Sixth Semester (Emerging Area Specialization: Artificial Intelligence and Machine Learning)

Group	Paper Code	Paper	L	P	Credits
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3	-	3
HS/MS	MS-302	Universal Human Values*	1	0	1
PCE 1	EEE-320T	Utilization of Electrical Energy	3	-	3
PCE 2	EEE-334T	Research Methodology for Electrical & Electronics Engineering	3	.	3
PCE 3	EEE-354	Electrical Power Generation Systems	4	-	4
AIML-EAE-1	AI-302T	Artificial Intelligence	3	-	3
AIML-EAE-2	DA-304T	Statistics, Statistical Modelling & Data Analytics	3	-	3
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**	-	-	2
PCE 1	EEE-320P	Utilization of Electrical Energy Lab	-	2	1
PCE 2	EEE-334P	Research Methodology for Electrical & Electronics Engineering Lab	-	2	1
AIML-EAE-1	AI-302P	Artificial Intelligence Lab	-	2	1
AIML-EAE-2	DA-304P	Statistics, Statistical Modelling & Data Analytics Lab	-	2	1
Total					26

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES**: Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co- ordinator for the period of 3rd semester to 6th semester only

Note : Following Programme Core Elective Paper (PCE) and Emerging Areas specialization AIML and Electrical Vehicles has been opted by students in Fifth semester

Sixth Semester(Emerging Area Specialization: Electrical Vehicles)

Group	Paper Code	Paper	L	P	Credits
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3	-	3
HS/MS	MS-302	Universal Human Values*	1	0	1
PCE 1	EEE-320T	Utilization of Electrical Energy	3	-	3
PCE 2	EEE-334T	Research Methodology for Electrical & Electronics Engineering	3	.	3
PCE 3	EEE-354	Electrical Power Generation Systems	4	-	4
EV-EAE-1	EV-308T	Electric Vehicle Powertrain and Motor Design	3	-	3
EV-EAE-2	EV-310T	Battery Management Systems	3	-	3
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**	-	-	2
PCE 1	EEE-320P	Utilization of Electrical Energy Lab	-	2	1
PCE 2	EEE-334P	Research Methodology for Electrical & Electronics Engineering Lab	-	2	1
EV-EAE-1	EV-308P	Electric Vehicle Powertrain and Motor Design Lab	-	2	1
EV-EAE-2	EV-310P	Battery Management Systems Lab	-	2	1
Total					26

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES**: Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co- ordinator for the period of 3rd semester to 6th semester only

Note : Following Programme Core Elective Paper (PCE) and Emerging Areas specialization AIML and Electrical Vehicles has been opted by students in Fifth semester

Artificial Intelligence	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-374T
ECE	6	PCE	PCE-1	ECE-318T
CSE-AI/CSE-AIML	6	PC	PC	AI-302T
EAE	6	AI-EAE	AI-EAE-1	AI-302T
EAE	6	AIML-EAE	AIML-EAE-1	AI-302T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the definition and basic knowledge of Artificial Intelligence.
2.	To introduces AI by examining the nature of the difficult problems.
3.	To understand with AI demonstration that intelligence requires ability to find reason.
4.	To understand the latest techniques and the future scope of the technology.

Course Outcomes (CO)

CO 1	Ability to use AI methods and control strategies to solve the problems.
CO 2	Understand the production system and its applications. Also, to understand the properties and applications for the different search algorithms.
CO 3	Applying the different algorithms and the techniques, also analyse the reason for the results.
CO 4	Study the expert systems and the modern approaches.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	-	-	-	-	2
CO 2	3	3	3	3	3	2	2	-	-	-	-	2
CO 3	3	3	3	3	3	2	2	-	-	-	-	2
CO 4	3	3	3	3	3	2	2	-	-	-	-	2

UNIT-I

AI Definition, Problems, The Foundations of Artificial Intelligence, Techniques, Models, Defining Problem as a state space search, production system, Intelligent Agents: Agents and Environments, Characteristics, Search methods and issues in the design of search problems.

UNIT-II

Knowledge representation issues, mapping, frame problem. Predicate logic, facts in logic, representing instance and Isa relationship, Resolution, procedural and declarative knowledge, matching, control knowledge. Symbolic reasoning under uncertainty, Non monotonic reasoning, statistical reasoning.

