



Department of Electrical and Electronics Engineering

**Batch 2020-2024**



**7<sup>th</sup> and 8<sup>th</sup> Semesters**  
**B.E. Scheme and Syllabus**  
**Academic Year 2023-24**

**Department of Electrical and Electronics Engineering**  
**Batch 2020-2024**

**7<sup>th</sup> and 8<sup>th</sup> Semesters**  
**B.E. Scheme and Syllabus**  
**Academic Year 2023-24**

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## VISION

To evolve into a centre of excellence in Electrical and Electronics Engineering for bringing out contemporary engineers, innovators, researchers and entrepreneurs for serving nation and society.

## MISSION

- To provide suitable forums to enhance the teaching-learning, research and development activities.
- Framing and continuously updating the curriculum to bridge the gap between industry and academia in the contemporary world and serve society.
- To inculcate awareness and responsibility towards the environment and ethical values.

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

<b>PEO1</b>	To provide good learning environment to develop entrepreneurship capabilities in various areas of Electrical and Electronics Engineering with enhanced efficiency, productivity, cost effectiveness and technological empowerment of human resource.
<b>PEO2</b>	To inculcate research capabilities in the areas of Electrical and Electronics Engineering to identify, comprehend and solve problems and adopt themselves to rapidly evolving technology.
<b>PEO3</b>	To create high standards of moral and ethical values among the graduates to transform them as responsible citizens of the nation.

## PROGRAM SPECIFIC OUTCOMES (PSOs)

<b>PSO 1</b>	Graduates will be able to solve real life problems of power system and power Electronics using Mi-Power, P-SPICE and MATLAB software tools and hardware.
<b>PSO 2</b>	Graduates will be able to Develop & support systems based on Renewable and sustainable Energy sources.

## PEOs TO MISSION STATEMENT MAPPING

Mission Statements	PEO1	PEO2	PEO3
<b>PEO1:</b> To provide good learning environment to develop entrepreneurship capabilities in various areas of Electrical and Electronics Engineering with enhanced efficiency, productivity, cost effectiveness and technological empowerment of human resource.	3	3	2
<b>PEO2:</b> To inculcate research capabilities in the areas of Electrical and Electronics Engineering to identify, comprehend and solve problems and adopt themselves to rapidly evolving technology	3	3	2
<b>PEO3:</b> To create high standards of moral and ethical values among the graduates to transform them as responsible citizens of the nation.	2	2	3

**Correlation:** 3- High, 2-Medium, 1-Low

## PROGRAM OUTCOMES (POs) WITH GRADUATE ATTRIBUTES

SL No	Graduate Attributes	Program Outcomes (POs)
1	Engineering Knowledge	PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem Analysis	PO2: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design and Development of Solutions	PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	Modern Tool usage	PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6	The Engineer and society	PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	Environment and sustainability	PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8	Ethics	PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Lifelong learning	PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### MAPPING OF POs TO PEOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	POS2
PEO1	3	3	3	3	3	2	2	2	2	2	2	3	3	3
PEO2	3	3	3	3	3	2	2	2	2	2	2	3	3	3
PEO3	2	2	2	2	2	3	3	3	3	2	2	2	2	2

**Correlation:** 3- High, 2-Medium, 1-Low

**New Horizon College of Engineering**  
**Department of Electrical and Electronics Engineering**  
**Scheme of Seventh Semester B.E Program**

Sl. No	Course Code	Course	Credit Distribution				Overall Credits	Contact Hours per Week	Marks		
			L	T	P	S			CIE	SEE	Total
1	20EEE71A	Special Electrical Machines	3	0	0	0	3	3	50	50	100
2	20EEE72A	Relay and High voltage Engineering	3	0	0	0	3	3	50	50	100
3	20EEE73A	Electrical Drives and vehicles	3	0	0	0	3	3	50	50	100
4	20EEE74XA	Professional Elective IV	3	0	0	0	3	3	50	50	100
5	20EEE75XA	Professional Elective V	3	0	0	0	3	3	50	50	100
6	20NHOP7XX	Open Elective- II	3	0	0	0	3	3	50	50	100
7	20EEL76A	Relay and High voltage Engineering laboratory	0	0	1.5	0	1.5	3	25	25	50
8	20EEL77A	Simulation tools for Electrical Engineering laboratory	0	0	1.5	0	1.5	3	25	25	50
9	20EEE78A	Project Phase I	0	0	2	0	2	4	50	50	100
<b>TOTAL</b>							<b>23</b>	<b>28</b>	<b>400</b>	<b>400</b>	<b>800</b>

<b>Professional Elective IV</b>	
Course Code	Course
20EEE741A	Digital Signal Processing
20EEE742A	FACTS and HVDC transmission
20EEE743A	Testing and Commissioning
20EEE744A	Energy Auditing and Demand Side Management
<b>Professional Elective V</b>	
Course Code	Course
20EEE751A	Utilization of Electrical Energy
20EEE752A	Power System Operation and Control
20EEE753A	Professional Ethics
20EEE754A	Neural network and Fuzzy logic in Electrical Engineering

**New Horizon College of Engineering**  
**Department of Electrical and Electronics Engineering**  
**Scheme of Eighth Semester B.E Program**

Sl. No	Course Code	Course	Credit Distribution				Overall Credits	Contact Hours per Week	Marks		
			L	T	P	S			CIE	SEE	Total
1	20EEE81XA	Professional Elective VI	3	0	0	0	3	3	50	50	100
2	20EEE82XA	Professional Elective VII	3	0	0	0	3	3	50	50	100
3	20EEE83A	Internship	0	0	4	0	4	8	50	50	100
4	20EEE84A	Project Phase II	0	0	10	0	10	20	50	50	100
<b>TOTAL</b>							<b>20</b>	<b>34</b>	<b>200</b>	<b>200</b>	<b>400</b>

<b>Professional Elective VII</b>		
Sl No	Course Code	Course
1	20EEE811A	Estimation and Costing of electrical systems
2	20EEE812A	Smart Grid Technologies
3	20EEE813A	Power Quality
4	20EEE814A	Integration of distributed generation

<b>Professional Elective VII</b>		
Sl No	Course Code	Course
1	20EEE821A	Photo Voltaic Systems and Applications
2	20EEE822A	Simulation of Power Electronics
3	20EEE823A	Biomedical Instrumentation
4	20EEE824A	Applications of IOT in Electrical Engineering



## SPECIAL ELECTRICAL MACHINES

Course Code : 20EEE71A

Credits : 3

L: T: P:S : 3:0:0:0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Acquire knowledge about construction and working principles of special electrical machines.
<b>CO2</b>	Analyze the performance of special electrical machines.
<b>CO3</b>	Acquire knowledge on various types of controllers for special motors
<b>CO4</b>	Understand the linear and nonlinear characteristics of special electrical machines.
<b>CO5</b>	Evaluate and formulate the EMF and torque equations.
<b>CO6</b>	Choose appropriate special machines based on applications.

### Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	3	3	2	3	2	2	1	1	1	1	3	-	1
<b>CO2</b>	3	3	3	2	3	2	2	1	1	1	1	3	-	1
<b>CO3</b>	3	3	3	2	3	2	2	1	1	1	1	3	-	1
<b>CO4</b>	3	3	3	2	3	2	2	1	1	1	1	3	-	1
<b>CO5</b>	3	3	3	2	3	2	2	1	1	1	1	3	-	1
<b>CO6</b>	3	3	3	2	3	2	2	1	1	1	1	3	-	1

Module No	Module Contents	Hours	Cos
1	<b>Reluctance Motors :</b> Constructional features, Principle of operation, Types, Axial and radial air gap motors, Phasor diagram, Torque Characteristics, Non-linear analysis, Power controllers, Microprocessor based control and Computer based control and Applications.	09	CO1, CO2, CO3, CO4, CO6
2	<b>Permanent Magnet Brushless Dc Motors&amp; its Controllers :</b> Commutation in DC motors, Hall sensors, Torque and EMF equation, Torque- speed characteristics, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Microprocessor based controller, Sensor less control and Applications	09	CO1, CO3, CO4, CO5, CO6
3	<b>Stepping Motors&amp; its Drive Systems :</b> Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor, Dynamic characteristics, Circuit for open loop & Closed loop control of stepping motor, microprocessor based controller and Applications	09	CO1, CO3, CO4, CO5, CO6
4	<b>Permanent Magnet Synchronous Motors&amp; its controllers:</b> Principle of operation, EMF equation, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self-control, Vector control, Current control schemes and Sensor less control, Applications	09	CO1, CO2, CO3, CO6
5	<b>Industrial Special Machines &amp; Applications:</b> AC servomotors, D.C servo motors, universal motors, hysteresis motor, Repulsion motor, Vernier motor, Construction, Working Principles, Characteristics and Applications	09	CO1, CO4, CO5, CO6

### Text Books:

1. Special Electrical Machines, mural Deshpande ,scitech publications,2017
2. Stepping Motors – A Guide to Motor Theory and Practice, P.P. Aearnley, , Peter Peregrines, London, 1982.
3. Stepping Motors and Their Microprocessor Controls, Kenjo, Takashi, Sugawara, Akira, Clarendon Press London, 2003
4. Stepper Motors – Fundamentals, Applications and Design, V. V. Athani, New Age International Publications, 2006
5. Switched Reluctance Motor and Drives, R. Krishnan, CRC Press, Washington.

### Reference Books:

1. Special electrical machines, E.G. Janardanan, PHI learning Private Limited, 2014
- 2.Special Electrical Machines, K. V. Rathnam Orient Black swan 2008
3. Permanent Magnet and Brushless DC Motors, T. Kenjo and S. Nagamori, Clarendon Press, London, 1988

### Assessment Pattern:

#### CIE- Continuous Internal Evaluation (50 Marks)

<b>Bloom's Taxonomy</b>	<b>Tests</b>	<b>Assignments</b>	<b>Quizzes</b>
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>15 Marks</b>	<b>10 Marks</b>
Remember	5	4	-
Understand	5	4	2
Apply	5	3	4
Analyze	5	2	4
Evaluate	5	2	-
Create	-	-	-

#### SEE- Semester End Examination (50 Marks)

<b>Bloom's Category</b>	<b>Marks Theory (50)</b>
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	-

## RELAY AND HIGH VOLTAGE ENGINEERING

Course Code : 20EEE72A

Credits : 03

L: T: P:S : 3:0:0:0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Understand the different breakdown mechanisms of dielectrics
<b>CO2</b>	Study the different generation and measurement techniques of high voltage
<b>CO3</b>	Apply different techniques for the testing of high voltage apparatus
<b>CO4</b>	Evaluate the characteristics of different protection relays and different types of electromagnetic relay.
<b>CO5</b>	Acquire the knowledge on digital relays
<b>CO6</b>	Apply the high voltage knowledge on real time applications

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	2	3	2	1	1	1	1	2	1	1	1	-	1
<b>CO2</b>	3	2	3	2	1	1	1	1	2	1	1	1	-	1
<b>CO3</b>	3	2	3	2	1	1	1	1	2	1	1	1	-	1
<b>CO4</b>	3	2	3	2	1	1	1	1	2	1	1	1	-	1
<b>CO5</b>	3	2	3	2	1	1	1	1	2	1	1	1	-	1
<b>CO6</b>	3	2	3	3	2	1	2	1	1	1	1	1	-	1

Module No	Module Contents	Hours	Cos
1	<b>Break Down in Gaseous, Liquid and solid Dielectrics</b> Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Panchen's law. Suspended Solid Particle Mechanism, Cavity breakdown Intrinsic breakdown, electromechanical breakdown, thermal breakdown.	09	CO1
2	<b>Generation and Measurement of high voltages and High currents</b> 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 Direct Current voltages, Measurement of High Voltages alternating and impulse.	09	CO2
3	<b>High Voltage Tests, on-Destructive Insulation Test Techniques</b> Measurement of D. C. Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements, Testing of Insulators and circuit breakers, testing of cables, Testing of Transformers, Testing of Surge Arresters.	09	CO3
4	<b>Protective and Distance Relays</b> Basic requirement of protective relaying, Zones of protection, Over Current relay- IDMT relays, PSM, TSM, problems, directional and non-directional relays, negative sequence relays. Impedance, Reactance, Mho and off set Mho relays, Characteristic of distance relays and comparison of differential Relay-Circulating current and opposite voltage differential scheme, Comparison of static and electromagnetic relay.	09	CO4
5	<b>Digital Relay &amp; Industrial Applications to High Voltage Engineering</b> Introduction to digital relay, microprocessor application to protection, desirable features in a protection scheme, integrated hierarchical computer control and protection Electrostatic applications – Electro static precipitator, Electro static separator, Electro static coating, Electro Static copying, pulsed power.	09	CO5, CO6

### Text Books:

1. High Voltage Engineering by M.S.Naidu & V. Kama Raju – TMH Publications, 5th Edition, 2013.
2. High Voltage Engineering by C.L.Waxhaw , New Age Internationals (P) Limited , 3<sup>rd</sup> Edition
3. Switchgear and Protection, J.B.Guptha ,S.K. Kataria & Sons , 2013
4. Switch gear Protection and Power systems, Sunil S. Rao, Khanna Publishers, 4th etc.

### Reference Books:

1. Advances in High Voltage Engineering by A.Haddad &Dwayne , The institution of engineering and technology , 2007
2. High Voltage and Electrical Insulation Engineering by Ravindra Arora & Wolfgang Mosch , Wiley Publishers , 2011.
3. High Voltage Engineering Fundamentals by E.Kuffel & W.S. Zaengl, Elsevier press , 2nd Edition , 2013.

