Curriculum for Undergraduate Degree (B.Tech.) in Electrical Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Seventh Semester (Fourth Year)

Course Name:	**Electric Drives**		
Course Code:	PC EE 701	**Category:**	Professional Core Course
Semester:	7th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Electric Machine I Electric Machine II Power Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand basic concept, classification and principle of operation of Electric Drive.
2	To understand methods of starting and braking of Electric Drive.
3	To understand methods of control of speed of DC and AC Drives.
4	To solve problem related to Electric Drive.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Electric Drive:** Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of Steady state stability, Transient stability, Multiquadrant operation of drives.	**5L**
2	**Motor power rating:** Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads, effect of load inertia & environmental factors.	**5L**
3	**DC motor drives:** State space modeling of DC motor drive, block diagram & Transfer function calculation, Stating of DC Drives- methods of stating of DC motor, energy losses during stating, methods to reduce the energy loss during starting, Armature voltage control & field flux control method, Single phase, three phases fully controlled and half controlled DC drives, Dual converter control of DC drives, Chopper controlled DC motor drives, closed loop control of DC Drives,	**10L**

	Different types of braking of DC motor drive, energy losses during braking.	
4	**Induction motor drives:** Stating of Induction Motor Drives, energy losses during stating, methods to reduce the energy loss during starting, Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme, Pulse width modulated inverter fed induction motor drive, Volts/Hertz Control, Vector or Field oriented control, different types of braking of Induction motor drive, energy losses during braking.	**10L**
6	**Synchronous motor drives:** Variable frequency control, Self-control, Voltage source inverter fed synchronous motor drive, braking of Synchronous motor drive.	**5L**
7	**Industrial application:** Introduction to Solar and Battery Powered Drive, Switched Reluctance motor drive, BLDC and PMSM drives.	**5L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the principle of operation of Electric Drive.
2	Describe different methods of starting and braking of Electric Drive.
3	Apply knowledge of power electronic converter to operate different electric drives.
4	Control speed of DC, Induction and Synchronous motor drives.
5	Recommend drives for different industrial applications.

Learning Resources:	
Recommended Text Books	
1	Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication, 2010.
2	Electric Drives, Vedam Subrahmanyam, TMH,1996
3	A first course on Electrical Drives, S.K. Pillai, New Age International Publication,2012.
Alternative Text Books	
4	Modern Power Electronics & AC drives, B.K. Bose, Prentice Hall, 2001.
Reference Books	
5	Electric Motor & Drives. Austin Hughes, Newnes.1990.
6	Analysis of Thyristor power conditioned motor, S.K. Pillai, University Press, 1995.

Course Name:	**Advanced Power System**		
Course Code:	PE-EE701A	**Category:**	Professional Elective Course
Semester:	7^{th}	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Power System I & II
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand basics of economic load dispatch
2	To understand basics of automatic generation control
3	To understand basics of compensation in powr system
4	To understand basics of power system transients

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Objectives of power system: Power system in restructured environment, distributed and dispersed generation, environmental impacts of electric power system.	**6L**
2	Economic operation of Energy Generation Systems: Generation Cost curves, operation of Thermal system plant scheduling, transmission loss and penalty factor, hydro-thermal scheduling, concepts of reserves and constraints, unit commitment.	**10L**
3	Automatic generation control; Concept of AVR and ALFC loops, Signifcance of double loop in ALFC, exciter and VAR control, single area load frequency control, two area load frequency control, frequency response	**8L**
4	Power System Transients: Types of system transients, overvoltage in transmission lines, propagation of surges and travelling waves, protection against lightening and surges.	**8L**
5	Compensation in Power system: Reactive power sensitivity and voltage control, load compensation with capacitor banks, line compensation with reactors, shunt and series compensation, fixed series capacitors, thyristor controlled series capacitors, introduction to SVC and STATCOM.	**8L**
Total		**40L**

Course Outcomes:	
After completion of the course students will be able to:	
1	Students will b able to understand all aspects of advanced power system
2	Students will be able to apply concepts of power system in real time applications
3	Students will be able to execute critical problems related to power system

Learning Resources:	
Recommended Text Books	
1	Power System analysis operation and control, Chakrabarti and Haldar, PHI, 2019
2	Power System Analysis, Nagsarkar & Sukhija, Pearson, 2012
3	Power system Analysis, Granger and Stevension, McGraw Hill, 2015
Reference Books	
1	Power System analysis operation and control, Chakrabarti and Haldar, PHI,2010.
2	Power System Analysis, Nagsarkar & Sukhija, Pearson, 2020.