UNIT-III

Game Playing, minimax search, Alfa beta cut-offs, Natural Language Processing, Learning, Explanation-based learning, discovery, analogy, Neural net learning and Genetic Learning.

UNIT - IV

Fuzzy logic systems, Perception and action, Expert systems, Inference in Bayesian Networks, K-means Clustering Algorithm, Machine learning.

Textbook(s):

1. Elaine Rich, Kevin Knight, and Shivashankar B Nair, "Artificial Intelligence", Tata McGraw Hill.
2. S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Pearson Edu.

References:

1. Deepak Khemani, "A First Choice in Artificial Intelligence", McGraw Hill.
2. K M Fu, "Neural Networks in Computer Intelligence", McGraw Hill.

Artificial Intelligence Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-374P
ECE	6	PCE	PCE-1	ECE-318P
CSE-AI/CSE-AIML	6	PC	PC	AI-302P
EAE	6	AI-EAE	AI-EAE-1	AI-302P
EAE	6	AIML-EAE	AIML-EAE-1	AI-302P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Artificial Intelligence) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of PROLOG.
2. Write simple fact for the statements using PROLOG
   a. Ram likes mango.
   b. Seema is a girl.
   c. Bill likes Cindy.
   d. Rose is red.
   e. John owns gold.
3. Write predicates, one converts centigrade temperatures to Fahrenheit, the other checksif a temperature is below freezing using PROLOG.
4. Write a program to implement Breath First Search Traversal.
5. Write a program to implement Water Jug Problem.
6. Write a program to remove punctuations from the given string.
7. Write a program to sort the sentence in alphabetical order.
8. Write a program to implement Hangman game using python.
9. Write a program to implement Hangman game.
10. Write a program to implement Tic-Tac-Toe game.
11. Write a program to remove stop words for a given passage from a text file using NLTK.
12. Write a program to implement stemming for a given sentence using NLTK.
13. Write a program to POS (part of speech) tagging for the give sentence using NLTK.
14. Write a program to implement Lemmatization using NLTK.
15. Write a program for Text Classification for the given sentence using NLTK.

Battery Management Systems	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	EV-EAE	EV-EAE-2	EV-310T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the different types of energy storage system.
2.	To study about the battery characteristic & parameters.
3.	To know the concepts of battery management system and design the battery pack.
4.	To study about the battery testing, disposal and recycling.

Course Outcomes (CO)

CO 1	Discuss about the different types of energy storage system.
CO 2	Describe about the battery characteristic & parameters.
CO 3	Apply the concepts of battery management system and design the battery pack.
CO 4	Explain about the battery testing, disposal and recycling.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zine Chloride battery; Ultra capacitors, General approach to modelling batteries.

UNIT II

Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables tocharacterize battery operating conditions and Specifications to characterize battery nominal and maximumcharacteristics; Efficiency of batteries; Electrical parameters- Heat generation- Battery design- Performancecriteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements ofbatteries, Meeting battery performance criteria- setting new targets for battery performance.

UNIT III

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring,

BatteryState of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface,SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery ManagementSystem: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, BatteryPack Safety, Battery Standards & Tests

UNIT IV

Chemical & structure material properties for cell safety and battery design, battery testing, limitations fortransport and storage of cells and batteries, Recycling, disposal and second use of batteries. Battery Leakage:gas generation in batteries, leakage path, leakage rates. Ruptures: Mechanical stress and pressure tolerance ofcells, safety vents, Explosions: Causes of battery explosions, explosive process, ThermalRunway: Highdischarge rates, Short circuits, charging and discharging. Environment and Human Health impactassessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries.

Textbook(s):

1. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric VehicleBattery Systems", John Wiley& Sons Ltd., 2016.
2. Chris Mi, Abul Masrur& David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric Hybrid Electric and Fuel Cell Vehicles",Taylor& Francis Group, 2010.

Reference Books:

1. G. Pistoia, J.P. Wiaux, S.P. Wolsky, "Used Battery Collection and Recycling", Elsevier, 2001. (ISBN: 0-444-50562-8)
2. Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017. (ISBN: 978-1-1193-2185-9)
3. T R Crompton, "Battery Reference Book", 3rd Edition, Newnes- Reed Educational and ProfessionalPublishing Ltd., 2000.
4. Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer,2018. (ISBN: 978-3-319-70571-2).
5. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.