### Assessment Pattern:

#### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks (Out of 50)	25 Marks	15 Marks	10 Marks
Remember	5	5	2
Understand	5	5	2
Apply	5	5	2
Analyze	5		2
Evaluate	5	-	2
Create	-	-	-

#### SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	-

## ELECTRICAL DRIVES AND VEHICLES

**Course Code : 20EEE73A**

**Credits : 03**

**L: T: P : S : 3:0:0:0**

**CIE Marks: 50**

**Exam Hours : 03**

**SEE Marks: 50**

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

<b>CO1</b>	Understand the dynamics of electrical drives
<b>CO2</b>	Analyze the operation of the Converter and Chopper fed dc drives
<b>CO3</b>	Analyze the operation of the induction and Synchronous Motor AC drive
<b>CO4</b>	Understand various types of motors used in electric vehicles and energy sources
<b>CO5</b>	Analyze various types of electrical drives to meet the requirement of electrical vehicles
<b>CO6</b>	Analyze need of electric vehicle and its environmental impact

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	1	1	1	1	3	3	2	1	1	2	3	1	1
<b>CO2</b>	3	1	1	1	1	3	3	2	1	1	2	3	1	1
<b>CO3</b>	3	3	3	1	2	3	2	2	1	1	2	3	1	1
<b>CO4</b>	3	3	3	1	2	3	3	2	1	1	2	3	1	1
<b>CO5</b>	3	3	3	1	2	3	3	2	1	1	2	3	1	1
<b>CO6</b>	3	1	1	1	1	3	3	3	3	1	2	3	1	1

SL No	Module Contents	Hours	COs
1	<b>DYNAMICS OF ELECTRICAL DRIVES:</b> Fundamental Torque Equation, Speed torque convention and multi-quadrant operation, Equivalent values of Drive parameters, Components of load torque, Nature of classification of load torque, calculation of time and energy-loss in transient operation, Steady state stability, Selection of Motor Power Ratings, Thermal Model of motor for heating and cooling, Classes of Motor duty, Determination of Motor rating.	09	CO1
2	<b>DC MOTOR DRIVES:</b> Starting, Braking, Transient Analysis, Speed control, Chopper-Controlled DC drives, Steady state analysis of the single and three phase converter fed separately excited DC motor drive Chopper control of separately excited DC motors, Chopper control of series motors, converter ratings and closed loop control, Applications	09	CO2
3	<b>AC MOTOR DRIVES and SPECIAL MACHINES AC DRIVES:</b> Induction Motor Drives: Starting, Braking, Transient Analysis, Speed Control, Analysis of Induction Motor fed from Non-sinusoidal voltage supply, variable frequency control from voltage source, voltage source inverter control, closed loop speed control of induction motor drives, current source inverter control. Synchronous Motor variable speed drives, Brushless DC motor drives, Switched Reluctance Motor Drive Construction-Working Principle.	09	CO3
4	<b>ELECTRIC VEHICLES:</b> History of Electric vehicle, Definition vehicle, Need of electric vehicle, Architecture of Electric Vehicle, Configuration of Electric vehicle, General description of vehicle movement, vehicle resistance, Dynamic equation, Tire ground adhesion and maximum traction effort, Power train tractive effort and vehicle speed, Vehicle performance, Breaking performance, Drive cycle.	09	CO4,
	<b>ELECTRIC VEHICLE ENERGY SOURCES:</b> Electrochemical batteries, Electrochemical reaction, Thermodynamic voltage, Specific energy, specific power, energy efficiency, Battery technology, ultra capacitors, Flywheels.	09	CO5,



### Text Books:

1. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC, Press, 2010.
2. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Esan, Yama Gao, Sebastian E. Gay, Ali Emad, Mehran CRC Press, 2004.
3. Electric Vehicle Technology Explained, James Larmenier, John Lowry, Wiley, 2003.

### Reference Books:

1. Power Electronics, Maharishi, Pearson, 3<sup>rd</sup> Edition, 2017.
2. Power Electronics – Converters, Applications and Design, Ned Mohan, Tore M. Undeland, and William P. Robins, Third Edition, John Wiley and Sons, 2011.
3. Power Electronics, Devices, Circuits and Industrial Applications, V.R. Moorthi, Oxford University Press, 2005

### Assessment Pattern:

#### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks (Out of 50)	25 Marks	15 Marks	10 Marks
Remember	4	-	-
Understand	4	5	2
Apply	9	5	3
Analyze	4	5	2
Evaluate	4	-	3
Create	-	-	-

#### SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	5
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	5

## PROFESSIONAL ELECTIVE-IV

### DIGITAL SIGNAL PROCESSING

Course Code : 20EEE741A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

SEE Marks : 50

Exam Hours : 03

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

<b>CO1</b>	Classify signals and systems & study their mathematical representation.
<b>CO2</b>	Determine the response of LTI systems to any input signal by using convolution.
<b>CO3</b>	Analyze the discrete time signals by Z transforms, DTFS, & DTFT.
<b>CO4</b>	Analyze the discrete time signals by DTFS, & DTFT.
<b>CO5</b>	Determine the spectrum of a signal by using various transformation techniques DFT & FFT.
<b>CO6</b>	Design and digital implementation of IIR, FIR filters using MATLAB.

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	2	-	-	-	-	1	1	2	2	2
CO2	3	3	1	2	2	-	-	-	-	1	1	2	2	2
CO3	3	3	1	2	2	-	-	-	-	1	1	2	2	2
CO4	3	3	1	2	2	-	-	-	-	1	1	2	2	2
CO5	3	3	1	2	2	-	-	-	-	1	1	2	2	2
CO6	3	3	1	2	2	-	-	-	-	1	1	2	2	2

Module No	Module Contents	Hours	COs
1	<p><b>Introduction</b> Elements of a Digital Processing System - Advantages of Digital over Analog Signal Processing. Discrete-Time Signals and Systems: Elementary Discrete-Time Signals- Classification of Discrete-Time Systems - LTIV systems- -Causality, Stability.</p> <p><b>LTI Systems</b> Convolution Sum - Impulse response, Properties - Solution of difference equation - block diagram representation.</p>	09	CO1
2	<p><b>Z-Transforms</b> Z-transform and its properties, Region of convergence (RoC) and its Properties, inverse z-transforms; difference equation – Solution by z-transform, Stability analysis, and frequency response – Convolution</p> <p><b>Fourier Representation</b> Discrete Time Fourier Series (DTFS) and its properties - Discrete Time Fourier transform (DTFT) and its properties.</p>	09	CO1, CO2
3	<p><b>Discrete Fourier Transform</b> Discrete Fourier Transform- properties, magnitude and phase representation, IDFT, linear convolution, circular convolution, periodic convolution, overlap add and save methods.</p> <p><b>Fast Fourier Transform</b> Computation of DFT using FFT algorithm – DIT &amp; DIF using radix 2 FFT – Butterfly structure.</p>	09	CO3
4	<p><b>Realization Of Digital Filters</b> FIR &amp; IIR filter realization – Parallel form, Cascade form, Lattice Ladder form.</p> <p><b>Design Of Digital Filters</b> FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design – Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation.</p>	09	CO3, CO4
5	<p><b>MATLAB Programs</b> Linear and Circular Convolutions in time domain and frequency domain, Fast Fourier Transform – DIT and DIF algorithm, Design of Butterworth &amp; Chebyshev Filter using Impulse Invariant and Bilinear transformation</p> <p><b>Applications</b> Audio and video compression, Audio signal processing, Image processing, Radar -Sonar signal analysis and processing</p>	09	CO5, CO6

### Text Books:

1. Digital Signal Processing Principle, Algorithm & application, Praxis, Pearson, 4<sup>th</sup> edition, 2014.
2. Digital Signal Processing, Sanjit. K. Mitra, TMH, 4<sup>th</sup> Edition, 2013.
3. Practical Applications in Digital Signal Processing, Richard Newbold, Prentice Hall, 1st Edition, 2013

### Reference Books:

1. Introduction to Digital Signal Processing, Johnny R. Johnson, 1<sup>st</sup> Edition, PHI, 2011
2. Discrete Time Signal Processing, Alan V. Oppenheim, Pearson, 2<sup>nd</sup> Edition, 2012
3. Digital Signal Processing, S. Salivahanan, TMH, 3<sup>rd</sup> Edition, 2014.
4. Digital Signal Processing, Infector Emmauel- Pearson education, 2<sup>nd</sup> Edition, 2006.
5. Fundamentals of Digital Signal Processing, Lonnie C. Ludeman, John Wiley, 3<sup>rd</sup> Edition, 2009
6. Signals & Systems, Simon Haykin and Barry Van Veen, John Wiley and Sons, 2<sup>nd</sup> Edition, 2010

### Assessment Pattern:

#### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks (Out of 50)	25 Marks	15 Marks	10 Marks
Remember	4	-	-
Understand	4	5	2
Apply	9	5	2
Analyze	4	5	2
Evaluate	4	-	2
Create	-	-	2

#### SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	5
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	5

## FACTS AND HVDC TRANSMISSION

Course Code : 20EEE742A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Learn the concept of power flow control through various power electronic controllers such as FACTS controllers, operational aspects and their capabilities and their integration in power flow analysis
<b>CO2</b>	Learn the method of shunt compensation by using static VAR compensators and their applications
<b>CO3</b>	Understand the working of STATCOM and UPFC.
<b>CO4</b>	Analyze different converter topologies viz. 3, 6 and 12 Pulse converters and understand it's control aspects.
<b>CO5</b>	Analyze different types of DC links and applications of DC transmission.
<b>CO6</b>	Understand the concepts of FACTS controllers and HVDC transmission

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	2	3	2	2	2	2	-	-	1	1	2	2	2
<b>CO2</b>	3	2	3	2	2	2	2	-	-	1	1	2	2	2
<b>CO3</b>	3	2	3	2	2	2	2	-	-	1	1	2	2	2
<b>CO4</b>	3	2	3	2	2	2	2	-	-	1	1	2	2	2
<b>CO5</b>	3	2	3	2	2	2	2	-	-	1	1	2	2	2
<b>CO6</b>	3	2	3	2	2	2	2	-	-	1	1	2	2	2

Module No	Module Contents	Hours	COs
1	<p><b>INTRODUCTION:</b></p> <p>Basics of power transmission networks-control of power flow in AC transmission line- Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers.</p>	09	CO1, CO2, CO6
2	<p><b>STATIC VAR COMPENSATOR (SVC):</b></p> <p>Configuration of SVC- voltage regulation by SVC- Modelling of SVC for load flow analysis- Modelling of SVC for stability studies-Design of SVC to regulate the mid-point voltage of a SMIB system- Applications: transient stability enhancement and power oscillation damping of SMIB system with SVC connected at the mid-point of the line.</p>	09	CO1, CO2, CO6
3	<p><b>VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS:</b></p> <p>Static synchronous compensator (STATCOM) - Static synchronous series compensator(SSSC) - Operation of STATCOM and SSSC-Power flow control with STATCOM and SSSC- Modelling of STATCOM and SSSC for power flow and transient stability studies –operation of Unified and Interline power flow controllers(UPFC and IPFC)- Modelling of UPFC and IPFC for load flow and transient stability studies Applications.</p>	09	CO3, CO6
4	<p><b>GENERAL ASPECTS OF DC TRANSMISSION AND COMPARISON OF IT WITH AC TRANSMISSION:</b></p> <p>Comparison of AC and DC Transmission-Economics of power transmission-Technical performance-Reliability, Application of DC transmission, Description of DC transmission system-Types of DC links-Converter station, planning for HVDC transmission, Modern trends in HVDC technology, Some operating problem, HVDC transmission based on Voltage Source Inverter.</p>	09	CO5, CO6
5	<p><b>STATIC POWER CONVERTERS:</b></p> <p>3-pulse, 6-pulse, and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers. Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters. VSC based HVDC and Hybrid HVDC systems. Back to back thyristor converter system.</p>	09	CO4, CO6

### Text Books:

1. Thyristor – Based Facts Controllers for Electrical Transmission Systems, R.Mohan Mathur, Rajiv K.Varma, IEEE press and John Wiley & Sons, Inc., 2011.
2. Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems, Narain G. Hingorani, Standard Publishers Distributors,2011
3. HVDC Power Transmission System, K.R. Padiyar, 2nd Edition, New Age International Publishers, 2012.
4. Power Transmission by Direct Current, Erich Uhlmann, Fourth Indian Reprint Springer International Edition, 2012.

### Reference Books:

1. Introduction to FACTS Controllers: Theory, Modeling, and Applications, KaylanK sen, Mey Ling Sen, Wiley & sons Ltd., 2016
2. Flexible AC Transmission System: Modelling and Control, Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, Springer, 2012
3. High Voltage Direct Current Transmission: Converters, Systems and DC Grids, Dragan Jovicic , Khaled Ahmed,John Wiley & sons Ltd., 2015
4. H.V.D.C Transmission, J Arrillaga , Peter Peregrinus Ltd , London UK 1998.