3	Power system Analysis, Granger and Stevension, McGraw hill, 1994.

Course Name:	**Advanced Electric Machine**		
Course Code:	PE-EE-701B	**Category:**	Professional Elective Course
Semester:	7th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Electric Machine I, Electric Machine II
Full Marks:			
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To introduce the concepts of generalized theory of electric machines.
2	To introduce models of DC machine incorporating the steady state and dynamic behavior.
3	To introduce the dynamics of synchronous machines and poly-phase induction machines and their modeling.
4	To understand the performance and theory of operation of electrical machines in the light of generalized theory.
5	To study the theory, construction and utilization of special machines like AC commutator machines, hysteresis motors, servomotors, reluctance motors etc.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Generalized theory of electric machines: The Primitive machine, Voltage equations of the Primitive machine, Invariance of power, Transformation from a displaced brush axis, Transformation from three phases to two phases, Transformation from rotating axes to stationary axes, Physical concepts of Park's transformations, Transformed impedance matrix, Electrical torque, Restriction of the generalized theory of electrical machines.	**10L**
2	Direct Current machine dynamics: Separately excited D.C. generators: steady state analysis, and transient analysis. Separately excited D.C. motor: steady state analysis, transient analysis, Transfer function & Block diagram.	**6L**
3	Transients and dynamics of A.C Machines, Synchronous and Induction achiness: Electrical transients in Synchronous machine, Expression for reactance and time constants. Dynamics of synchronous machine, Electromechanical equation-motor operation generator operation - small oscillations, general equation for small oscillations representation of oscillations in state variable form. Dynamics of Induction machine, Induction machine dynamics during starting and braking, acceleration time, Induction machine dynamics during normal operation, Equation of dynamical response of Induction motor.	**10L**

4	**AC Commutator Motors:** Rotational EMFs in commutator windings, action of commutator as frequency converter, effect of EMF injection in secondary circuit of three-phase slip-ring induction motor, secondary (slip) power, constant HP and constant torque drives, Kramer and Scherbius system of speed control, single-phase series motors, universal motors, phasor diagrams, methods of improving commutation. **Special Motors:** Hystersis motor, Servomotors, reluctance motor, stepper motor, Synchros, Resolvers, linear induction motor, Permanent magnet brushless DC motor.	**10L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1.	Explain the concept of generalized theory of electric machine
2.	Study the transient and steady state behaviour of DC machines using models.
3.	Study the transient and steady state behaviour of polyphase machines using models.
4.	Explain the performance and theory of operation of electrical machines in the light of generalized theory.
5.	Explain construction of and evaluate basic operations and performance of different special machines like AC commutator machines, hysteresis motors, servomotors, reluctance motors etc.

Learning Resources:	
Recommended Text Books	
1	Generalized theory of Electrical machines, 7th ed., P.S.Bimbhra, Khanna publishers, 2021
2	Electric motor drives, modeling, analysis and control, R. Krishnan, PHI, 2001
3	Performance and design of AC commutator machines, E. O. Taylor.
Alternative Text Books	
4	General theory of electrical machines, 1st ed., Adkins, John Wiley & Sons, 1957
5	Electrical machines, Fitzerald and Kingseley, 7th edition, McGrawHill, 2013
6	Fundamentals of Electrical Drives, G. K. Dubey, Narosa, 2009.
Reference Books	
7	Modern power electronics and AC drives, B.K. Bose, 1st ed., Pearson education, 2015
8	Electrical Machinery, A.E. Fitzgereld, C. Kingslay and S.D. Uman, Mc Graw Hills, 2017
9	Electrical Machinery, S. K. Sen, Khanna Publishers, 1977.

Course Name:	**Sensors and Transducers**		
Course Code:	PE-EE701C	**Category:**	Professional Elective Course
Semester:	7th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Electric Circuit Theory, Electromagnetic Field Theory, Electrical and Electronics Measurement
Full Marks:	100		

Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand the principle of operation of Transducers and Sensors
2	To understand the application of Transducers and Sensors

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Definition, significance of measurement and instruments. Principle of sensing & transduction, transducer classification, Transducer characteristics, emerging fields of sensor technologies.	**5L**
2	**Resistive transducers:** Potentiometers: types, loading error, metal and semiconductor strain gauges, types, resistance measuring methods, strain gauge applications: Load and torque measurement.	**5L**
3	**Inductive transducers:** Transformer type, synchros, eddy current transducers, LVDT: Construction, material, input-output characteristics.	**4L**
4.	**Optical Sensors:** LDR, Photo Diode, Stroboscope, IR Sensor (Different application areas of Optical Sensor)	**4L**
5.	**Capacitive transducers:** Variable distance-parallel plate type, variable area- parallel plate type, cylindrical type, differential type, variable dielectric constant type, calculation of sensitivity. Capacitive microphone, fluid level measurement.	**5L**
6.	**Piezoelectric transducers:** piezoelectric effects, Materials, natural and synthetic types – their comparison, Charge and voltage coefficient, Force and stress sensing, displacement measurement.	**2L**
7.	**Magnetic Transducer:** Hall effect sensors Magnetostrictive transducers: principle, positive and negative magnetostriction.	**3L**
8.	**Thermal sensors:** Resistance temperature detector (RTD): principle, materials and types; Thermistor: principle, materials and types; Thermocouple, Thermoelectric effects, laws of thermocouple, thermocouple types, construction. IC temperature sensor, PTAT type sensor. Radiation sensors: types, characteristics and comparison. Pyroelectric type.	**6L**
9.	**Micro-sensors and smart sensors:** Construction, characteristics and applications. Standards for smart sensor interface. Recent Trends in Sensor Technologies: Introduction; Film sensors. Thick film sensors, thin film (sensor-IPMC) and other examples.	**4L**
		38L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the basic principle of operation of Transducers and Sensors.
2	Distinguish different sensors and transducers.
3	Identify suitable transducer by comparing different industrial standards and procedures for measurement of physical parameters
4	Estimate the performance of different transducers.
5	Design real life electronics and instrumentation measurement systems.
6	Apply smart sensors, bio-sensors, PLC and Internet of Things to different applications.