Battery Management Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	EV-EAE	EV-EAE-2	EV-310P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Battery Management Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study the basic parameters of battery.
2. Measure the charging voltage and current of given battery.
3. Demonstrate any charging technique of lead acid battery/ Lithium Ion battery.
4. Demonstrate the discharging process of battery using various values of C-rate and compare it.
5. Simulate battery model of given battery using any simulation tool.
6. Simulation on charging techniques of battery.
7. Study the process of battery testing and measure the parameters of battery.
8. Study and Demonstration of Battery Temperature Measurement (Thermocouple, Thermistor etc)
9. Battery pack design for given EV application (Testing Various series parallel combinations for given application)
10. Case Study: Design, selection, sizing and components of any developed charging station for EV.
11. Visit to any industry/ Research laboratory related to battery and EV.

Electric Vehicle Powertrain and Motor Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	EV-EAE	EV-EAE-1	EV-308T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic knowledge of EV technologies.
2.	To impart the knowledge of different storage technologies.
3.	To impart the knowledge of Electric Machines and Drives in EVs.
4.	To impart the knowledge of converters and controllers used in EVs.

Course Outcomes (CO)

CO 1	To understand the different EV technologies.
CO 2	To provide the solution of energy storage in EVs.
CO 3	To understand the Electric machines and Drives in EVs.
CO 4	To understand the different converters and controllers in EVs.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction to EVs, Comparison with Internal combustion Engine : Technology, Comparison with Internal combustion Engine: Benefits and Challenges Components of Electric Vehicle, Electric Vehicle Powertrain block diagram,

UNIT II

Battery Energy StorageBatteries in Electric and Hybrid Vehicles: Battery Basics, Battery Parameters, Electrochemical Cell Fundamentals. Battery Modeling: Electric Circuit ModelsBasic Battery Model, Run-Time Battery Model, Impedance-Based Model, First Principle Model, Empirical Models: Range Prediction with Constant Current Discharge, Range Prediction with Power Density Approach. Traction Batteries, Battery Pack Management

UNIT III

Electric Machines and Drives in EVs: Principle of Induction Motors,Speed Control of Induction Machine, Variable Frequency, Variable Voltage Control of Induction Motors, Field-Oriented Control of Induction Machine, Basic Principle and Operation of PM Motors, Design and Sizing of Traction Motors. Speed Rating of the Traction Motor, Determination of the Inner Power, Thermal Analysis and Modeling of Traction Motors.

UNIT IV

Introduction to Power Electronic Switches, DC/DC Converters, Buck Converter, Boost Converter, Buck-Boost Converter, EV Powertrain Converters: Powertrain Boost Converter, Traction Inverter:Power Device Selection, Busbar and Packaging, DC Bus Filtering, Gate Drive Design, Controller and Sensors,Thermal Design. High- to Low-Voltage DC/DC Converter, On-Board Battery Charger, Cell-Balancing Converters

Textbook(s):

1. Iqbal Husain , "Electric and Hybrid VehiclesDesign Fundamentals", CRC Press
2. John G. Hayes, "Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid,Electric and Fuel Cell Vehicles", Wiley
3. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley, 2003

Reference Books:

1. Mehrdad Ehsani, "Modern Electric,Hybrid Electric, andFuel Cell Vehicles" CRC Press
2. Electric and Hybrid Vehicles Technologies, Modeling and Control: A Mechatronic Approach By Amir Khajepour, Saber Fallah, AvestaGoodarzi, Wiley

Electric Vehicle Powertrain and Motor Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EAE	6	EV-EAE	EV-EAE-1	EV-308P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Electric Vehicle Powertrain and Motor Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1 Battery testing

2 Alternator testing.

3 Starter motor testing

4 Diagnosis of ignition system.

5 Diagnosis of automotive electrical wiring.

6 Fault finding of relay & fuses in car using Off Board Diagnostics Systems (OBDS).

7 Relay & fuse Fault diagnostic of a car using OBDS

8 Powertrain Design- Continuously Variable Transmission (CVT) and Belt Drive

9 Powertrain Design- Using Planetary Gear Sets

10 Powertrain Design- Using CVT and a Bevel Gearbox

11 Driving Cycle Simulation

Electrical Power Generation Systems	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE	6	PCE	PCE-1	EEE-358
EEE	6	PCE	PCE-3	EEE-354