### Assessment Pattern:

#### CIE- Continuous Internal Evaluation (50 Marks)

<b>Bloom's Taxonomy</b>	<b>Tests</b>	<b>Assignments</b>	<b>Quizzes</b>
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>15 Marks</b>	<b>10 Marks</b>
Remember	5	-	4
Understand	5	-	2
Apply	5	7.5	2
Analyze	10	7.5	2
Evaluate		-	-
Create	-	-	-

#### SEE- Semester End Examination (50 Marks)

<b>Bloom's Category</b>	<b>Marks Theory (50)</b>
Remember	15
Understand	15
Apply	10
Analyze	10
Evaluate	-
Create	-

## TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT

Course Code : 20EEE743A

Credits : 03

L: T: P :S : 3:0:0 :0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Describe the procurement process and the state-of-the art global practices in maintenance of electrical equipment.
<b>CO2</b>	Mention the requirement of electrical equipment
<b>CO3</b>	Understand the specifications in Installation and testing of transformers
<b>CO4</b>	Design the Installation process of induction motors and synchronous machines
<b>CO5</b>	Analyze the testing process of induction motors and synchronous machines
<b>CO6</b>	Choose the appropriate electrical equipment for the real time applications

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	2	2	1	2	3	2	-	-	1	2	2	1	1
<b>CO2</b>	3	2	2	1	2	3	2	-	-	1	2	2	1	1
<b>CO3</b>	3	2	2	1	2	3	2	-	-	1	2	2	1	1
<b>CO4</b>	3	2	2	1	2	3	2	-	-	1	2	2	1	1
<b>CO5</b>	3	2	2	1	2	3	2	-	-	1	2	2	1	1
<b>CO6</b>	3	2	2	1	2	3	2	-	-	1	2	2	1	1



Module No	Module Contents	Hours	COs
1	<b>PROCUREMENT PROCESS:</b> Tender specifications based on requirement and national, international codes and standards, compiling tender documents & vendor assessment, inviting tenders, scrutiny and evaluation of bids (technical and financial) acceptance and award of contract with necessary safety and security classes.	6	CO1
2	<b>REQUIREMENTS COMMON TO ALL EQUIPMENT:</b> Types of construction, design details and dimensional layout. Types of enclosure (IP code) and cooling system, Insulation class, Physical inspection, handling and storage, Foundation details f) Tests- factory, site and stage wise-inspection and certification. Name plates-code of practice ,Duty cycle and cyclic duration factor, Vibration and noise levels control, Tips for trouble shooting ,Maintenance schedules and assessment of their effectiveness, Documentation of all factory and field test results with equipment and instruction manuals for operation and maintenance.	8	CO2
3	<b>TRANSFORMERS:</b> Specification: Power& distribution transformers as per BIS standard. Acceptance Tests: Type, routine and special tests applicable. Installation: Location, foundation details, conductor/cable termination boxes, bushings, polarity and phase sequence, oil tank and radiators, nitrogen and oil filled trafos, drying of windings and general inspection. Commissioning Tests: Pre-commissioning, tests as per relevant BIS or IEC standards, ratio and polarity, insulation resistance, oil dielectric strength, tap changing gear, fans and pumps for cooling, neutral earthing resistance, buchholz relay, load tests and temperature rise, hot and cold IR value.	12	CO2, CO3, CO6
4	<b>INDUCTION MOTORS:</b> Specifications: For different types of induction motors as per BIS including duty and IP protection. Acceptance Tests: Type, routine and special tests as specified by BIS codes of testing. Installation: Location and details of mounting and foundation, control gear, alignment with driven equipment with coupling, fitting of pulleys, bearings, drying of windings. Commissioning Tests: Pre-commissioning tests, physical examination, alignment and airgap, bearing, balancing and vibration, insulation resistance, no-load run, frame earthing and bearing pedestal insulation, load test and temperature rise, hot and cold IR values.	10	CO4, CO5, CO6
5	<b>SYNCHRONOUS MACHINES:</b> Specifications: As per BIS Standards. Acceptance Tests: Type, routine- and special tests applicable as per BIS. Installation: Location and details of mounting and foundations, control gear, excitation system and cooling arrangements. Commissioning Tests: Pre-Commissioning tests, physical examination, alignment and air gap, armature and filed winding insulation resistance, balancing and vibration, no load run and frame	9	CO4, CO5, CO6

### **Text Books:**

1. Testing & Commissioning of Electrical Equipment, Ramesh. L. Chakrasali, Elite Publishers, Mangalore.
2. Testing & commissioning of Electrical Equipment, S.Rao, Khanna Publishers.

### **Reference Books:**

1. Power Station and Substation Practice, M.P. Krishan Pillai, Standard Publishers Distributors. BIS Standards
2. Hand Books: Transformers – BHEL Handbook, Switchgear - J&P Handbook.

### **Assessment Pattern:**

#### **CIE- Continuous Internal Evaluation (50 Marks)**

<b>Bloom's Taxonomy</b>	<b>Tests</b>	<b>Assignments</b>	<b>Quizzes</b>
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>15 Marks</b>	<b>10 Marks</b>
Remember	5	-	2
Understand	5	-	2
Apply	5	7.5	2
Analyze	10	7.5	2
Evaluate	-	-	2
Create	-	-	-

#### **SEE- Semester End Examination (50 Marks)**

<b>Bloom's Category</b>	<b>Marks Theory (50)</b>
Remember	10
Understand	15
Apply	10
Analyze	15
Evaluate	-
Create	-

## ENERGY AUDITING AND DEMAND SIDE MANAGEMENT

Course Code : 20EEE744A

Credits : 03

L: T: P:S : 3:0:0:0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Understand the energy situation and need for energy economic analysis.
<b>CO2</b>	Analyse the concept of energy auditing.& need for Electrical System Optimization.
<b>CO3</b>	understand the energy audit instruments
<b>CO4</b>	Apply energy auditing for buildings
<b>CO5</b>	understand the concept of the energy conservation
<b>CO6</b>	Understand the concept of Demand Side Management.

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	1	3	1	1	1	-	-	-	-	3	-	-	1
<b>CO2</b>	3	1	3	3	3	1	3	-	-	-	3	-	-	1
<b>CO3</b>	3	1	1	3	3	1	-	-	-	-	-	-	-	1
<b>CO4</b>	3	1	1	3	2	3	3	3	-	-	3	2	-	1
<b>CO5</b>	3	2	1	3	2	2	-	-	-	-	1	-	-	1
<b>CO6</b>	3	2	1	3	2	2	-	-	-	-	-	-	-	1

Module No	Module Contents	Hours	COs
1	<p><b>INTRODUCTION:</b> Energy situation – world and India, energy consumption, conservation. Codes, standards and Legislation.</p> <p><b>ENERGY ECONOMIC ANALYSIS:</b> The time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit – numerical problems.</p>	09	CO1, CO2
2	<p><b>ENERGY AUDITING:</b> Introduction, Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results</p> <p><b>ELECTRICAL SYSTEM OPTIMIZATION:</b> The power triangle, Motor horsepower, Power flow concept. Electrical Equipment and power factor –correction &amp; location of capacitors.</p>	09	CO3 CO4
3	<p><b>LIGHTING AND ENERGY INSTRUMENTS</b> Good lighting system design and practice, lighting control ,lighting energy audit - Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's</p> <p><b>ENERGY EFFICIENT MOTORS</b> Energy efficient motors , factors affecting efficiency, loss distribution , constructional details , characteristics - variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit.</p>	09	CO3 CO5
4	<p><b>ENERGY CONSERVATION:</b> Motivation of energy conservation, Principles of Energy conservation, Energy conservation planning, Energy conservation in industries, EC in SSI, EC in electrical generation, transmission and distribution, EC in household and commercial sectors, EC in transport, EC in agriculture, EC legislation</p> <p><b>ENERGY AUDIT APPLIED TO BUILDINGS:</b> Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings</p>	09	CO4 CO6
5	<p><b>DEMAND SIDE MANAGEMENT – I:</b> Introduction to DSM, concept of DSM, benefits of DSM, different Techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning.</p> <p><b>Demand Side Management -II</b> Load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. Management and Organization of Energy</p>	09	CO2, CO3, CO6,

### Text Books:

1. Handbook on Energy Audit, Sonal Desai, McGraw Hill 2014.
2. Generation of Electrical Energy, B R Gupta, S. Chand, 1st Edition, 1983
3. Electrical distribution, Pabla, 6th edition, TMH, 2012..

### Reference Books

1. Recent Advances in Control and Management of Energy Systems D.P.Sen, K.R.Padiyar, Indrane Sen, M.A.Pai Interline Publisher, Bangalore, 1993.
2. Energy Demand – Analysis, Management and Conservation, Ashok V. Desai, Wiley Eastern Ltd., New Delhi., 1990.
3. Demand Side Management Jyothi Prakash, TMH Publishers.
4. Hand book on energy auditing - TERI (Tata Energy Research Institute)

### Assessment Pattern:

#### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks (Out of 50)	25 Marks	15 Marks	10 Marks
Remember	7	-	2
Understand	8	-	2
Apply	5	7.5	2
Analyze	3	7.5	2
Evaluate	2	-	2
Create	-	-	-

#### SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	15
Understand	15
Apply	10
Analyze	5
Evaluate	5
Create	-

## PROFESSIONAL ELECTIVE-V

### UTILIZATION OF ELECTRICAL ENERGY

Course Code : 20EEE751A

Credits : 03

L: T: P:S : 3:0:0:0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Obtain the fundamental concept of electric traction
<b>CO2</b>	Design the different lighting system for various requirement
<b>CO3</b>	Understand the concepts of electric welding and heating
<b>CO4</b>	Acquire knowledge in refrigeration and air conditioning system
<b>CO5</b>	Identify the economic aspects of power factor necessity and its improvement methods
<b>CO6</b>	Utilize the electrical energy as per the requirement

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	2	3	2	1	3	1	-	-	-	1	3	-	2
<b>CO2</b>	3	3	3	3	1	2	1	-	-	-	1	3	-	2
<b>CO3</b>	3	1	1	1	1	-	2	1	-	-	1	2	-	2
<b>CO4</b>	3	1	1	-	1	2	3	1	-	-	-	2	-	2
<b>CO5</b>	3	3	3	2	1	2	1	-	-	-	3	3	-	2
<b>CO6</b>	3	3	3	3	1	2	1	-	-	-	1	3	-	2

Module No	SYLLABUS	Hours	COs
1	<p><b>ELECTRIC DRIVES AND TRACTION</b></p> <p>Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.</p>	09	CO1, CO6
2	<p><b>ILLUMINATION</b></p> <p>Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.</p>	09	CO2, CO6
3	<p><b>HEATING AND WELDING</b></p> <p>Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding</p>	09	CO3, CO6
4	<p><b>REFRIGERATION AND AIR CONDITIONING</b></p> <p>Refrigeration Systems – Refrigerants – Types of Refrigeration Systems – Electrical Circuit of a Domestic Refrigerator – Trouble shooting of Refrigerator. Air Conditioning Systems – Types - Electrical circuit of window and Central Air Conditioning Systems</p>	09	CO4, CO6
5	<p><b>ECONOMIC ASPECTS OF UTILISING ELECTRICAL ENERGY</b></p> <p>Power Factor Improvement, Improvement of Load Factor, Off Peak Loads- Use of Exhaust Steam, Waste Heat recovery, Pit Head Generation, Diesel Plant, General Comparison of Private Plant and Public Supply- Initial Cost and Efficiency, Capitalization of Losses, Choice of Voltage</p>	09	CO5, CO6

### Text Books:

1. N.V.Suryanarayana, Utilisation of Electric Power : Including Electric Drives and Electric Traction, New Age International Publishers, Second Edition 2014
2. Utilization of Electric Power and Electric Traction, J.B. Gupta, S.K.Kataria and Sons, Eleventh Edition 2015.
3. Utilization of Electric Energy, E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009

### Reference Books:

1. C.L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', New Age International Pvt. Ltd, Third Edition 2015
2. H. Partab, 'Art and Science of Utilisation of Electrical Energy', Dhanpat Rai and Co, New Delhi, Third Edition 2014.
3. R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited.,2007

### Assessment Pattern:

#### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	IBM/Co-Curricular activities	Quizzes
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>7.5 Marks</b>	<b>7.5 Marks</b>	<b>10 Marks</b>
Remember	4	-	-	-
Understand	4	2.5	2	2
Apply	9	2.5	3	2
Analyze	4	2.5	2.5	2
Evaluate	4	-	-	2
Create	-	-	-	2

#### SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	5
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	5



## POWER SYSTEM OPERATION AND CONTROL

Course Code : 20EEE752A

Credits : 03

L: T: P: S : 3:0:0:0

CIE Marks : 50

Exam Hours : 3

SEE Marks : 50

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

<b>CO1</b>	Understand the Operating States of Power System and Megawatt-frequency and Megavar-Voltage control loops.
<b>CO2</b>	Model the Generator, Turbine, Governor, Tie-Line and analyze the response of single area and two area systems.
<b>CO3</b>	Analyze the reactive power requirement at a point in system and suggest the compensation.
<b>CO4</b>	Apply Equal Incremental Cost method and allocate optimal generation for generating units in a generating station and apply Unit Commitment Solution Methods and find the Units to be Committed for optimal generation
<b>CO5</b>	Analyze the contingency of a system using Linear Sensitivity Factors and understand the concept of Synchrophasors, Phasor Measurement Unit and Wide Area Monitoring Systems
<b>CO6</b>	Understand the concept of Synchrophasors, Phasor Measurement Unit and Wide Area Monitoring Systems.