Learning Resources:	
Recommended Text Books	
1	Sensors and Transducers, D. Patranabis, Prentice Hall India, 2003.
2	Measurement Systems - Application and Design, E.O. Doebelin, McGraw-Hill, 2008.
3	Industrial Instrument and Control, S K Singh, McGraw Hill Education; 3rd edition,2007.
Alternative Text Books	
4	Transducers and Instrumentation , D.V.S. Murthy, Prentice Hall, 2008.
5	Instrument Transducers - An Introduction to their Performance and Design", H.K.P. Neubert, Oxford University Press, 1999.
6	Measurement Systems and Sensors, Waldemar Nawrocki Artech House, 2016.
Reference Books	
7	Semiconductor sensors", S.M. Sze, Wiley - Interscience, 1994.
8	Instrumentation Measurement and Analysis", B. C. Nakara & Chaudhry TATA McGraw-Hill, 2009.
9	Smart Sensors and Sensing Technology, Daniel E. Suarez, Nova Science Publishers, 2011.

Course Name:	**Biomedical Instrumentation**		
Course Code:	PE-EE702A	**Category:**	Professional Elective Course
Semester:	7^{th}	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Analog Electronics, Digital Electronics, Electrical and Electronics Measurement
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand the fundamental of Medical Instruments
2	To understand Biomedical recorders, Medical Imaging equipment, Surgical, Therapeutic Instruments and Medical Laboratory equipment.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**

1	**Fundamentals of Medical Instruments:** Introduction to basic cell structure, basic nervous system, cardiovascular and respiratory system. Fundamentals of medical instrumentation- Introduction to biomechanics, Sources of biomedical signals, Generalized medical instrumentation block diagram. Medical electrodes - ECG, EEG, EMG, Defibrillator. Medical transducers: Body temperature, Blood pressure, respiration rate. Classification of Medical instruments based on application - (diagnostic, therapeutic, Imaging, analytical).	**8L**
2	**Biomedical Recorders:** Electrocardiograph (ECG) machine -ECG block diagram, Bipolar and unipolar leads, Phono-cardiograph. Electroencephalograph (EEG). 10-20 electrode placement system, EEG readout device, Electro-myograph (EMG) machine. Bio-feedback Instrumentation. Pulse Oximeter	**8L**
3	**Medical Imaging Equipments:** X-ray machine, CT-Scan machine, MRI Scan machine, Properties of ultrasound, Ultrasonic foetal monitors. Echoencephalography. Echocardiograph. Colour Doppler ultrasound machine.	**8L**
4	**Surgical & Therapeutic Instruments:** Electro-surgery machine (cautery), Hemo-dialysis machine Muscle stimulators, Defibrilator Machine	**6L**
5	**Medical Laboratory Instruments:** Types of test- Blood cell, Bio chemistry, Blood Cell Counter, Bio chemistry analyze, Auto analyzer, Blood gas analyzer, Isolation measures with risk prone instruments.	**6L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe the principle of medical transducers for temperature, pressure and respiration rate.
2	Explain the principle of operation of Biomedical recorders, Medical Imaging equipments Surgical & Therapeutic Instruments and Medical Laboratory Instruments.
3	Use different Medical laboratory equipments for different tests.
4	Analyze any measurement application and suggest suitable measurement methods.
5	Suggest suitable imaging methodology for a specific ailment.

Learning Resources:	
Recommended Text Books	
1	Handbook of Biomedical instrumentation, R. S. Khandpur, Tata McGraw Hill, New Delhi, 2003.
2	Introduction to Biomedical equipment technology, Joseph J. Carr and J.M. Brown , Pearson education, New Delhi, 2000.
Alternative Text Books	
3	Biomedical instrumentation measurements , Lesli P Cromwell, Fred J. Weibell, Erich A. Pfeiffer, PHI Learning, New Delhi, 2018.
Reference Books	
4	Medical instrumentation application & design, John G. Webster, Editor, John Wiley and Sons, New Delhi, 2009.
5	Introduction to Biomedical Instrumentation, Mandeep Singh, PHI, 2010.

Course Name:	**Power Generation and Economics**		
Course Code:	PE-EE702B	**Category:**	Professional Elective Course
Semester:	7th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Electric Power system-I (PC-EE-502) Electric Power system-II (PC-EE-601
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand the basics of economics of Power
2	To understand different methods of Tariff
3	To understand the optimization with unit commitment in power system.
4	To understand the principle of economic load dispatch.
5	To understand the method of state estimation and load forecasting in a power system.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Economics of Generation: Cost of power generation- Thermal, Hydro and Nuclear. Types of Consumers in a distribution system Domestic, Commercial, Industrial etc. Concept of load factor, plant capacity factor, plant use factor, diversity factor, demand factor. Choice of size and number of generation units.	7L
2	Tariff: Block rate, flat rate, two part, maximum demand, Power factor and three part tariffs. Subsidization and Cross subsidization. Availability tariff of generation companies. Pool tariff of transmission companies. Availability based tariff (ABT).	8L
3	Unit Commitment: Constraints in Unit Commitment, Spinning reserve, Thermal unit constraints, Hydro constraints, Must run, Fuel constraints. Unit commitment solution methods.	7L
4	Economic Dispatch: Transmission loss formula and its application in economic load scheduling. Computational methods in economic load scheduling. Active and reactive power optimization	8L
5	State Estimation and load forecasting in power system: Introduction, state estimation methods, concept of load forecasting, load forecasting technique and application in power system.	8L
Total		**38L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the different terms e.g. load factor etc for economics of generation.,

2	Apply different types of tariff for electricity pricing.
3	Optimize the operation of power system with unit commitment.
4	Determine generation levels such that the total cost of generation becomes minimum for a defined level of load.
5	Determine the state of the system given by the voltage magnitudes and phase angles at all buses
6	Predict the power or energy needed to balance the supply and load demand at all the times.