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Study the effect of renewable energy resources and thermal power plant
2.	Explore Gas turbine Power plant and hydro electric methods used in power system
3.	Deep knowledge of various components of substations.
4.	Design of various new technologies to optimize the economic operations

Course Outcomes (CO)

CO 1	Understand the economics of power generation.
CO 2	Understand Gas turbine Power plant and hydroelectric methods used in power system
CO 3	Have a deep knowledge of various components of substations.
CO 4	Apply various new technologies to optimize the economic operations

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	-	-	-	1	-	-	-	1	2
CO 2	3	2	2	-	2	2	2	-	-	-	1	2
CO 3	3	2	2	-	-	2	1	-	-	1	2	2
CO 4	3	-	2	-	-	-	3	-	-	-	3	2

UNIT I

Different form of energy sources: Fossils fuels, Nuclear energy and Hydro power

Renewable Energy Sources: Introduction to Solar energy, geo-thermal energy, tidal energy, wind energy, bio-gas energy and M.H.D. Power generation.

Thermal Power Plant: Location and Site selection, general layout and working of plant, boilers, economizers, super heaters, draft equipments, fuel and ash handling plants**.**

UNIT II

Gas Turbine Power Plant: Lay out, Working and components of gas turbine power plant, combined gas and steam turbine plant.

Hydro Electric Plant: Location and site selection, general layout and operation of plant, Types of Hydro Turbines and their characteristics – Impulse and reaction type (Pelton Wheel, Francis and Kaplan turbines), speed governing system.

Diesel Power Plant: Layout and components of plant auxiliary equipments.

UNIT III

Nuclear Power Plant: Location and site selection, general layout and operation of plant, brief description of reactors, moderators and reflectors.
Substation Layout: Types of substations, typical layout and constructional details of pole mounted, Indoor, Outdoor sub-stations, hybrid gas insulated sub stations, bus bar arrangements, application of substation equipment like transformer , circuit breaker, isolator, metering equipments and protecting equipment , substation grounding.

UNIT IV

Economic Operation Of Power System: Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula. Cost analysis and economics of power generation.

Textbooks:

1. M. V. Deshpande, "Elements of Electric Power Station Design", Wheeler Publishing Co.
2. B. G. A. Skrotzki& W. A. Vopat, "Power Station Engineering and Economy", Tata McGraw Hill. 5th Ed. 2013
3. Harish.C.Rai, "Power Plant Engineering", I.K. International Publishers.

References:

1. S. L. Uppal, "Electrical Power", Khanna Publishers. 13th edition 2003
2. M. L. Soni, P. V. Gupta and U. S. Bhatnagar, "A Course in Electrical Power", Dhanpat Rai & Sons, 1st Ed 2005
3. B. R. Gupta, "Generation of Electrical Energy", S. Chand & Co. Ltd.
4. C.L. Wadhwa, "Generation distribution and utilization of Electrical Energy", New Age International Publishers, 3rd Ed, 2017

Principles of Management for Engineers	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	6	HS/MS	MS	MS-302

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To describe the functions, roles and skills of managers and illustrate how the manager's job is evolving.
2.	To evaluate approaches to goal setting, planning and organizing in a variety of circumstances.
3.	To evaluate contemporary approaches for staffing and leading in an organization
4.	To analyze contemporary issues in controlling for measuring organizational performance.

Course Outcomes (CO)

CO 1	Examine the relevance of the political, legal, ethical, economic andcultural environments in global business
CO 2	Evaluate approaches to goal setting, planning and organizing in a variety of circumstances.
CO 3	Evaluate contemporary approaches for staffing and leading in an organization
CO 4	Analyze contemporary issues in controlling for measuring organizational performance.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	1	2	-	2	-	-	1	2	3	2
CO 2	2	2	1	2	-	2	-	-	1	2	3	2
CO 3	2	2	1	2	-	2	-	-	1	2	3	2
CO 4	2	2	1	2	-	2	-	-	1	2	3	2

UNIT-I

Introduction to Managers and Management: Management an Overview: Introduction, Definition ofManagement, Role of Management, Functions of Managers,Levels of Management, Management Skills andOrganizational Hierarchy, Social and EthicalResponsibilities of Management: Arguments for and againstSocial Responsibilities of Business, Social Stakeholders,Measuring Social Responsiveness and Managerial Ethics,Omnipotent and Symbolic View, Characteristics andimportance of organizational culture, Relevance of political,legal, economic and Cultural environments to globalbusiness, Structures and techniques organizations use asthey go international .

