:

CO81D. 1	Discuss the fundamentals of energy, the current energy scenario, energy management and energy conservation.
CO81D. 2	Explain the importance of Energy audit, concept of energy audit, the energy conservation act and its features.
CO81D. 3	Conduct energy audit of fans, power plants.
CO81D. 4	Conduct energy audit of motors and lighting systems
CO81D. 5	Explain energy saving measures in existing as well as new buildings.

Textbooks:

1. Energy Management Conservation and Audits, Anil Kumar, Om Prakash, Prashant Singh Chauhan, Samsher First edition 2020, CRC Press.
2. Handbook of Energy Audit, Sonal Desai, 2015, McGraw Hill Education (India) Private Limited

Reference books:

1. Energy Management Handbook, W.C. Turner, John Wiley and Sons
2. Energy Efficient Electric Motors and Applications, H.E. Jordan, Plenum Pub. Corp

E-Books / Web References

1. http://sites.google.com>venusict.org>ntpl-video-link

MOOCs

1. https://nptel.ac.in/courses/112105221
2. https://nptel.ac.in/courses/105102175

Scheme of Evaluation:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE final marks.
CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test – 1	40	50 (Average of Three CIE(40)+ AAT(10))
	CIE Test – 2	40	
	CIE Test – 3	40	
	Quiz / assignment/group discussion/presentation/mini projects	10	
SEE	Semester End Examination	100	50
Grand Total			100

CO – PO Mapping With Strengths															
CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO81D. 1	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO81D. 2	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO81D. 3	3	1	-	1	-	-	-	1	-	-	1	-	-	1	-
CO81D. 4	3	1	-	1	-	-	-	1	1	-	1	-	-	1	-
CO81D. 5	3	1	-	1	-	-	-	1	1	-	1	-	-	1	-
Average	3	1	-	1	-	-	-	1	1	-	1	-	-	1	-