Learning Resources:	
Recommended Text Books	
1	Power system Analysis, operation & control, A. Chakrabarty & S. Haldar, PHI, 2010
2	Modern power system analysis, D.P. Kothari & I.J. Nagtrath, Tata McGraw Hill, 2007.
Alternative Text Books	
3	Economic operation of Power System, L.K. Kirchmayar Wiely India Pvt. Ltd, 20092
Reference Books	
4	Power generation operation & control, A.J. Wood & B.F. Wollenberg, G.B. Sheble, Wiley, 2013
5	Operation and control in power system, P.S.R. Murthy, BSP Publication. 2009

Course Name:	**Illumination Engineering**		
Course Code:	PE-EE702C	**Category:**	Professional Elective Course
Semester:	7th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Utilization of Electric Power
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand basic principle (Light, sight & colour) of illumination and good lighting practices.
2	To Understand working principles & construction of different artificial light sources (GLS, FTL, CFL, SV,MV, MH & LED).
3	To understand design & control of the basic artificial lighting system

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Light, sight & colour:** Sources of light: Day light, artificial light sources, energy radiation, and visible spectrum of radiation, black body radiation and full radiator. Incandescence, dependence of light o/p on temperature. Theory of gas discharge and production of light. Perception of light and color, optical system of human eye, eye as visual processor. Reflection, refraction and other behavior of light.	**10L**
2	**Measurement of light:** Measurement of light - radiometric and photometric quantities, units of measurement, standardization. Measurement of light distribution, direct and diffused reflection, fundamental concepts of colourimentry and measurement of colour.	**10L**

3	**Lamp, accessories & luminaries:** Light production by gas discharge, fluorescence, incandescence, daylight principle of operation, light efficacy, color, electrical characteristics, typical applications, dimming condition of GLS filament, tungsten halogen lamps, fluorescent tubes, compact fluorescent lamp (CFL), low and high pressure sodium lamps, high pressure mercury lamp, metal halide lamp. Functions of luminaries, classification, Materials Used in luminaries manufacturing, reflection, refraction, diffusion, polarization and optical design, photometric measurements, application data and its use. LED and its application in lighting.	**12L**
4	**Lighting control:** Types of lighting controls, strategy for selection, benefits of lighting control. Electric distribution system for lighting, maintenance strategies, group replacement schedule. Techniques of achieving energy efficient lighting design, role of computers in lighting.	**8L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	State & explain basic principle of Illumination & good lighting practices.
2	Apply an appropriate measurement technique of artificial lighting for different specific purposes.
3	Investigate on various types of artificial light sources (GLS, FTL, CFL, SV, MV, MH & LED) as well as can evaluate their performance in terms of their colour rendering and luminous efficacy.
4	Prescribe (Design outline) appropriate illumination techniques for selected applications (Domestic, Official, Industrial, Arena & Street).
5	Select as well as apply appropriate Luminaires for specific application.

Learning Resources:	
Recommended Text Books	
1	Utilization of Electric Power, C.L. Wadha, New Age International Ltd, 2010.
2	Generation, Distribution and Utilization of electrical energy, C.L. Wadha, New Age International Ltd, 2015.
Alternative Text Books	
3	Art and Science of Utilization of Electrical Energy, H. Partab, Dhanpat Rai& Sons, 2014.
4	Standard Hand Book for Electrical Engineers, Fink &Beaty, McGraw Hill International,2013.
Reference Books	
5	Generation and Utilization of Electrical Energy by S. Sivanagaruju, Pearson, 2010.
6	Utilization of Electrical Energy by J. B. Gupta, Rajeev Manglik, RohitManglik, Kataria Publications, 2012.

Course Name:	**Electrical and Hybrid Vehicle**		
Course Code:	PE-EE702D	**Category:**	Professional Elective Courses

Semester:	7th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	1. Electric Machine-I 2. Electric Machine-II 3. Power Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand the basic difference between conventional and Hybrid vehicles.
2	To understand different configuration and control of Electric drives.
3	To understand energy storage system in Hybrid vehicles.
4	To understand different energy management strategies of Hybrid vehicles.
5	To solve numerical problems on the topics studied

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	**9L**
2	**Electric Trains:** Electric Drive-trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis, advantages and disadvantages of Electric trains. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	**9L**
3	**Energy Storage:** Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.	**8L**

4	**Energy Management Strategies:** Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.	**6L**
5	**Case Studies:** Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).	**3L**
Total		**35L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the principle of Electric traction.
2	Describe suitable drive scheme for Hybrid Electric Vehicles depending on resources.
3	Explain various drive train topologies for electric vehicles.
4	Explain proper energy storage systems for vehicle applications.
5	Apply different energy management strategies for hybrid vehicle.