UNIT-II

Planning: Nature & Purpose, Steps involved in Planning, Objectives, Setting Objectives, Process of Managing by Objectives, Strategies, Policies & Planning Premises, CompetitorIntelligence, Benchmarking, Forecasting, Decision-Making.

Directing: Scope, Human Factors, Creativity and Innovation,Harmonizing Objectives, Leadership, Types of Leadership,Directing, Managers as leaders, Early LeadershipTheories…Trait Theories, Behavioral Theories, ManagerialGrid, Contingency Theories of Leadership, Directing ...PathGoal Theory, contemporary views of Leadership, CrossCultural Leadership, Leadership Training, Substitutes ofLeadership

UNIT-III

Organizing: Organizing ,Benefits and Limitations-De-Centralization andDelegation of Authority, Authority versus Power,Mechanistic Versus Organic Organization ,CommonOrganizational Designs, Contemporary OrganizationalDesigns and Contingency Factors, The LearningOrganization Nature and Purpose, Formal and InformalOrganization, Organization Chart, Structure and Process,Departmentalization by difference strategies, Line and Staffauthority- Benefits and Limitations-De-Centralization andDelegation of Authority Versus, Staffing,Human ResourceInventory, Job Analysis , Job Description, Recruitment and

UNIT - IV

Controlling: Controlling, Introduction to Controlling System and processof Controlling, Requirements for effective control, Theplanning Contol link, The process of control, types ofcontrol The Budget as Control Technique, InformationTechnology in Controlling, Productivity, Problems andManagement, Control of Overall Performance, Direct andPreventive Control, Financial Controls, Tools formeasuring organizational Performance, Contemporaryissues in control Workplace concerns, employee theft,employee violence

Textbook(s):

1. Tripathi PC. Principles of management. Tata McGraw-Hill Education; 6th Edition 2017.

References:

1. Koontz H, Weihrich H. Essentials of management: an international, innovation, and leadershipperspective. McGraw-Hill Education; 10th Edition 2018.
2. Principles of Management Text and Cases, Pravin Durai , Pearson ,2015
3. Robbins, S.P. &Decenzo, David A. Fundamentals of Management,7th ed., Pearson, 2010
4. Robbins, S.P. & Coulter, Mary Management; 14 ed.,Pearson , 2009

Research Methodology for Electrical & Electronics Engineering	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-334T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand different types of research methodology
2.	To create datasheet and its analysis
3.	To implement optimization techniques
4.	To design research papers

Course Outcomes (CO)

CO 1	Ability to understand different types of research methodology
CO 2	Ability to create datasheet and its analysis
CO 3	Ability to implement optimization techniques
CO 4	Ability to design research papers

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

Research Formulation and Design: Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

UNIT II

Data Collection and Analysis: Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools,data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing

UNIT III

Soft Computing: Computer and its role in research, Use of statistical software SPSS, GRETL etcin research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems

UNIT IV

Research Ethics, IPR and Scholary Publishing: Ethics-ethical issues, ethical committees (human & animal); IPR-intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

Textbooks:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.

References:

1. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
2. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.

Research Methodology for Electrical & Electronics Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-2	EEE-334P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Research Methodology for Electrical & Electronics Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the different types of research methodology.
2. To understand how to create datasheet, processing and do its analysis.
3. Take one research paper and do literature survey for the same.
4. To study different soft computing techniques and learn how to implement it on your research.
5. To do practice to identify the research problem based on literature survey.
6. To learn how to determine research objectives based on research problem.
7. Try to implement the research objectives in the system by using software tool like MATLAB, Python etc.
8. Write research paper based on your system results and check its plagiarism.