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	-	-	-	-	-	-	-	-	-	-	-	1	2
<b>CO2</b>	3	3	-	-	-	-	-	-	-	-	-	-	1	2
<b>CO3</b>	3	3	1	2	-	-	-	2	-	-	2	3	1	2
<b>CO4</b>	3	3	-	2	-	2	2	2	-	-	2	3	1	2
<b>CO5</b>	3	3	-	2	-	2	2	-	-	-	-	3	1	2
<b>CO6</b>	3	3	-	2	-	2	2	-	-	-	-	3	1	2

Module No	Module Contents	Hours	COs
1	<b>INTRODUCTION:</b> Structure of Electric Energy System, Operating States of Power System, Transmission Capacity. Load Characteristics: Voltage and Frequency Load Dependency. The Real Power Balance and its Effect on System Frequency. The Reactive Power Balance and its Effect on System Voltage. Control of Generation: Megawatt- frequency and Mega -voltage control, Generator Model, Load Model, Prime-Mover Model, Governor Model.	09	CO1, CO2
2	<b>LOAD FREQUENCY CONTROL:</b> Speed-Load characteristics of Governor, Parallel operation of Generators, Concept of Control Area. Megawatt-Frequency Control of Single Area: the uncontrolled and controlled case. The two area system: Block diagram of two area system. Static and Dynamic response of uncontrolled two-area system, Static and Dynamic response of controlled two-area system.	09	CO2
3	<b>REACTIVE POWER AND VOLTAGE CONTROL:</b> Production and absorption of reactive power, Methods of Voltage Control, Shunt reactors Shunt Capacitors, Series Capacitors Synchronous condensers, Static VAR systems, Principles of Transmission system compensation, Modeling of reactive compensating devices, Application of tap changing transformers to transmission systems, Distribution system voltage regulation, Modeling of transformers ULTC control systems.	09	CO3
4	<b>ECONOMIC DISPATCH OF THERMAL UNITS AND UNIT COMMITMENT:</b> Optimal operation of Generators in Thermal Power Stations, - heat rate Curve – Cost Curve – Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected using Lagrangian function. Optimum generation allocation including the effect of transmission line losses – Loss Coefficients, General transmission line loss formula. Unit Commitment: Constraints in Unit Commitment, Spinning Reserve, Thermal Unit Constraints, Hydro-Constraints, Must Run Constraint & Fuel Constraints. Unit Commitment Solution Methods: Priority List, Lagrange Relaxation Solution.	09	CO4
5	<b>POWER SYSTEM SECURITY&amp; MODERN TRENDS IN POWER SYSTEM CONTROL:</b> Factors affecting Power System Security, Linear Sensitivity Factors (LSFs). Contingency Analysis using LSFs, Numerical Problems. Energy Management Systems, SCADA Control of the Indian Power Grid, Role of Load Dispatch Centers, ,Synchro-phasors, Phasor Measurement Unit (PMU), Wide Area Monitoring System (WAMS), Overview of WAMS in Indian Grid.	09	CO5

### Text Books:

1. Power Generation Operation and Control, Allen J.Wood, Bruce.F.Wollenberg, Gerald B. ShebléWiley & Sons,, 2013.
2. Electric Energy Systems Theory, Elgerd.O.I McGraw Hill Education; Second Edition, 2017.
3. Power system operation and control, V.Ramanathan &P.S.Manoharan, Charulatha Publications, Chennai, 2008.

### Reference Books:

1. Reactive Power Control in Electric Systems, Timothy J. E. Miller, Wiley, First Edition, Reprint 2010.
2. EPRI Power System Dynamics Tutorial, Electric Power Research Institute, Jul 27, 2009
3. Unified Real Time Dynamic State Measurement (URTSM), Power Grid Corporation of India, Feb 2012

### Assessment Pattern:

#### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	IBM/Co-Curricular activities	Quizzes
Marks (Out of 50)	25 Marks	7.5 Marks	7.5 Marks	10 Marks
Remember	5	-	-	4
Understand	5	2	2	2
Apply	5	3	3	2
Analyze	5	2.5	2.5	2
Evaluate	-	-	-	-
Create	5	-	-	-

#### SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	5
Understand	5
Apply	15
Analyze	15
Evaluate	-
Create	10

## PROFESSIONAL ETHICS

Course Code : 20EEE753A

L: P: T :S : 3:0:0:0

Exam Hours : 03

Credits : 03

CIE Marks : 50

SEE Marks : 50

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

<b>CO1</b>	Understand the ethical behaviour of an engineer, professional ethics and human values
<b>CO2</b>	Analyze the basic perception of profession, professional ethics, various moral issues and uses of ethical theories
<b>CO3</b>	Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field
<b>CO4</b>	Know the responsibilities of an engineer for safety and risk benefit analysis
<b>CO5</b>	Acquire knowledge about various roles of engineers in variety of global issues
<b>CO6</b>	Apply ethical principles to resolve situations in their professional lives

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	-	-	-	-	-	1	1	3	1	2	-	-	-	-
<b>CO2</b>	-	-	-	-	-	1	1	3	1	2	-	-	-	-
<b>CO3</b>	-	-	-	-	-	3	2	3	-	2	-	-	-	-
<b>CO4</b>	-	-	-	-	-	3	2	3	-	2	-	-	-	-
<b>CO5</b>	-	-	-	-	-	3	2	3	-	2	3	-	-	-
<b>CO6</b>	-	-	-	-	-	3	2	3	1	2	3	-	-	-

Module No	Module Contents	Hours	Cos
1	<b>HUMAN VALUES:</b> Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.	09	CO1, CO2
2	<b>ENGINEERING ETHICS:</b> Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.	09	CO3
3	<b>ENGINEERING AS SOCIAL EXPERIMENTATION:</b> Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	09	CO4
4	<b>SAFETY, RESPONSIBILITIES AND RIGHTS:</b> Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.	09	CO5
5	<b>GLOBAL ISSUES:</b> Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.	09	CO2, CO4, CO5,

**Text Books:**

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

**Reference Books:**

1. Engineering Ethics, Charles B. Fleddermann, Pearson Prentice Hall, New Jersey, 2004.
2. Engineering Ethics – Concepts and Cases, Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, Cengage Learning, 2009
3. Ethics and the Conduct of Business, John R Boatright, Pearson Education, New Delhi, 2003
4. Fundamentals of Ethics for Scientists and Engineers, Edmund G Seebauer and Robert L Barry, Oxford University Press, Oxford, 2001
5. Business Ethics: Decision Making for Personal Integrity and Social Responsibility , Laura P. Hartman and Joe Desjardins, Mc Graw Hill education, India Pvt. Ltd., New Delhi 2013.
6. Value Education, World Community Service Centre, Vethathiri publications, Erode, 2011

**Assessment Pattern:****CIE- Continuous Internal Evaluation (50 Marks)**

<b>Bloom's Taxonomy</b>	<b>Tests</b>	<b>Assignments</b>	<b>IBM/Co-Curricular activities</b>	<b>Quizzes</b>
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>7.5 Marks</b>	<b>7.5 Marks</b>	<b>10 Marks</b>
Remember	5	-	-	-
Understand	5	2.5	2	2
Apply	5	2.5	3	4
Analyze	10	2.5	2.5	4
Evaluate	-	-	-	-
Create	-	-	-	-

**SEE- Semester End Examination (50 Marks)**

<b>Bloom's Category</b>	<b>Marks Theory (50)</b>
Remember	10
Understand	10
Apply	10
Analyze	20
Evaluate	-
Create	-

## NEURAL NETWORKS AND FUZZY LOGIC IN ELECTRICAL ENGINEERING

Course Code : 20EEE754A  
 L:P:T :S : 3:0:0:0  
 Exam Hours : 3

Credits :03  
 CIE Marks :50  
 SIE Marks :50

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

<b>CO1</b>	Understand the concepts of Neuron model and its terminologies
<b>CO2</b>	Develop the Neural Network Models for Single layer and Multi-layer Network
<b>CO3</b>	Apply ANN Techniques to Electrical Load Forecasting problem and Control system problem
<b>CO4</b>	Analyze the operation of Fuzzy based systems
<b>CO5</b>	Apply Fuzzy Logic for motor control and AVR operation and 18 bus bar system
<b>CO6</b>	Apply Modern tools for understanding and implementation of Neuro-fuzzy model

### Mapping of Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	3	3	2	1	3	1	2	2	1	1	2	1	1
<b>CO2</b>	3	3	3	2	2	3	1	2	3	3	3	2	1	1
<b>CO3</b>	3	3	3	3	2	3	1	3	3	3	3	2	1	1
<b>CO4</b>	3	3	3	3	2	3	1	3	3	3	3	2	1	1
<b>CO5</b>	3	3	3	3	2	3	1	3	3	3	3	2	1	1
<b>CO6</b>	3	3	3	3	2	3	1	3	3	3	3	2	1	1

<b>Module No</b>	<b>Module Contents</b>	<b>Hours</b>	<b>COs</b>
<b>1</b>	<b>ARTIFICIAL NEURAL NETWORKS</b> Basics of ANN - Comparison between Artificial and Biological Neural Networks – Basic Building Blocks of ANN – Artificial Neural Network Terminologies – McCulloch Pitts Neuron Model	<b>9</b>	<b>CO1</b>
<b>2</b>	<b>SINGLE LAYER AND MULTI LAYER NETWORKS</b> Learning Rules – ADALINE and MADALINE Models – Perception Networks – Back Propagation Neural Networks – Associative Memories.	<b>9</b>	<b>CO2</b>
<b>3</b>	<b>ANN APPLICATIONS TO ELECTRICAL ENGINEERING</b> ANN approach to: Electrical Load Forecasting Problem – System Identification –Control Systems – Pattern Recognition.	<b>9</b>	<b>CO3 CO6</b>
<b>4</b>	<b>FUZZY LOGIC</b> Classical Sets – Fuzzy Sets – Fuzzy Properties and Operations – Fuzzy Logic System– Fuzzification – Defuzzification – Membership Functions – Fuzzy Rule base – Fuzzy Logic Controller Design.	<b>9</b>	<b>CO4</b>
<b>5</b>	<b>FUZZY LOGIC APPLICATIONS TO ELECTRICAL ENGINEERING</b> Fuzzy Logic Implementation for Induction Motor Control – Switched Reluctance Motor Control –Fuzzy Excitation Control Systems in Automatic Voltage Regulator – Fuzzy Logic Controller in an 18 Bus Bar System	<b>9</b>	<b>CO5 CO6</b>



### Text Books:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Neural Networks using MATLAB", McGraw Hill Edition, 2016.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, WILEY India Edition, 2018.

### References:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", Springer International Edition, 2016.
2. Yung C. Shin and Changing Xu, "Intelligent System – Modeling, Optimization & Control", CRC Press, 2017.
3. Jacek M. Zurada, "Introduction To Artificial Neural Network", Jaico Publishing House, New Delhi, Third Edition, 2019
4. Vinoth Kumar K, "Fundamentals of Soft Computing", S.K.Kataria and Sons Publishers, New Delhi, Second Edition, 2020

### Assessment Pattern:

#### CIE – Continuous Internal Evaluation (50 Marks)

Blooms Taxonomy	Tests	Assignments	IBM/Co-Curricular activities	Quizzes
<b>Marks(out of 50)</b>	<b>25 Marks</b>	<b>7.5 Marks</b>	<b>7.5 Marks</b>	<b>10 Marks</b>
Remember	5	-	-	2
Understand	5	2	2	3
Apply	10	3	3	3
Analyze	3	2.5	2.5	2
Evaluate	2	-	-	-
Create		-	-	-

#### SEE – Semester End Examination (50 Marks)

Blooms Category	Marks Theory (50)
Remember	10
Understand	10
Apply	20
Analyze	5
Evaluate	5
Create	-

## INDUSTRIAL OPEN ELECTIVES

<b>Open Elective - II</b>	
<b>Course Code</b>	<b>Course</b>
20NHOP701	Big Data Analytics using HP Vertica-1
20NHOP702	VM Ware Virtualization Essentials-1
20NHOP704	Big Data Analytics using HP Vertica-2
20NHOP705	VM Ware Virtualization Essentials-2
20NHOP707	SAP
20NHOP708	Schneider-Industry Automation
20NHOP709	Cisco-Routing and Switching-1
20NHOP710	Data Analytics
20NHOP711	Machine learning
20NHOP712	CISCO-Routing and switching - 2
20NHOP714	Block Chain
20NHOP715	Product Life cycle management
20NHOP720A	Robotic Process Automation
20NHOP721A	Industry 4.0
20NHOP722A	Programing of Industrial Robot
20NHOP723A	5G Communication
20NHOP725A	Physical Design 1
20NHOP726A	Physical Design 2
20NHOP727A	Juniper Network Operating System
20NHOP728A	Database Administrator using DB2

## RELAY AND HIGH VOLTAGE ENGINEERING LABORATORY

Course Code : 20EEL76A  
 L:T: P: S : 0:0:1.5:0  
 Exam Hours : 03

Credits :1.5  
 CIE Marks : 25  
 SEE Marks : 25

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

CO1	Experimentally verify the characteristics of over current, over voltage, under voltage and negative sequence relays both electromagnetic and static type
CO2	Analyze the spark over characteristics for both uniform and non-uniform configurations using High AC and DC voltages
CO3	Measure the breakdown strength of transformer oil , electric field and find the capacitance of different electrode configuration models
CO4	Analyzing the Performance of generator and transformer with different techniques

Mapping of Course Outcomes to Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	2	1	-	-	-	2
CO2	3	3	2	2	3	-	-	-	2	1	-	-	-	2
CO3	3	3	3	3	3	-	-	-	2	1	-	-	-	2
CO4	3	3	3	3	3	-	-	-	2	1	-	-	-	2