Learning Resources:	
Recommended Text Books	
1	Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, 2011.
2	Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons,2011.
3	Electric and Hybrid Vehicles: A.K Babu, Khanna Publishing House, 2019.
Alternative Text Books	
4	Hybrid Electric Vehicles: Energy Management Strategies, Onori Simona, Serrao Lorenzo and Rizzoni Giorgio, Springer, 2020.
5	Electric and Hybrid Vehicles, T. Denton, Routledge, 2020.
Reference Books	
6	Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley, 2003.
7	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi CRC Press, 2004.

Course Name:	**Data Base Management System**		
Course Code:	OE-CS701F	**Category:**	Open Elective Course
Semester:	7th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic programming Knowledge, Concept of Set theory, Tree Data structure
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand the different issues involved in the design and implementation of a database system.
2	To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3	To understand and use data manipulation language to query, update, and manage a database
4	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.
5	To understand the different issues involved in the design and implementation of a database system.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to database management, data abstraction and system structure, Database users, Database Administrator	**4L**
2	Entity relational model, entity set, relationship sets, mapping cardinalities, keys, E-R diagrams.	**4L**
3	Relational model, database schema, relational algebra, outer join and manipulation of databases. Tuple relational calculus: Example queries, formal definitions and safety of expressions; SQL: Query processing and optimization, set operations, aggregate functions, data definition language and views, comparison of queries in relational algebra, SQL, tuple relation calculus and domain relation calculus.	**8L**
4	Introduction to Schema Refinement - Problems Caused by redundancy, Decompositions - Problem related to decomposition, Functional Dependencies - Reasoning about FDS, Normal Forms - FIRST, SECOND, THIRD Normal forms - BCNF - Properties of Decompositions - Loss less join Decomposition, Dependency preserving Decomposition, Schema Refinement in Data base Design - Multi valued Dependencies - FOURTH Normal Form, Join Dependencies, FIFTH Normal form, Inclusion Dependencies.	**8L**
5	Transaction Management, ACID property, Transaction state, Serializability and testing for serializability, concurrency control schemes, lock-based protocols, two-phase locking protocols, graph, time stamp-based protocols, deadlocks.	**8L**
6	Recovery systems, log-based recovery, deferred and immediate database modification, object oriented database design.	**4L**

7	Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing - Clustered Indexes, Primary and Secondary Indexes, Index data Structures – Hash-Based Indexing, Tree-based Indexing, Comparison of File Organizations.	**4L**
Total		**40L**

Course Outcomes:	
After completion of the course ,students will be able to:	
1	Describe the fundamental concept of File System and DBMS Architecture.
2	Understand the concepts of different types of attribute, keys and Entity Relationship model.
3	Apply concepts of relational algebra, calculus and Structured Query language.
4	Apply concepts of functional dependency and normalization process to construct normalized database.

Learning Resources:	
Recommended Text Books	
1	Data base System Concepts, A.Silberschatz, H.F. Korth, S.Sudarshan, McGraw Hill, VI edition, 2006.
2	Elmasi, R. and Navathe, S.B., "Fundamentals of Database Systems", 4th Ed., Pearson Education, 2021.
Alternative Text Books	
3	Ramakrishnan, R. and Gekhre, J., "Database Management Systems", 3rd Ed., McGraw-Hill, 2010.
Reference Books	
4	Date, C. J., "Introduction to Database Systems", Pearson Education.2004.

Course Name:	**Software Engineering**		
Course Code:	OE-CS701I	**Category:**	Open Elective Course
Semester:	7th	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Programming for Problem Solving
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	Express the challenges of large scale software development and the ideas of how to overcome those.
2	To provide the idea of decomposing the given problem into Analysis, Designing, Implementation, Testing and Maintenance phases.
3	To provide an idea of using various process models in the software industry according to given circumstances.
4	To gain knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Module I:** Overview of System, System Development Life Cycle, Waterfall Model, Iterative Waterfall Model, V Model, Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model, SRS.	**8L**
2	**Module II:** System Design – DFD, Top-Down And Bottom-Up design; Decision tree, Decision table and structured English; Functional vs. Object-Oriented approach.	**10L**
3	**Module III:** Coding & Documentation guidelines, Errors, Faults and Failures. Testing – Levels of Testing, Unit Testing, Integration Testing, System Testing, Validation & Verification in Testing, Black Box Testing, White Box Testing Strategies.	**10L**
4	**Module IV:** UML diagrams: Class diagram, interaction diagram, collaboration diagram, sequence diagram, state chart diagram, activity diagram.	**8L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Compare and apply the software development models.
2	Apply the data flow model, relational model and unified model to visualize the design of a system.
3	Know the degree of functionality and the relationship of modules of a software system.
4	Illustrate the validation and verification types of testing techniques and the steps of project management and scheduling.

Learning Resources:	
Recommended Text Books	
1	Rajib Mall, Fundamental of Software Engineering, PHI Learning Pvt. Ltd, 2014.
Alternative Text Books	
2	Roger S. Pressman, Bruce R. Maxim, Software Engineering: A practitioner's approach– Pressman, McGraw Hill Education, 2019.
Reference Books	
3	Pankaj Jalote , Software Engineering: A Precise Approach, Wiley, 2010.