Statistics, Statistical Modelling & Data Analytics	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI/CSE-AIML/CSE-DS	6	PC	PC	DA-304T
EAE	6	AI-EAE	AI-EAE-2	DA-304T
EAE	6	AIML-EAE	AIML-EAE-2	DA-304T
EAE	6	DS-EAE	DS-EAE-1	DA-304T
EAE	6	SC-EAE	SC-EAE-1	DA-304T
EAE	6	MLDA-EAE	MLDA-EAE-1	DA-304T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart basic knowledge about Statistics, visualisation and probability.
2.	To impart basic knowledge about how to implement regression analysis and interpret the results.
3.	To impart basic knowledge about how to describe classes of open and closed sets of R, concept of compactness Describe Metric space - Metric in Rn.
4.	To impart basic knowledge about how to apply Eigen values, Eigen vectors.

Course Outcomes (CO)

CO 1	Ability to learn and understand the basic concepts about Statistics, visualisation and probability.
CO 2	Ability to implement regression analysis and interpret the results. Be able to fit a model to data and comment on the adequacy of the model
CO 3	Ability to describe classes of open and closed sets of R, concept of compactness Describe Metric space - Metric in Rn.
CO 4	Ability to impart basic knowledge about how to apply Eigen values, Eigen vectors.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	-	-	1	2	-	-	3
CO 2	3	3	3	3	3	-	-	1	2	-	-	3
CO 3	3	3	3	3	3	-	-	1	2	-	-	3
CO 4	3	3	3	3	3	-	-	1	2	-	-	3

UNIT-I

Statistics: Introduction & Descriptive Statistics- mean, median, mode, variance, and standard deviation. Data Visualization, Introduction to Probability Distributions.

Hypothesis testing, Linear Algebra and Population Statistics, Mathematical Methods and Probability Theory, Sampling Distributions and Statistical Inference, Quantitative analysis.

UNIT-II

Statistical Modelling: Linear models, regression analysis, analysis of variance, applications in various fields. Gauss-Markov theorem; geometry of least squares, subspace formulation of linear models, orthogonal projections; regression models, factorial experiments, analysis of covariance and model formulae; regression diagnostics, residuals, influence diagnostics, transformations, Box-Cox models, model selection and model building strategies, logistic regression models; Poisson regression models.

UNIT-III

Data Analytics: Describe classes of open and closed set. Apply the concept of compactness. Describe Metric space - Metric in Rn. Use the concept of Cauchy sequence, completeness, compactness and connectedness to solve the problems.

UNIT – IV

Advanced concepts in Data Analytics: Describe vector space, subspaces, independence of vectors, basis and dimension. Describe Eigen values, Eigen vectors and related results.

Textbook(s):

1. Apostol T. M. (1974): Mathematical Analysis, Narosa Publishing House, New Delhi.
2. Malik, S.C., Arora, S. (2012): Mathematical Analysis, New Age International, New Delhi

References:

1. Pringle, R.M. and Rayner, A.(1971): Generalized Inverse of Matrices with Application to Statistics, Griffin, London
2. Peter Bruce, Andrew Bruce (2017), Practical Statistics for Data Scientists Paperback

Statistics, Statistical Modelling & Data Analytics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI/CSE-AIML/CSE-DS	6	PC	PC	DA-304P
EAE	6	AI-EAE	AI-EAE-2	DA-304P
EAE	6	AIML-EAE	AIML-EAE-2	DA-304P
EAE	6	DS-EAE	DS-EAE-1	DA-304P
EAE	6	SC-EAE	SC-EAE-1	DA-304P
EAE	6	MLDA-EAE	MLDA-EAE-1	DA-304P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Statistics, Statistical Modelling & Data Analytics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Exercises to implement the basic matrix operations in Scilab.
2. Exercises to find the Eigenvalues and eigenvectors in Scilab.
3. Exercises to solve equations by Gauss elimination, Gauss Jordan Method and Gauss Siedel in Scilab.
4. Exercises to implement the associative, commutative and distributive property in a matrix in Scilab.
5. Exercises to find the reduced row echelon form of a matrix in Scilab.
6. Exercises to plot the functions and to find its first and second derivatives in Scilab.
7. Exercises to present the data as a frequency table in SPSS.
8. Exercises to find the outliers in a dataset in SPSS.
9. Exercises to find the most risky project out of two mutually exclusive projects in SPSS
10. Exercises to draw a scatter diagram, residual plots, outliers leverage and influential data points in R
11. Exercises to calculate correlation using R
12. Exercises to implement Time series Analysis using R.
13. Exercises to implement linear regression using R.
14. Exercises to implement concepts of probability and distributions in R