Exp. No.	Experiments	COs
1	Breakdown characteristics of sphere -sphere gap with HVAC	<b>C02</b>
2	Breakdown characteristics of sphere -sphere gap with HVDC	<b>C02</b>
3	Breakdown test of transformer oil	<b>C02</b>
4	Field mapping using electrolytic tank	<b>C03</b>
5	Performance of IDMT characteristic for microprocessor based over current relay	<b>C01</b>
6	Performance of DMT characteristic of solid state under voltage relay	<b>C01</b>
8	Breakdown characteristics of sphere -point gap with HVAC	<b>C02</b>
8	Breakdown characteristics of sphere -point gap with HVDC	<b>C02</b>
9	Protection of generator by differential scheme	<b>C04</b>
10	Performance of IDMT characteristic for microprocessor Based under voltage relay	<b>C02</b>
11	Negative sequence relay	<b>C01</b>
12	Protection of transformer by Merz-Price protection scheme	<b>C04</b>

**Assessment Pattern:**

**CIE- Continuous Internal Evaluation (25 Marks)**

<b>Bloom's Category</b>	<b>Performance (day to day)</b>	<b>Internal Test</b>
<b>Marks (Out of 25)</b>	<b>15</b>	<b>10</b>
Remember	02	01
Understand	03	03
Apply	05	03
Analyze	05	03
Evaluate	-	-
Create	-	-

**SEE- Semester End Examination (25 Marks)**

<b>Bloom's Category</b>	<b>Lab (25)</b>
Remember	3
Understand	5
Apply	9
Analyze	8
Evaluate	-
Create	-

## SIMULATION TOOLS FOR ELECTRICAL ENGINEERING LABORATORY

Course Code : 20EEL77A  
 L:T: P:S : 0:0:1.5:0  
 Exam Hours : 03

Credits : 1.5  
 CIE Marks : 25  
 SEE Marks : 25

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

<b>CO1</b>	Apply the knowledge to simulate DC and AC circuits
<b>CO2</b>	Analyze and simulate the control signals for the requirement
<b>CO3</b>	Design the operational amplifier for the integrated circuits
<b>CO4</b>	Acquire knowledge on the power electronic converters

**Mapping of Course Outcomes to Program Outcomes:**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	2	1	-	-	3	3
CO2	3	3	2	2	3	-	-	-	2	1	-	-	3	3
CO3	3	3	3	3	3	-	-	-	2	1	-	-	3	3
CO4	3	3	3	3	3	-	-	-	2	1	-	-	3	3

Exp. No.	Experiments	COs
1	Simulation of DC circuits	CO1
2	Simulation of transient response of RLC Circuit to step, pulse and sinusoidal signals	CO1
3	Design and simulation of Lag, Lead and Lag-Lead Compensators	CO2
4	Analysis of 3 phases circuit representing the generator transmission line and load.	CO2
5	Simulation of integrator and differentiator circuits using Op-AMP	CO3
6	Simulation of Comparator circuit using OP-AMP	CO3
7	Simulation of Schmitt trigger circuit using OP-AMP	CO3
8	Simulation of single-phase full converter using RLE loads and single phase AC voltage controller using RL load	CO4
9	Simulation of single phase inverter using PWM control	CO4
10	Simulation of power electronic converters	CO4
11	Simulation of DC separately excited motor using transfer function.	CO4
12	Simulation of Chopper fed DC motor drives	CO4

**Assessment Pattern:**

**CIE- Continuous Internal Evaluation (25 Marks)**

<b>Bloom's Category</b>	<b>Performance (day to day)</b>	<b>Internal Test</b>
<b>Marks (Out of 25)</b>	<b>15</b>	<b>10</b>
Remember	02	02
Understand	03	02
Apply	05	03
Analyze	05	03
Evaluate	-	-
Create	-	-

**SEE- Semester End Examination (25 Marks)**

<b>Bloom's Category</b>	<b>Lab (25)</b>
Remember	3
Understand	5
Apply	9
Analyze	8
Evaluate	-
Create	-

## PROJECT PHASE I

Course Code : 20EEE78A

Credits : 2

L: T: P:S : 0:0:2:0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Analyse complex engineering problems through review research literature to reach conclusions.
<b>CO2</b>	Evaluate the methodologies and select based on specific criteria.
<b>CO3</b>	Integrate theoretical and subject-specific knowledge to solve complex real-world problems.
<b>CO4</b>	Interpret the progress and outputs of the project through professional engineering reports and present it to a community or industry.

### Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	3	3	3	3	2	2	2	3	3	3	2	3	3
<b>CO2</b>	3	3	3	3	3	2	2	2	3	3	3	2	3	3
<b>CO3</b>	3	3	3	3	3	2	2	2	3	3	3	2	3	3
<b>CO4</b>	3	3	3	3	3	2	2	2	3	3	3	2	3	3

Project is an experimental learning course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications. The student shall be capable to recognise a problem in the area of Electrical and Electronics Engineering and solve it using latest technologies in a project. Based on the ability/abilities of the student/s and recommendations of the guide, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. The project work will be reviewed by a panel of experts throughout the semester. The CIE marks awarded for the project work shall be based on the work accomplishment, project presentation skill, and question and answer session. The Plagiarized projects will automatically result an F grade and the student will be liable for further disciplinary action. At the completion of a project the student will submit a project report, which will be evaluated by duly appointed examiner(s).

The students will be required to complete the following process:

S.No	Content	COs
1.	Perform a literature search to review current knowledge and developments in the chosen technical area. Review and finalization of the Approach to the Problem relating to the chosen topic/title. Preparation of work schedule with a team.	CO1, CO3
2.	Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as required for the chosen field	CO1, CO2
3.	Development of product/process, testing, results, conclusions and future directions.	CO1, CO2
4.	Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.	CO4
5.	Preparation of a project report in the standard format for being evaluated by the guide and the department with plagiarism certificate.	CO3
6.	Preparing a paper for Conference presentation/Publication in Journals, if possible	CO3,CO4

#### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Level	Bloom's Category	Review 1 (25 Marks)	Review 2 (25 Marks)
L1	Remember	-	-
L2	Understand	4	4
L3	Apply	5	6
L4	Analyze	7	6
L5	Evaluate	6	4
L6	Create	3	5

#### SEE – Semester End Examination (50 Marks)

Bloom's Category	Marks
Marks (out of 50)	
Remember	-
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10



**SYLLABUS**  
**VIII SEMESTER**

## PROFESSIONAL ELECTIVE-VI

### ESTIMATION AND COSTING OF ELECTRICAL SYSTEMS

Course Code : 20EEE811A

L: T: P:S : 3:0:0:0

Exam Hours : 03

Credits : 03

CIE Marks : 50

SEE Marks : 50

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

<b>CO1</b>	Analyze estimation & costing, Necessity and procedures for estimation and costing, major applicable I.E rules and acts, Types and materials used for wiring
<b>CO2</b>	Understand general rules, guidelines for internal wiring, preparation of detailed estimates and costing of internal wiring, Inspection and testing of wiring installations
<b>CO3</b>	Apply the procedure for service connection, design, estimation and costing of underground and overhead service connections.
<b>CO4</b>	Analyze the Important considerations regarding motor installation wiring, Design and Estimation of components required for Motor installation and costing the same
<b>CO5</b>	Design overhead transmission & distribution lines. Typical AC electrical power system, Estimation & costing of transmission & distribution lines
<b>CO6</b>	Design, estimate and costing of the components of substations and substation Earthing, Remote control wiring

**Design and Estimation of components required for Motor installation and costing the same**

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	3	2	1	2	2	1	1	3	3	3	3	-	2
<b>CO2</b>	3	3	2	2	2	2	1	1	3	3	3	3	-	2
<b>CO3</b>	3	3	2	2	2	2	1	1	3	3	3	3	-	2
<b>CO4</b>	3	3	3	2	2	2	1	1	3	3	3	3	-	2
<b>CO5</b>	3	3	3	2	2	2	1	1	3	3	3	3	-	2
<b>CO6</b>	3	3	3	2	2	2	1	1	3	3	3	3	-	2

Module No	Module Contents	Hours	Cos
1	<p><b>PRINCIPLES OF ESTIMATION &amp; COSTING:</b> Introduction to estimation &amp; costing, Electrical Schedule, Catalogues, Market Survey and source selection, Recording of estimates, Determination of required quantity of material, Determination of cost of material and labour, Contingencies, Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills, Tender form, Indian Electricity Act and major applicable I.E rules.</p> <p><b>WIRING:</b> Introduction, Distribution of energy in a Building, PVC Casing and Capping, Conduit Wiring, Types of cables used in Internal Wiring, Multi Strand Cables, Voltage Grading and Specification of Cables, Main Switch and Distribution Board, Conduits and its accessories and Fittings. Lighting Accessories and Fittings, Types of Fuses, Size of Fuse, Fuse Units, Earthing Conductor.</p>	09	CO1
2	<p><b>INTERNAL WIRING ESTIMATION:</b> General rules for wiring, Determination of number of points, Total load, number of sub-circuits, Size of conductor, Rating of main switch and distribution board, mounting arrangements and positioning of switchboards, distribution boards main switch etc, Sequence to be followed for preparing estimate, Preparation of detailed estimates and costing of residential installation.</p> <p><b>INSPECTION AND TESTING OF INSTALLATIONS:</b> Inspection of internal wiring installations, Inspection of new installations, testing of installations, Testing of wiring installations, Reason for excess recording of energy consumption by energy meter.</p>	09	CO2
3	<p><b>INSTALLATION OF SERVICE CONNECTIONS:</b> Concept of service connection, Types of service connection and their features, Method of installation of service connection, estimation and costing of overhead and underground service connections,</p> <p><b>ELECTRICAL INSTALLATION FOR POWER CIRCUITS :</b> Introduction, Important considerations regarding motor installation wiring, Determination of input power, Determination of input current to motors, Determination of rating of cables, determination of rating of fuse, Determination of size of Conduit, distribution Board main switch and starter.</p>	09	CO3, CO4
4	<p><b>ESTIMATION OF OVERHEAD TRANSMISSION &amp; DISTRIBUTION LINES:</b> Introduction, Typical AC electrical power system, Main components of overhead lines, Line supports, Factors governing height of pole, Conductor materials, Determination of size of</p>	09	CO5

	<p>conductor for overhead transmission line, Cross arms, Pole brackets and clamps, Guys and Stays, Conductors configuration spacing and clearances, Span lengths, Overhead line insulators, Insulator materials, Types of insulators, Lightning Arrestors, Phase plates, Danger plates, Anti climbing devices, Bird guards, Beads of jumpers, Muffs.</p> <p><b>ESTIMATION OF OVERHEAD TRANSMISSION &amp; DISTRIBUTION LINES (CONTINUED):</b></p> <p>Points to be considered at the time of erection of overhead lines, Erection of supports, Setting of stays, Fixing of cross arms, Fixing of insulators, Conductor erection, Repairing and jointing of conductor , Dead end clamps, Positioning of conductors and attachment to insulators, Jumpers, Tee-offs, Earthing of transmission lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between conductors, Testing and commissioning of overhead distribution lines, Some important specifications.</p>		
5	<p><b>DESIGN AND ESTIMATION OF SUBSTATIONS:</b></p> <p>Introduction, Classification of substation, Indoor substations, Outdoor substations, Selection and location of site for substation, Main Electrical Connections, Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, Key diagram of typical substations, Equipment for substation and switchgear installations, Substation auxiliaries supply, Substation Earthing.</p> <p><b>REMOTE CONTROL WIRING:</b></p> <p>Remote control Switching, Remote control selection considerations, types of control devices, motor control circuits.</p>	09	CO6

**Text Books:**

1. Electrical Installation Estimating & Costing, J.B.Gupta, S.K. Katria & Sons New Delhi, IX Edition, 2013
2. 1. Electrical Design Estimating and Costing, K.B.Raina S.K.Bhattacharya, New Age International second edition 1<sup>st</sup> Mar 2017.

**Reference Books:**

1. Electrical Wiring Estimating and Costing, Uppal, Khanna Publishers Delhi, 2008
2. Electrical Systems Design, M.K.Giridharan, I K International Publishing House Pvt. Ltd Revised edition 30th November 2015
3. I.E. Rules and Act Manuals.