Course Name:	**Object-Oriented Programming**		
Course Code:	OE-IT701E	**Category:**	Open Elective Course
Semester:	Seventh	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	ES-CS 101 (Programming for Problem Solving), PC-CS 392 (IT Workshop (Using Python) Lab)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	Gain knowledge about basic Java language syntax and semantics to write Java programs and use concepts such as variables, conditional and iterative execution methods etc.
2	Understand the fundamentals of object-oriented programming in Java, including defining classes, objects, invoking methods etc and exception handling mechanisms.
3	Understand the principles of inheritance, packages and interfaces.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Object-oriented design Concepts of object-oriented programming language, Major and minor elements, Object, Class, relationships among objects, aggregation, links, relationships among classes-association, aggregation, using, instantiation, meta-class, grouping constructs.	**10L**
2	Object-oriented concepts Difference between OOP and another conventional programming – advantages and disadvantages. Class, object, message passing, inheritance, encapsulation, polymorphism	**4L**
3	Class & Object proprieties Basic concepts of java programming – advantages of java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, garbage collection, nested & inner classes, basic string handling concepts. command line arguments, basics of I/O operations – keyboard input using Buffered Reader& Scanner classes.	**6L**
4	Reusability properties Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super () method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages.	**6L**

5	Exception handling & Multithreading Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter- thread communication, deadlocks for threads, suspending & resuming threads.	**6L**
6	Applet Programming (using swing) [4L] Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets, concept of delegation event model and listener, I/O in applets, use of repaint(), get Document Base(), get Code Base() methods, layout manager (basic concept), creation of buttons (JButton class only) & text fields.	**4L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify classes, objects, members of a class and relationships among them, needed for a specific problem.
2	Demonstrate the concepts of polymorphism and inheritance
3	Implement Java collection API as well as the java standard class library.
4	Implement error-handling techniques using exception handling.
5	Implement the concept of Multithreading and Applet programing.

Learning Resources:	
Recommended Text Books	
1	Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India,1990.
2	E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH, 2007.
3	Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH, 2002.
Alternative Text Books	
4	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson,2004.
Reference Books	
5	Ivor Horton's Beginning Java 2 SDK – Wrox, 2002.

Course Name:	**Principles of Management**		
Course Code:	HM-HU702	**Category:**	Humanities and Social Sciences
Semester:	7th	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	English
Full Marks:			
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance:05

Course Objectives:	
1	To understand basic concept and approaches to management.

2	To understand planning and decision-making processes. .
3	To understand organizational design and structure.
4	To understand various aspects of leadership.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Concept & approaches to management:** Meaning & Definition of the term Management, Management as a Science or an Art, Management as a Profession, Management as a Process, Difference between Management & Administration; Levels of Management, Roles of a Manager, Quality of a good Manager, Significance of Management, Limitations of Management, Business Environment and its interaction with Management. Approaches to Management – Classical, Neo-classical and Modern Contributors to Management Thought – Taylor and Scientific Theory, Fayol's and Administrative Theory, Peter Drucker and MBO.	**8L**
2	**Planning & decision making:** Planning: Meaning, Definition, Process, Types, Principles, Premises Significance & Limitations of Planning; Strategic Planning – Meaning & Process, MBO – Meaning, Process and Requirements for Implementation. Responsibility and Accountability; Delegation – Meaning, Process; Principles; Centralization and Decentralization – Meaning; Degree of Decentralization, Difference between Delegation and Decentralization.	**8L**
3	**Directing:** Motivation – Meaning, Definition, Significance & Limitations; Financial and non-financial incentives of Motivation Leadership - Meaning, Definition, Significance of Leadership, Leadership styles Type, Process and Barriers of Communication, Strategies to overcome barriers.	**4L**
4	**Operations & Technology Management** – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma.	**4L**
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the concept and approaches of Management.
2	Demonstrate the roles, skills and functions of management.
3	Diagnose and solve organizational problems.
4	Apply different methods of Customer, Operation and Technology management.

Learning Resources:	
Recommended Text Books	
1	Essentials of Management. H. Koontz and H. Weihrich , 7th Edition, Tata McGraw Hill, India, 2012.
2	Principles of Management, Premvir Kapoor, Khanna Publishing House, 2019.
Alternative Text Books	
3	Principles of Management - Text and Cases, Dipak Kumar Bhattacharyya. Pearson Education,India, 2011.

4	Principles of Management, T. Ramaswami, Himalaya Publishing House, 2014.
Reference Books	
5	Industrial Engineering and Production Management, Mahajan, M., Dhanpat Rai & Co., 2015.
6	Principles of Management, Gupta, Gupta and Shair, Kalyani Publishers, 2014.

Laboratory

Course Name:	**Electric Drives Lab**		
Course Code:	PC EE 791	**Category:**	Professional Core Course
Semester:	7th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Electric Machine I Electric Machine II Power Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment:35	Attendance: 05

Course Objectives:	
1	To understand starting method of DC Drive.
2	To understand different braking methods of Electric Drive.
3	To understand methods of control of speed of DC and AC Drives.
4	To understand the operation of PWM Inverter fed induction motor drive.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Study of speed control of Thyristor controlled DC Drive.	**3P**
2	Study of speed control of Chopper fed DC Drive	**3P**
3	Study of starting method of DC Drive.	**3P**
4	Study of speed control of single phase motor using TRIAC	**3P**
5	Study of V/f control of 3phase Induction motor drive.	**3P**
6	Study of four quadrant operation of full controlled rectifier fed DC motor drives using software.	**3P**
7	Study of Dynamic braking operation for DC Motor using software.	**3P**
8	Study of PWM Inverter fed 3 phase Induction Motor control using software.	**3P**
9	Study of Dynamic braking operation of Induction motor using software.	**3P**
10	Study of Plugging operation of Induction motor using software.	**3P**
Total		**30P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Demonstrate starting method of rectifier fed DC drive.