Universal Human Values	L	P	C
	1		1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	6	HS/MS	HS	HS-304

Marking Scheme:

4. Teachers Continuous Evaluation: 25 marks

5. Term end Theory Examinations: 75 marks

6. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives :

1.	To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2.	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3.	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4.	To analyze the value of harmonious relationship based on trust and respect in their life and profession

Course Outcomes (CO)

CO 1	Evaluate the significance of value inputs in formal education and start applying them in their life and profession
CO 2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO 3	Examine the role of a human being in ensuring harmony in society and nature.
CO 4	Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution: The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution

UNIT-II

Understanding Human Being: Understanding the human being comprehensively as the first step and the core

theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self

UNIT-III

Understanding Nature and Existence: A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self-awareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

UNIT - IV

Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living: Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence

Textbook(s):

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.
2. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
9. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press
10. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Utilization of Electrical Energy	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-1	EEE-320T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Demonstrate laws of illumination and lightning schemes
2.	Principles and operations of electrical heating and welding
3.	Characteristics and operation of various traction motors
4.	Demonstrate electrolysis and design of batteries

Course Outcomes (CO)

CO 1	Implement laws of illumination
CO 2	Demonstrate electrical heating and welding
CO 3	Implement braking schemes on traction motors
CO 4	Acquire knowledge of construction of energy storage devices

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	3	3	2	2	2	3	2	3
CO 2	3	2	1	2	3	3	3	2	2	2	2	2
CO 3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	2	3	3	2	2	3	2	2	2

UNIT I

Illumination: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light, discharge lamps, Mercury Vapour and Sodium Vapour lamps- their characteristic and applications. Performance comparison between tungsten filament lamps, fluorescent tubes, CFL and LED Lights. Basic principles of light control, types and design of lighting schemes and flood lighting.

UNIT II

Electrical Heating : Principle and application of resistance, induction and dielectric heating;,Infrared or radiant heating, High frequency eddy current heating, arc furnaces, induction furnace, electric supply for high frequency heating applications.

Welding: Resistance welding; arc welding, welding generator and welding transformer, properties of arcing electrode, comparison between resistance and arc welding, comparison between A.C. and D.C. welding.

UNIT III

Electric Traction: Advantages of electric traction, requirements of an ideal traction system, different system of electric traction; comparison between D.C. and A.C. systems of railway electrification; speed – time curves, different types of traction motors and their characteristics; parallel operation of traction motors.
Starting and speed control of 3 phase induction motors, braking, advantages and disadvantages of regenerative braking. Calculation of energy returned during regeneration.

UNIT IV

Electroplating: Principles and applications of electrolysis. Faraday's law of electrolysis, electroplating; calculation of current required for depositing given amount of metal, current efficiency, voltage-energy efficiency, extraction of metals electro deposition, factors governing deposition process.
Energy Storage Devices: Constructional details, principle of operation of Rechargeable Alkaline, Nickel – Cadmium, Nickel-Metal Hydride, Lithium ion and Lead-acid batteries, their comparison and applications. Charging of batteries and rating. Fuel cell and use of electric double layer capacitor (super capacitor) as battery bank.

Textbooks:
1. Pratab. H. "Art and Science of Utilization of Electrical Energy": Dhanpat Rai & Sons.
2. N.V. Suryanarayana, "Utilization of Electrical Power including Electric Drives and ElectricTraction",New Age.

References:
1. C.L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age.
2. E. Openshaw Taylor, "Utilization of Electric Energy", Orient Longman, Universities Press

Utilization of Electrical Energy Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
EE/EEE	6	PCE	PCE-1	EEE-320P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Utilization of Electrical Energy) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Demonstration and calculation of current for electro plating process used to different metals.
2. Demonstration of large size cut model of different types of batteries.
3. Study of charging methods of batteries and calculation of their life cycle.
4. Charging and discharging of super capacitors.
5. To plot polar curves for various lamps.
6. Verification of illumination laws.
7. Performance comparison of MV lamps, SV lamps, filament lamps, CFL & LED lights.
8. Design of lighting schemes for house / commercial complex / industry / street light / flood light.
9. Demonstration of resistance / inductance / dielectric heatings.
10. Characteristics of welding transformer.
11. Speed control of various traction motors.
12. Braking schemes for traction motors.