**Assessment Pattern:****CIE- Continuous Internal Evaluation (50 Marks)**

<b>Bloom's Taxonomy</b>	<b>Tests</b>	<b>Assignments</b>	<b>IBM/Co-Curricular activities</b>	<b>Quizzes</b>
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>7.5 Marks</b>	<b>7.5 Marks</b>	<b>10 Marks</b>
Remember	4	-	-	-
Understand	4	2	2	2
Apply	4	3	3	2
Analyze	4	2.5	2.5	2
Evaluate	4	-	-	2
Create	5	-	-	2

**SEE- Semester End Examination (50 Marks)**

<b>Bloom's Category</b>	<b>Marks Theory (50)</b>
Remember	5
Understand	10
Apply	10
Analyze	5
Evaluate	10
Create	10

## SMART GRID TECHNOLOGIES

Course Code : 20EEE812A

L:T: P:S : 3:0:0:0

Exam Hours : 03

Credits : 03

CIE Marks : 50

SEE Marks : 50

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

<b>CO1</b>	Understand the concept of Smart Grid, compare with conventional grid, and identify its opportunities and barriers.
<b>CO2</b>	Investigate the components of smart grid and know about Plug in Hybrid Electric Vehicles, Vehicle to Grid, Smart Sensors.
<b>CO3</b>	Assess the role of digitization in Substation Automation, Feeder Automation, Intelligent Electronic Devices, Smart storage like Battery.
<b>CO4</b>	Describe the concept of micro grid, distributed energy resources, Power Quality and its issues of Grid connected Renewable Energy Sources, Power Quality Audit and role of ICT in smart grid
<b>CO5</b>	Identify the stake holders and market drivers of smart grid
<b>CO6</b>	Recognize the role of Electric vehicles in smart grid

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	2	1	1	-	2	-	-	-	-	-	1	1	2
<b>CO2</b>	3	2	2	1	-	3	-	-	-	-	-	2	1	2
<b>CO3</b>	2	2	1	2	-	2	-	-	-	-	-	2	1	2
<b>CO4</b>	2	3	2	2	-	2	-	-	-	1	-	3	1	2
<b>CO5</b>	3	3	3	3	1	2	-	-	2	1	-	3	1	2
<b>CO6</b>	3	3	2	1	1	1	-	-	2	2	1	2	1	2

Module No	Module Contents	Hours	COs
1	<p><b>SMART GRID EVOLUTION:</b></p> <p>Evolution of Indian Power Grid, Smart Grid-Definitions, Functions of Smart Grid, Opportunities &amp; Barriers of Smart Grid, Drivers for SG in India, Challenges for SG, Difference between conventional &amp; smart grid, Smart Grid Vision &amp; Roadmap for India, Concept of Resilient and Self-Healing Grid, Present development &amp; International policies of Smart Grid.</p> <p><b>ARCHITECTURE AND APPLICATIONS OF SMART GRID:</b></p> <p>Functionalities and key components of smart grid. Smart grid Components for Transmission system, Smart grid components at distribution level, Architecture of smart grid, Pilot projects of Smart Grid in India.</p>	09	CO1
2	<p><b>SMART GRID TECHNOLOGIES:</b></p> <p>Introduction to Smart Meters, Advanced Metering Infrastructure, Distribution Automation, Automatic Meter Reading (AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid Technology (V2G), Smart Sensors, Smart Homes, Building Energy Management System</p> <p><b>AUTOMATION AND ENERGY STORAGE:</b></p> <p>Substation Automation, Feeder Automation. Geographic Information System (GIS), Peak load Management, Energy Storage systems, Pumped hydro storage, CAES, FES, storage batteries, Thermal energy storage, Super capacitors.</p>	09	CO2 CO3
3	<p><b>MICROGRIDS:</b></p> <p>Architecture and Layout of Microgrid, Types of Micro grid- DC Micro grid, AC Microgrid, Hybrid AC/DC Microgrid, Benefits of Distributed generation, Energy storage in Microgrids, Micro grid-Protection, Case studies of Micro grid in India</p> <p><b>DISTRIBUTED ENERGY RESOURCES:</b></p> <p>Small scale distributed generation, Distributed Generation Resources-Fuel Cells, Solar Photovoltaic cells, Wind power, Fixed speed Wind Turbine generators, Variable speed wind turbine generators, Synchronous generator with In-line frequency control, Advantages of DG.</p>	09	CO4
4	<p><b>POWER QUALITY MANAGEMENT IN SMART GRID:</b></p> <p>Power Quality-Basic definitions, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Power Quality Audit and its significance.</p> <p><b>INFORMATION AND COMMUNICATION TECHNOLOGY FOR SMART GRID:</b></p> <p>Advanced Metering Infrastructure (AMI), Home Area Network</p>	09	CO4

	(HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi- Max based communication, Wireless Mesh Network, Broadband over Power line (BPL).		
5	<p><b>SMART GRID MARKET DRIVERS:</b></p> <p>Introduction – Comparison of Micro grid, power grid and Smart grid – Case study of STUXNET –Cyber security, Smart Grid Stake holders-Roles and Responsibilities, Technical challenges in SG Market operation.</p> <p><b>Electric Vehicles:</b></p> <p>Electric Vehicle Technology, EV charging Infrastructure, EVSE Power standards, EVSE communication standards, Vehicle grid Integration (VGI), Challenges associated with VGI.</p>	09	CO5, CO6

### Text Books:

1. Smart grid Advance Technology and solution, Stuart Borlase, CRC Press, Second edition, Nov 2017
2. Smart Grids: Clouds, Communications and Automation, Krzysztof Iniewski, David Bakken, Open Source, CRC Press, Taylor and Francis group, May 2014
3. Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities, Peter S. Fox Penner, Island Press; 1 edition, Jun 2010
4. Microgrids and Active Distribution Networks, S. Chowdhury, S. P. Chowdhury, P. Crossley, Institution of Engineering and Technology, Jun 2009

### References Books:

1. Control and Automation of Electric Power Distribution Systems (Power Engineering), James Northcote, Green, Robert G. Wilson CRC Press, 2017.
2. Substation Automation systems Design and Implementation, Evelio Padilla Wiley Publishers, 2015.
3. Smart Grid: Fundamentals of design and analysis, James Momoh, John Wiley & sons Inc, IEEE press, 2015.
4. Smart Grid: Technology and Applications, Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, John Wiley & sons inc, 2012.
5. Smartgrid Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication, 2012.



**Assessment Pattern:****CIE- Continuous Internal Evaluation (50 Marks)**

<b>Bloom's Taxonomy</b>	<b>Tests</b>	<b>Assignments</b>	<b>IBM/Co-Curricular activities</b>	<b>Quizzes</b>
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>7.5 Marks</b>	<b>7.5 Marks</b>	<b>10 Marks</b>
Remember	2	-	-	-
Understand	2	2	2	2
Apply	8	3	3	2
Analyze	5	2.5	2.5	2
Evaluate	4	-	-	2
Create	4	-	-	2

**SEE- Semester End Examination (50 Marks)**

<b>Bloom's Category</b>	<b>Marks Theory (50)</b>
Remember	5
Understand	8
Apply	10
Analyze	10
Evaluate	12
Create	5

## POWER QUALITY

Course Code : 20EEE813A

L: T: P :S : 3:0:0:0

Exam Hours : 03

Credits : 03

CIE Marks : 50

SEE Marks : 50

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

<b>CO1</b>	Describe and Classify power quality issues in a power system and know the standards
<b>CO2</b>	Analyze Voltage sag ,Over voltage and Harmonics problems and suggest preventive techniques
<b>CO3</b>	Identify the DG sources, analyze the power quality issues and operating conflicts when DG is interconnected to the grid
<b>CO4</b>	Solve power quality problems using Power Quality Equipments
<b>CO5</b>	Understand and analyze the functions of Custom Power Devices
<b>CO6</b>	Apply in industries and Power System Engineering

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	1	1	1	1	1	1	1	-	1	1	1	1	3
<b>CO2</b>	3	2	2	2	1	1	1	-	-	-	-	1	1	3
<b>CO3</b>	3	2	2	2	1	2	1	-	-	1	1	1	1	3
<b>CO4</b>	3	2	2	2	2	2	1	-	-	-	1	1	1	3
<b>CO5</b>	3	2	2	2	1	2	1	1	1	1	-	1	1	3
<b>CO6</b>	3	2	2	2	1	2	1	1	1	1	1	1	1	3

Module No	Module Contents	Hours	COs
1	<p><b>INTRODUCTION:</b> Power quality definitions, Power quality as voltage quality, power quality evaluation procedure, terms and definitions, sources of pollution, international power quality standards and regulations, Computer Business Equipment Manufacturers Associations (CBEMA)curve.</p> <p><b>POWER QUALITY PROBLEMS:</b> Concepts of transients - short duration variations such as interruption - long duration variation such as sustained interruption - Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations.</p>	09	CO1

2	<p><b>VOLTAGE SAGS:</b> Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection, motor starting sags, Solutions at end-user level</p> <p><b>OVERVOLTAGE:</b> Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners</p>	09	CO1 CO2 CO4
3	<p><b>HARMONICS:</b> Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics vs transients. Effect of harmonics - harmonic distortion - voltage and current distortion</p> <p><b>APPLIED HARMONICS:</b> Harmonic indices - inter harmonics – Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters.</p>	09	CO1 CO2 CO4
4	<p><b>POWER QUALITY MONITORING:</b> Monitoring considerations, power quality measurement equipments, Power line disturbance analyzer –harmonic / spectrum analyzer - flicker meters - disturbance analyzer</p> <p><b>CUSTOM POWER DEVICES:</b> Operation and characteristics of DVR, STATCOM, UPFC</p>	09	CO4 CO5 CO6
5	<p><b>DISTRIBUTED GENERATION AND POWER QUALITY:</b> DG technologies, interface to utility system, power quality issues</p> <p><b>FUTURE APPLICATIONS:</b> Industrial Power Quality Monitoring Applications, Power System Performance Assessment and Benchmarking, Power Quality Monitoring and Internet, Future direction – Smart Grid</p>	09	CO3 CO5 CO6

### Text Books:

1. Electrical Power Systems Quality, Roger. C. Dugan, Mark. F. McGranaghan, Surya Santoso, H.Wayne Beaty, McGraw Hill, 3<sup>rd</sup> edition, 2012
2. Power Quality, C.Sankaran, CRC publication, 2017

### Reference Books:

1. Electric Power Quality, G.T. Heydt, 2nd Edition, West Lafayette, IN, Stars in a Circle Publications, 1994.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, M.H.J Bollen, New York: IEEE Press, 2000.
3. Power System Quality Assessment, J. Arrillaga, N.R. Watson, S. Chen, New York: Wiley, 1999.
4. Power Quality, Simmi P.Burman, Bipin Singh, S.K.Kataria publication, re-print- 2014

**Assessment Pattern:****CIE- Continuous Internal Evaluation (50 Marks)**

<b>Bloom's Taxonomy</b>	<b>Tests</b>	<b>Assignments</b>	<b>IBM/Co-Curricular activities</b>	<b>Quizzes</b>
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>7.5 Marks</b>	<b>7.5 Marks</b>	<b>10 Marks</b>
Remember	5	-	-	-
Understand	10	2	2	2
Apply	5	3	3	2
Analyze	5	2.5	2.5	2
Evaluate	-	-	-	2
Create	-	-	-	2

**SEE- Semester End Examination (50 Marks)**

<b>Bloom's Category</b>	<b>Marks Theory (50)</b>
Remember	5
Understand	15
Apply	15
Analyze	10
Evaluate	5
Create	-

## INTEGRATION OF DISTRIBUTED GENERATION

Course Code : 20EEE814A

Credits : 03

L: T: P :S : 3:0:0:0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Understand and evaluate economic issues and key engineering features and concepts of distributed generation that are used in grid integration
<b>CO2</b>	Able to investigate the operation of renewable energy generators at a systems level and analysis of distributed generation systems.
<b>CO3</b>	Analyze the grid integration issues of renewable generation and its performance of the network
<b>CO4</b>	Understand the converter principles and electronic devices developed for the integration of distributed generations into the grid.
<b>CO5</b>	Determine the different topologies used for grid integration of distributed power generations.
<b>CO6</b>	Understand the different law and economic regulations in distributed generation for the liberalized markets, and to identify the boundaries and opportunities in those fields.

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	2	2	2	2	1	2	-	1	2	1	1	1	2
<b>CO2</b>	3	2	1	1	2	1	1	-	1	1	1	1	1	2
<b>CO3</b>	3	2	2	2	2	1	1	-	1	2	-	1	1	2
<b>CO4</b>	3	2	2	1	2	1	1	-	1	1	1	1	1	2
<b>CO5</b>	3	2	1	2	2	1	1	-	1	1	-	1	1	2
<b>CO6</b>	3	2	1	1	1	-	1	-	1	1	-	1	1	2

<b>Module No</b>	<b>Module Contents</b>	<b>Hours</b>	<b>COs</b>
1	<p><b>DISTRIBUTED GENERATION</b></p> <p>Electric grid scenario - Supply guarantee and power quality - Stability - Effects of distributed energy into the grid - Boundaries of the actual grid configuration - Consumption models and patterns- Integration in power systems - Distributed generation advantages and needs.</p>	09	CO1, CO2
2	<p><b>DISTRIBUTED GENERATION AND STORAGE TECHNOLOGIES</b></p> <p>Wind power generation profiles -Photovoltaic and Thermo-solar power generation profiles-Biomass Power-Hydroelectric centrals with asynchronous machine - Hydroelectric centrals with synchronous machine - Secondary regulation-Hydrogen Technologies- Diary/Monthly generation simulations and its comparison to a building consumption- Power Storing- Battery types - Ultra capacitors based energy storage systems – Flywheel- Electric Vehicles</p>	09	CO1, CO2
3	<p><b>DISTRIBUTED GENERATION INTEGRATION SYSTEMS AND ITS CONTROL TECHNIQUES</b></p> <p>AC/DC Drives Control- Introduction to basic analysis and operation techniques on power electronic systems. - Functional analysis of power converters main topologies - Power conversion schemes between electric machines and the grid- Predictive direct power control of systems connected into the grid- Technological aspects of power electronic systems connection to the grid- Active Network Devices, Control and FACTS Technology- Micro-Grids</p>	09	CO3, CO4
4	<p><b>POWER GRID ANALYSIS AND ITS STUDIES</b></p> <p>Electric Systems Modelling- Simulation grid studies and used tools. Unit systems.</p> <p>Electric systems modelling for permanent regime studies - Steady state simulation studies. Load flow- Optimization and Grid Planning- SMART GRIDS</p>	09	CO3, CO4
5	<p><b>STANDARDS AND ELECTRIC MARKETS</b></p> <p>Electric Market- The electric sector: structures and models - Economics in distributed generation-Regulation comparison with other international electric markets experiences - Regulation of the electric sector impact on distributed generation- Standard State of the art - Power supply quality generic standards - Renewable energies specific standards</p>	09	CO5, CO6

### Text Books:

1. Renewable and Efficient Electric Power Systems, Gilbert M, A John Wiley & Sons, Inc., Publication
2. Integration of Distributed Generation in the Power System-2011, Math H. J. Bollen and Fainan Hassan, IEEE Press
3. Control of Power Inverters in Renewable Energy and Smart Grid Integration (Wiley-IEEE Press, 2013).