2	Apply speed control method to different Electric drives in laboratory.
3	Design PWM inverter fed 3 phase induction motor drive using software simulation.
4	Design Full controlled rectifier fed DC motor drive using software simulation.
5	Demonstrate different braking operation of electric drive using software simulation.

Learning Resources:	
Recommended Text Books	
1	Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication, 2016.
2	Electric Drives, Vedam Subrahmanyam, TMH, 2021.
3	A first course on Electrical Drives, S.K. Pillai, , New Age International Publication,2012.
Alternative Text Books	
4	Electric motor drives, R. Krishnan, PHI, 2015.
5	Modern Power Electronics & AC drives, B.K. Bose, Prentice Hall, 2002.
Reference Books	
1	Electric Motor & Drives. Austin Hughes, Newnes, 2006.
2	Analysis of Thyristor power conditioned motor, S.K. Pillai, University Press, 2010.

Course Name:	**Database Management System Lab**		
Course Code:	OE-CS791F	**Category:**	Open Elective Course
Semester:	7th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic understanding in database management
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Learn to create and use a database.
2	Be familiarized with a query language.
3	Have a good understanding of DDL, DML and DCL commands.
4	Familiarize advanced SQL queries.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Structured Query Language Creating Database, Creating a Table, Specifying Relational, Data Types, Specifying Constraints, Creating Indexes.	**4P**
2	Table and Record Handling, INSERT statement, Using SELECT and INSERT together, DELETE, UPDATE, TRUNCATE statements, DROP, ALTER statements.	**4P**
3	Retrieving Data from a Database The SELECT statement, Using the WHERE clause, Using Logical	**4P**

	Operators in the WHERE clause, Using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING Clause *Using Aggregate Functions *Combining Tables Using JOINS * Subqueries	
4	Database Management Creating Views, Creating Column Aliases, Creating Database,Users, Using GRANT and REVOKE commands – Commit, Rollback, Save point.	**4P**
5	PL/SQL Concepts Introduction, Cursors, Stored Procedures, Stored Functions, Database Triggers.	**8P**
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the basic concepts of Database Systems and Applications.
2	Use the basics of SQL and construct queries using SQL in database creation and interaction.
3	Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.
4	Analyze and Select storage and recovery techniques of database system.

Learning Resources:	
1	Beginning SQL Programming,Kauffman, SPD/WROX
2	Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle"

Course Name:	**Software Engineering Lab**		
Course Code:	OE-CS791I	**Category:**	Open Elective Course
Semester:	7th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Programming for Problem Solving
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To provide an idea of how to design various steps of life cycle model in the software industry according to given circumstances.
2	To gain knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**

1	Problem Analysis and Project Planning -Thorough study of the problem – Identify Project scope, Objectives and Infrastructure.	**1P**
2	Software Requirement Analysis – Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.	**2P**
3	Calculation of the AFP (Adjustable functional point) for different projects. Calculate the effort and time duration of a project using COCOMO model.	**2P**
4	Software Designing - Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.	**5P**
Total		**10P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	To understand the software engineering methodologies involved in the phases for project development.
2	To gain knowledge about open source tools used for implementing software engineering methods.
3	To exercise developing product startups implementing software engineering methods.
4	Learn simple optimization techniques.

Learning Resources:	
Recommended Text Books	
1	Rajib Mall, Fundamental of Software Engineering, PHI Learning Pvt. Ltd.,2018.
Alternative Text Books	
2	Roger S. Pressman, Bruce R. Maxim, Software Engineering : A practitioner's approach– Pressman, McGraw Hill Education,2015.
Reference Books	
3	Pankaj Jalote , Software Engineering: A Precise Approach, Wiley,2008.

Course Name:	**Object Oriented Programming Lab**		
Course Code:	OE-IT791E	**Category:**	Open Elective Course
Semester:	7th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic understanding of object oriented paradigm
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To build software development skills using java programming for real-world applications.
2	To understand and apply the concepts of classes, packages, interfaces, Array List, exception handling and file processing.

3	To develop applications using generic programming and event handling.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Assignments on class, constructor, overloading, inheritance, overriding	6P
2	Assignments on wrapper class, arrays	2P
3	Assignments on developing interfaces- multiple inheritance, extending interfaces	4P
4	Assignments on creating and accessing packages	2P
5	Assignments on multithreaded programming	4P
6	Assignments on generic class and array list	4P
7	Assignments on applet programming	2P
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.
2	Develop and implement Java programs with Array List, exception handling and multithreading.
3	Design applications using file processing, generic programming and event handling.