### Reference Books:

1. Integration of Alternative Sources of Energy, Felix A. Farret and M. Godoy Simoes. 2006, John Wiley and Sons.
2. Distributed Generation The Power Paradigm for the New Millennium Anne-Marie Borbely, Jan F. Kreider CRC Press, 2001.
3. Large Energy storage Systems Handbook , Frank S. Barnes & Jonah G. Levine, CRC Press, 2011.
4. Integration and Control of Renewable Energy in Electric Power System, Ali Keyhani Mohammad Marwali and Min Dai John Wiley publishing company 2009.
5. Renewable Energy Sources and Emerging Technologies, Ranjan Rakesh, Kothari D.P, Singal K.C, 2<sup>nd</sup> Ed.

### Assessment Pattern:

#### CIE- Continuous Internal Evaluation (50 Marks)

<b>Bloom's Taxonomy</b>	<b>Tests</b>	<b>Assignments</b>	<b>IBM/Co-Curricular activities</b>	<b>Quizzes</b>
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>7.5 Marks</b>	<b>7.5 Marks</b>	<b>10 Marks</b>
Remember	5	-	-	-
Understand	4	2	2	2
Apply	8	3	3	2
Analyze	4	2.5	2.5	2
Evaluate	4	-	-	2
Create	-	-	-	2

#### SEE- Semester End Examination (50 Marks)

<b>Bloom's Category</b>	<b>Marks Theory (50)</b>
Remember	5
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	5

## PROFESSIONAL ELECTIVE-VI

### PHOTO VOLTAIC SYSTEMS AND APPLICATIONS

Course Code : 20EEE821A

L: T: P:S : 3:0:0:0

Exam Hours : 03

Credits : 03

CIE Marks : 50

SEE Marks : 50

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

<b>CO1</b>	Understand the basics of photovoltaic cells
<b>CO2</b>	Choose appropriate battery charging for different applications
<b>CO3</b>	Develop maximum power point tracking techniques
<b>CO4</b>	Analyze solar irradiation and design an appropriate solar PV system for power generation
<b>CO5</b>	Evaluate and design standalone and grid connected PV systems based on the consumer demand
<b>CO6</b>	Design appropriate PV arrays based on the applications

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	3	3	2	2	-	1	-	1	-	1	1	3	3
<b>CO2</b>	3	3	3	2	2	-	1	-	1	-	1	1	3	3
<b>CO3</b>	3	3	3	2	2	-	1	-	1	-	1	1	3	3
<b>CO4</b>	3	3	3	2	2	-	1	-	1	-	1	1	3	3
<b>CO5</b>	3	3	3	2	2	-	1	-	1	-	1	1	3	3
<b>CO6</b>	3	3	3	2	2	-	1	-	1	-	1	1	3	3



Module No	Module Contents	Hours	Cos
1	<b>THE PV CELL:</b> Evolution of PV cell, Characteristics and equivalent circuit, Model of PV cell, Short Circuit, Open Circuit and Peak power parameters, Data sheet study Cell efficiency, Effect of temperature, Temperature effect calculation, Fill factor, PV cell simulation, PV cell interconnection	09	CO3
2	<b>PV DESIGN:</b> Solar modules, Storage systems, Power conditioning and regulation, Protection, Sizing and design of PV system	09	CO1
3	<b>MAXIMUM POWER POINT TRACKING:</b> Concept of MPPT, algorithms, Perturb-Observe method, Incremental Conductance method,	09	CO2, CO6
4	<b>STAND ALONE AND GRID CONNECTED PV SYSTEM:</b> Stand –alone PV system, Configurations, Grid connected PV systems, Configuration and working of single stage grid connected PV system	09	CO5, CO6
5	<b>APPLICATIONS OF SOLAR PV SYSTEM:</b> Battery chargers, Domestic and Street lighting, Water pumping, Solar PV power plant, Industry applications and Telecommunications.	09	CO4

### Text Books:

1. Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki, Prentice-Hall of India Pvt. Limited, Third Edition edition, 2018 Reprint.
2. Applied Photovoltaics, Stuart R. Wenham, Martin A. Green, Muriel E. Watt and Richard Corkish, 2017, Earthscan, UK
3. Large Energy storage Systems Handbook, Frank S. Barnes & Jonah G. Levine, CRC Press, 2015.

### Reference Books:

1. Renewable and Efficient Electric Power Systems, Gilbert M. Masters: John Wiley & Sons, 2014.
2. Photovoltaic Systems Engineering, Roger A. Messenger & Jerry Ventre: CRC Press, 2014, 2<sup>nd</sup> edition.

**Assessment Pattern:****Continuous Internal Evaluation:**

<b>Bloom's Taxonomy</b>	<b>Test</b>	<b>Assignment</b>	<b>Quizzes</b>
<b>Marks (Out of 50)</b>	<b>25 Marks</b>	<b>15 Marks</b>	<b>10 Marks</b>
Remember	-	-	-
Understand	2	-	2
Apply	5	7.5	2
Analyze	8	7.5	2
Evaluate	5	-	2
Create	5	-	2

**Semester End Examination:**

<b>Blooms levels</b>	<b>SEE – Theory (50 Marks)</b>
Remember	-
Understand	5
Apply	10
Analyze	10
Evaluate	15
Create	10

## SIMULATION OF POWER ELECTRONICS

Course Code : 20EEE822A

Credits : 03

L: T: P :S : 3:0:0 :0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Apply mathematical skills to represent mathematically a physical system
<b>CO2</b>	Apply various modelling methods to develop mathematical modelling
<b>CO3</b>	Design and develop digital controllers to control current and voltage of a Power Electronics system
<b>CO4</b>	Apply modern engineering software tools such as MATLAB software to develop model for various Power Electronics circuits.
<b>CO5</b>	Extract information through appropriate design techniques and tools for simulation of Power Electronics based circuits published in conference/ journal papers.
<b>CO6</b>	Demonstrate capacity for self-management and teamwork, communicate regarding activities carried out as a part of self-study confidently and effectively, to comprehend and write effective reports and design documentation

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	3	2	2	2	-	-	-	-	-	1	1	3	3
<b>CO2</b>	3	3	2	2	2	-	-	-	-	-	1	1	3	3
<b>CO3</b>	3	3	2	2	2	-	-	-	-	-	1	1	3	3
<b>CO4</b>	3	3	2	2	2	-	-	-	-	-	1	1	3	3
<b>CO5</b>	3	3	2	2	2	-	-	-	-	-	1	1	3	3
<b>CO6</b>	3	3	2	2	2	-	-	-	-	-	1	1	3	3

Module	Module Contents	No Hours	COs
1	<p><b>COMPUTER SIMULATION OF POWER ELECTRONIC CONVERTERS AND SYSTEMS</b></p> <p>Challenges in computer simulation, simulation process, Types of analysis, mechanics of simulation, circuit-oriented simulators, equation solvers, comparison of circuit oriented simulators and equation solvers.</p>	9	CO1 CO2
2	<p><b>MODELLING OF SYSTEMS</b></p> <p>Input-Output relations, differential equations and linearization, state space representation, transfer function representation, modelling of an armature controlled DC Motor, poles and zeroes circuit averaging method of modelling approach for switched power electronic circuits,</p>	9	CO3
3	<p><b>SPACE VECTOR MODELLING</b></p> <p>Space vectors, representation of space vectors in orthogonal co-ordinates, space vector transformations, modelling of induction motor, and state space representation of the d-q model of the induction motor.</p>	9	CO4
4	<p><b>DIGITAL CONTROLLER DESIGN</b></p> <p>Controller design techniques, Bode diagram method, PID controller, design, root locus method, state space method. Tracker, controller design, controlling voltage, controlling current.</p>	9	CO5
5	<p><b>DISCRETE COMPUTATION ESSENTIALS</b></p> <p>Numeric formats, fixed -point numeric format, floating -point numeric format, tracking the base point in the fixed point system, addition of numbers, subtraction of numbers, multiplication of numbers, normalization and scaling, multiplication algorithm, arithmetic algorithm reciprocal, square root, reciprocal of square root, sine and cosine exponential, logarithm, implementation examples, pi controller, sine and cosine, pulse width modulation, space vector pwm, over-modulation.</p>	9	CO6

## TEXT BOOKS:

1. Simulation of Power Electronic circuits, M.B.Patil, M.C.Chandorkar, Ramanarayanan. V, Ranganathan, V. T, Alpha Science International Ltd, 2015
2. Control Design Techniques in Power Electronics Devices, Hebertt Sira-Ramirez, Silva-Ortigoza, Springer, 2016.

## REFERENCES:

1. Power Electronics (With MATLAB), Bansal RC, Joshi RR, Vinod kumar, Himanshu Publications, 2009
2. Power Electronics: Devices, Circuits And Matlab Simulations, Alok Jain, Penram International Publishing Pvt Ltd, 2010

## Assessment Pattern:

### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks (Out of 50)	25 Marks	15 Marks	10 Marks
Remember	2	-	-
Understand	5	-	2
Apply	5	7.5	2
Analyze	5	7.5	2
Evaluate	5	-	2
Create	3	-	2

### SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	5
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	5

## BIOMEDICAL INSTRUMENTATION

Course Code : 20EEE823A

Credits : 03

L: T: P:S : 3:0:0 :0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Inculcate the knowledge about the electrodes and equivalent circuits
<b>CO2</b>	Illustrate origin of bio potentials and its propagations
<b>CO3</b>	Understand the different types of electrodes and its placement for various recordings
<b>CO4</b>	Design bio amplifier for various physiological recordings
<b>CO5</b>	Learn the different measurement techniques for non-physiological parameters.
<b>CO6</b>	Summarize different biochemical measurements.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	2	-	-	-	1	-	-	-	1	-	-	-	-
<b>CO2</b>	3	2	1	-	-	2	-	-	-	1	-	-	-	-
<b>CO3</b>	3	1	1	-	-	2	1	-	-	1	-	2	-	-
<b>CO4</b>	3	2	3	2	-	2	1	-	-	-	2	2	-	-
<b>CO5</b>	3	1	1	1	-	1	1	1	-	-	-	2	-	-
<b>CO6</b>	3	1	1	1	-	2	2	-	-	-	-	-	-	-

Module	Module Contents	No Hours	COs
1	<b>BIOPOTENTIAL ELECTRODES:</b> Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarisable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - motion artefacts, measurement with two electrodes.	9	CO1 CO2
2	<b>BIOPOTENTIAL MEASUREMENTS:</b> Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven’s triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG.	9	CO3
3	<b>SIGNAL CONDITIONING CIRCUITS:</b> Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering	9	CO4
4	<b>MEASUREMENT OF NON-ELECTRICAL PARAMETERS:</b> Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.	9	CO5
5	<b>BIOCHEMICAL MEASUREMENT AND BIOSENSORS:</b> Biochemical sensors - pH, pO <sub>2</sub> and pCO <sub>2</sub> , Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description) – Bio Sensors – Principles – amperometric and volt metric techniques.	9	CO6

## TEXT BOOK:

1. Leslie Cromwell, —Biomedical Instrumentation and measurement||, 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, —Medical Instrumentation Application and Design||, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.

## REFERENCES:

1. Joseph J. Carr and John M. Brown, —Introduction to Biomedical Equipment Technology||, Pearson Education, 2004.
2. Myer Kutz, —Standard Handbook of Biomedical Engineering and Design||, McGraw Hill Publisher, 2003.
3. Khandpur R.S, —Handbook of Biomedical Instrumentation||, 3rd edition, Tata McGraw-Hill

## Assessment Pattern:

### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks (Out of 50)	25 Marks	15 Marks	10 Marks
Remember	2	-	-
Understand	5	-	2
Apply	5	7.5	2
Analyze	5	7.5	2
Evaluate	5	-	2
Create	3	-	2

### SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	5
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	5



## APPLICATIONS OF IOT IN ELECTRICAL ENGINEERING

Course Code : 20EEE824A

Credits : 03

L: T: P:S : 3:0:0:0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Identify the main components of Internet of Things.
<b>CO2</b>	Program the sensors and controller as part of IOT.
<b>CO3</b>	Assess different Internet of Things technologies and their applications.
<b>CO4</b>	Design a component or a product applying all the relevant standards and with realistic constraints.
<b>CO5</b>	Identify a suitable hardware and software solution for the given electrical and electronics problems.
<b>CO6</b>	Execute their electrical and electronics product ideas into a real-time working model.

**Mapping of Course Outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	-	3	-	-	-	-	-	-	-	-	-	3	3	3
<b>CO2</b>	3	1	1	2	3	-	-	-	1	1	-	-	3	3
<b>CO3</b>	-	-	3	-	3	3	3	3	-	-	-	-	3	3
<b>CO4</b>	3	3	3	3	3	3	3	1	3	-	2	3	3	3
<b>CO5</b>	-	3	3	3	3	2	1	2	3	-	3	3	3	3
<b>CO6</b>	3	3	3	3	3	3	1	1	3	-	3	3	3	3

Module No	Contents of the Module	Hours	COs
1	<p><b>INTRODUCTION TO INTERNET OF THINGS:</b>            Definition &amp; Characteristics of IoT - Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security.</p> <p><b>COMPONENTS IN INTERNET OF THINGS:</b>            Control Units – Communication modules –Bluetooth – Zigbee – Wifi – GPS- IOT Protocols (IPv6, 6LoWPAN, RPL, CoAP), MQTT, Wired Communication, Power Sources. Current trends in IoT.</p>	09	CO1 CO2
2	<p><b>PROGRAMMING THE MICROCONTROLLER FOR IOT:</b>            Introduction of Raspberry Pi 3 B+ - About Raspberry version and processor, specification, pin details, features. Raspberry OS, IP configuration, Wi-Fi configuration, supporting package installation. Basic Linux commands, basic python programming, web server installation, Basic HTML and PHP, connecting My SQL data base. Different type of IoT Gate way.</p>	09	CO2 CO3
3	<p><b>HARDWARE INTERFACING:</b>            Working principles of sensors – IOT deployment for Raspberry Pi – Reading from Sensors, Communication: Connecting microcontroller with mobile devices– communication through Bluetooth, Wi-Fi and USB - Contiki OS. Camera interface, Think speck IoT platform, Android interface with IoT.</p>	09	CO2 CO3
4	<p><b>RESOURCE MANAGEMENT IN IOT:</b>            Clustering, Clustering for Scalability, Clustering Protocols for IoT - From the internet of things to the web of things - The Future Web of Things – Set up cloud environment – Cloud access from sensors– Data Analytics for IOT- Case studies- Open Source ‘e-Health sensor platform’ – ‘Be Close Elderly monitoring’ – Other recent projects.</p>	09	CO2 CO3 CO4 CO5
5	<p><b>IOT APPLICATIONS:</b>            Businessmodelsforthe internetofthings, Home energy management, home automation, smart meter, smartcity,smart mobility and transport, smart buildings and infrastructure, smarthealth, environment monitoring and surveillance.</p>	09	CO6

## Text Books:

1. Architecting the Internet of Things, Dieter Uckelmann et.al Springer, 2011
2. Internet of Things – A Hand-on Approach, Arshdeep Bahga and Vijay Madiseti, Universities press, 2015

## Reference Books:

1. Building Internet of Things with the Arduino, Charalampos Doukas, Create space, April 2002.
2. Internet of Things: From research and innovation to market deployment, Dr. Ovidiu Vermesan and Dr. Peter Friess, River Publishers 2014.
3. 8051 Microcontroller:An Application Based Introduction, David Calcutt, Fred Hassan, Newness,2008.
4. Contiki: The open source for IOT, [www.contiki-os.org](http://www.contiki-os.org)

## Assessment Pattern:

### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks (Out of 50)	25 Marks	15 Marks	10 Marks
Remember	-	-	-
Understand	5	-	2
Apply	5	7.5	2
Analyze	-	7.5	2
Evaluate	5	-	2
Create	10	-	2

### SEE- Semester End Examination (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	10
Create	10

## INTERNSHIP

**Course Code : 20EEE83A**

**Credits : 4**

**L: T: P:S : 0:0:4:0**

**CIE Marks : 50**

**Exam Hours : 03**

**SEE Marks : 50**

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

<b>CO1</b>	Apply and test the basic theoretical knowledge learnt during academics on to projects in industry.
<b>CO2</b>	Cater to the recent industrial demands by analyzing and designing complex engineering solutions.
<b>CO3</b>	Work in real-life scenarios.
<b>CO4</b>	Perform either as an individual or as a team to communicate the complex engineering activities with the community and with the society.

### Mapping of Course Outcomes to Program Outcomes:

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>
<b>CO1</b>	3	3	3	3	3	3	2	1	3	3	3	3	2	3
<b>CO2</b>	3	3	3	3	3	3	2	1	3	3	3	3	2	3
<b>CO3</b>	3	3	3	3	3	3	2	1	3	3	3	3	2	3
<b>CO4</b>	3	3	3	3	3	3	2	1	3	3	3	3	2	3

The student undergoes an internship for the duration of 4 to 6 weeks. Students are encouraged to carry out internship in reputed industries/ public sector to get the practical exposure from industries. Internship coordinators assigned by Head of the department will allot the mentors for students to guide them in internship. Students shall report the progress of the internship to the guide in regular intervals. CIE marks of 50 and SEE marks of 50 are allotted for internship. After successful completion of internship, internal and SEE reviews will be conducted as per the rubrics.

### INTERNSHIP GUIDELINES:

#### Step: 1

Request Letter/ Email from the office of Training & Placement cell of the college should go to industry to allot various slots of 4-6 weeks during summer vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training.

#### Step 2:

Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students in the office of Training & Placement through concerned department. Based on the number of slots agreed to by the Industry,

TPO will allocate the students to the Industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the TPO or other members of the T&P cell / Faculty members who are particularly looking after the Final/Summer Internship of the students.

**Step 3:** Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

**Step 4:** Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department office/TPO with the consent of Industry persons/ Trainers. (Sample Attached)

**Step 5:** Students will submit training report after completion of internship.

**Step 6:** Training Certificate to be obtained from industry.

**Step 7:** List of students who have completed their internship successfully will be issued by Training and Placement Cell.

**CIE- Continuous Internal Evaluation (50 Marks)**

Bloom's Level	Bloom's Category	Review 1 (25 Marks)	Review 2 (25 Marks)
L1	Remember	-	-
L2	Understand	4	4
L3	Apply	7	7
L4	Analyze	8	8
L5	Evaluate	6	6
L6	Create	-	-

**SEE – Semester End Examination (50 Marks)**

Bloom's Category	Marks
Marks (out of 50)	
Remember	-
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	-

## PROJECT PHASE II

Course Code : 20EEE84A

Credits : 10

L: T: P:S : 0:0:10:0

CIE Marks : 50

Exam Hours : 03

SEE Marks : 50

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

<b>CO1</b>	Use disciplinary and fundamental concepts and procedures in ways that are appropriate for their main fields of study.
<b>CO2</b>	Identify, analyze, and solve problems creatively through sustained critical investigation with teamwork and multidisciplinary approach.
<b>CO3</b>	To Create engineering solutions to challenging issues using the most recent information, technology tools, and methods that are unique to the professional field of study.
<b>CO4</b>	Present excellent communication skills, act with professionalism and ethics, and connect technical concerns to broader societal contexts through publishing the project details.

### Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
<b>CO1</b>	3	3	2	3	3	2	2	2	3	3	3	2	3	3
<b>CO2</b>	3	3	3	3	3	2	2	2	3	3	3	2	3	3
<b>CO3</b>	3	3	3	3	3	2	2	2	3	3	3	2	3	3
<b>CO4</b>	3	3	3	3	3	2	2	2	3	3	3	2	3	3

Project is an experimental learning course which will provide a platform to students to enhance their practical knowledge and skills by the development of existing systems/ novel prototypes. The student shall be capable to recognise a problem in the area of Electrical and Electronics Engineering and solve it using latest technologies in a project. Based on the ability/abilities of the student/s and recommendations of the guide, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. The project work will be reviewed by a panel of experts throughout the semester. The CIE marks awarded for the project work shall be based on the work accomplishment, project presentation skill, and question and answer session. The Plagiarized projects will automatically result an F grade and the student will be liable for further disciplinary action. At the completion of a project the student will submit a working module and project report, which will be evaluated by duly appointed examiner(s).

The students will be required to complete the following process:

S.No	Content	COs
1.	Perform a literature search to review current knowledge and developments in the chosen technical area. Review and finalization of the Approach to the Problem relating to the chosen topic/title. Preparation of work schedule with a team.	CO1, CO3
2.	Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as required for the chosen field	CO1, CO2
3.	Development of product/process, testing, results, conclusions and future directions.	CO1, CO2
4.	Present the work in a forum involving poster presentations and demonstrations of operational hardware and software.	CO4
5.	Preparation of a project report in the standard format for being evaluated by the guide and the department with plagiarism certificate.	CO3
6.	Preparing a paper for Conference presentation/Publication in Journals, if possible	CO3,CO4

#### CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Level	Bloom's Category	Review 1 (25 Marks)	Review 2 (25 Marks)
L1	Remember	-	-
L2	Understand	4	4
L3	Apply	5	6
L4	Analyze	6	6
L5	Evaluate	6	4
L6	Create	4	5

#### SEE – Semester End Examination (50 Marks)

Bloom's Category	Marks
Marks (out of 50)	
Remember	-
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10

## APPENDIX A

### Outcome Based Education

**Outcome-based education (OBE)** is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

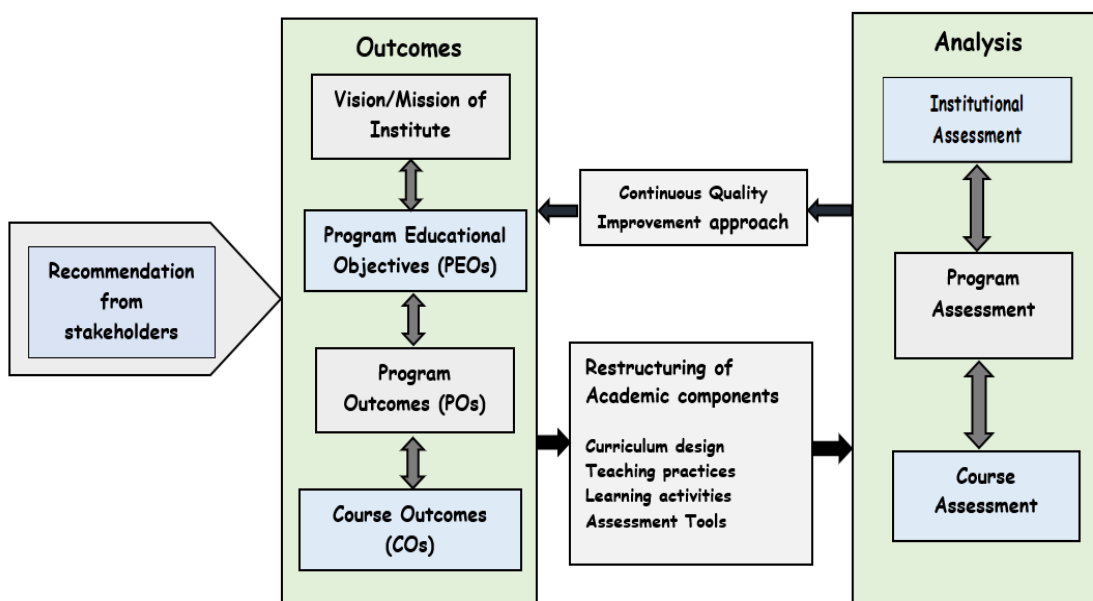
There are three educational Outcomes as defined by the National Board of Accreditation:

**Program Educational Objectives:** The Educational objectives of engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

**Program Outcomes:** What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

**Course Outcome:** The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

### Mapping of Outcomes





## APPENDIX B

### The Graduate Attributes of NBA

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

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

**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**Conduct investigations of complex problems:** The problems that cannot be solved by straight forward application of knowledge, theories and techniques applicable to the engineering discipline. \* That may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions. Hat require consideration of appropriate constraints/requirements not explicitly given in the problem statement. (like: cost, power requirement, durability, product life, etc.). which need to be defined (modeled) within appropriate mathematical framework. that often require use of modern computational concepts and tools.#

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

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

**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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

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

**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to

comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

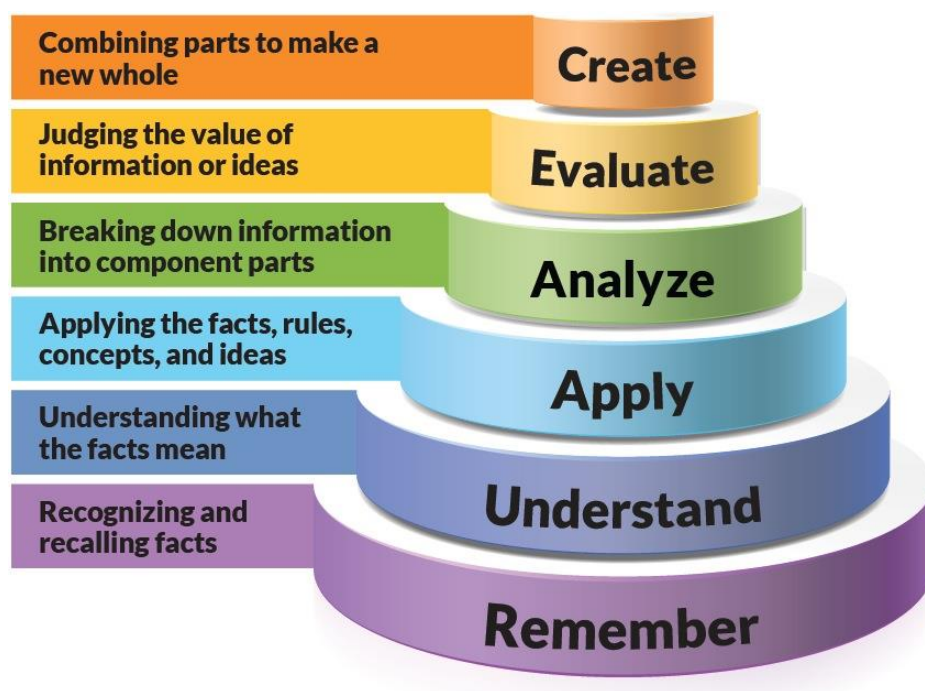
**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

## APPENDIX C

### BLOOM’S TAXONOMY

Bloom’s taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom’s taxonomy to inform or guide the development of [assessments](#) (tests and other evaluations of student learning), [curriculum](#) (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. [eduglosarry.org]



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