Learning Resources:	
1	P. J. Deitel, H. M. Deitel, "Java for Programmers", Pearson Education, PHI, 4th Edition, 2007.
2	P. Radha Krishna, "Object Oriented Programming through Java", Universities Press, 2nd Edition, 2007
3.	Bruce Eckel, "Thinking in Java", Pearson Education, 4th Edition, 2006.
4.	Sachin Malhotra, Saurabh Chaudhary, "Programming in Java", Oxford University Press, 5th Edition, 2010.

Course Name:	**Electrical and Electronic Design Lab-I**		
Course Code:	PW EE 781	**Category:**	Project Work, Seminar and Internship
Semester:	7^{th}	**Credit:**	2
L-T-P:	1-0-2	**Pre-Requisites:**	Electric Machine I, Electric Machine II
Full Marks:	100		
Examination Scheme:	Semester Examination: 100	Continuous Assessment:00	Attendance: 00

Course Objectives:	
1	To understand the circuits with instruments and safety precaution

2	To understand the design aspect of heating element, distribution system
3	To design the induction motor and speed controller of DC machine

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, System assembly considerations, PCB design software.	**7P**
2	Designing a heating element with specified wattage, voltage and ambient temperature.	**6P**
3	Designing power distribution system for a small township, IOT based smart city.	**4P**
4	Designing a split phase squirrel cage induction motor for a ceiling fan or a domestic pump.	**6P**
	Design a controller for speed control of DC machine.	**4P**
Total		**27P**

Course Outcomes:

After completion of the course, students will be able to:

1.	Explain basic concept of measurement, noise in electronic system, sensor and signal conditioning circuits.
2.	Understand PC based data acquisition systems.
3.	Construct circuits with appropriate instruments and safety precautions.
4.	Design heating elements, power distribution system for small township and Electric machines.
5.	Design electronic hardware for speed of AC/DC motor.

Learning Resources:

Recommended Text Books	
1	A. K. Sawhney; A Course in Electrical Machine Design; Dhanpat Rai & Co, 2013.
2	M. G. Say : The Performance and Design of Alternating Current Machines; CBS Publishers and Distributors,2002.
Alternative Text Books	
3	S. K. Sen : Principles of Electrical Machine Design with Computer Programs ; Oxford & IBH Pub. Co., 2006.
4	M K. Giridharan, Electrical Systems Design, I. K. International Pvt Ltd, 2010.
Reference Books	
5	A.E. Clayton & N. N. Hancock : The Performance and Design of Direct Current Machines ; CBS Publishers and Distributors, 2004.

Course Name:	**Project Stage-I**		
Course Code:	PW-EE782	**Category:**	Project Work, Seminar and Internship
Semester:	7th	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Knowledge on domain of project work and associated tools.
Full Marks:	100		
Examination Scheme:	Semester Examination: 100	Continuous Assessment: 00	Attendance: 00

Course Objectives:	
1	To study the content and techniques of the literature for project problem formulation.
2	To inculcate skills for team work, independent study, analysis and modeling based on literature survey and innovative thinking.
3	Planning, Preliminary Modeling, Simulation and Experiment Design (or building a prototype model) related to the topic.
4	Developing skills for writing a project report, preparing presentation on the topic and demonstrating a prototype if applicable.

Guide Line:

Module No.	**Description of Topic**	**Contact Hrs.**
	Guide Line: **1.** This particular course would be organized as a guided assignment, which should normally include literature survey on the assigned topic. The assignment could be allocated to an individual students or small group of students. (Called hear after as team). **2.** The team would work out a preliminary approach to the Problem relating to the assigned topic. **3.** The team would Conduct Modeling, Simulation, Experiment preparation of bill of materials, project planning and design as applicable. **4.** The team would prepare a written report and presentation materials (including prototype if any) on the study conducted for presentation to the department. **5.** Individual members of the team would make oral presentation before a departmental committee as final seminar.	**30P**
Total		**30P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the content and techniques of the literature for project problem formulation.

2	Analyze the model based on literature survey and plan for innovative thinking to inculcate skills for team work
3	Plan, design of Preliminary Model by Simulation or Experiment for building a prototype related to the topic.
4	Represent project report and prepare presentation on the topic to demonstrate a prototype.

Course Name:	**Industrial Training Evaluation**		
Course Code:	PW -EE783	**Category:**	Project Work, Seminar and Internship
Semester:	7th	**Credit:**	1
L-T-P:	0-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 100	Continuous Assessment: 00	Attendance: 00

Course Objectives:	
1	Get sensitized about actual tools and practices in industry by participating in an industrial project.
2	To learn about industrial safety practices and work culture by observation and participation.
3	To learn how to communicate with industry personnel for effective learning.
4	To know how to prepare work report and effective technical presentation.

Guide Line:

Module No.	Description of Topic	Contact Hrs.
	Guide lines: The Training is provided based on the consultation with concerned industry to familiar the students with different real time project works and acquire knowledge about the broad field of Electrical Engineering. 1. Students may appear for the training assigned by the Department / personally arranged on an individual basis or two/three students in a group. 2. Participation in the training during the 6th & 7th semester break. 3. After completion of the training prepare a written report on the training topic. 4. Prepare a presentation on training and place it before a Departmental Committee.	---

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the operation of actual tools for practices in industry by participating in an

	industrial project.
2	Understand about industrial safety practices and work culture by observation and participation.
3	Get knowledge from industry personnel by effective communication.
4	Represent a work report and prepare effective technical presentation.