SCHEME OF INSTRUCTION AND EVALUATION

UNIVERSITY COLLEGE OF ENGINEERING & TECHNOLOGY

B.TECH., (CBCS) 4-YEARS (8-SEMESTERS) REGULAR PROGRAMME

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)

(Applicable from the batch admitted from the Academic Year 2023-24 onwards)

III –Semester

S.No.	Code	CourseTitle	SchemeofInstruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	BS301MT	Mathematics III	3	-	-	3	3	30	45	3
2	PC301EE	ElectricalCircuits –I	3	-	-	3	3	30	45	3
3	PC302EE	Electrical Machines–I	3	-	-	3	3	30	45	3
4	PC303EE	Electromagnetic Fields	3	-	-	3	3	30	45	3
5	PC304EE	Power systems -I	3	-	-	3	3	30	45	3
6	ES305ME	PMP	3	-	-	3	3	30	45	3
7	PC306EC	Analog Electronics	3	-	-	3	3	30	45	3
Practicals										
8	PC351EE	Electrical Machines–I Lab	-	-	2	2	3	20	30	1
9	PC352EE	DE&LD Lab	-	-	2	2	3	20	30	1
10	ES353ME	MT Lab	-	-	2	2	3	20	30	1
Total			21	-	6	27	30	270	405	24

L: Lectures
T: Tutorials
P: Practical's
CIE: Continuous Internal Evaluation
SEE: Semester End Examination
BSC: Basic Science Course
HS: Humanities and Social Sciences
ESC: Engineering Science Course

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BS 301 MT	ENGINEERING MATHEMATICS-III					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	45 Marks	CIE		30 Marks	

Course Objectives:

- To introduce the concepts of Numerical interpolation approach for differential equations and applications
- To provide the knowledge of Numerical methods.
- To provide the knowledge of Z-Transforms, Fourier- Transforms and Integral transforms.
- To acquire the solving the differential equations using transforms

Course outcomes:

After completion of this course students able to

- Find solutions of the Heat equation, Wave equation and the Laplace equation subject to boundary conditions.
- Solve differential equations using Laplace and Fourier transforms.
- Solve differential equations by using Z-Transforms.

Unit-I:

Numerical methods: Solutions of Algebraic and Transcendental equations - Bisection method, Regula-Falsi method and Newton-Raphson's method, Solution of Linear system of equations, Gauss elimination method, LU Decomposition method, Gauss-Jacobi and Gauss Seidel iterative method.

Unit-II:

Interpolation, Lagrange's interpolation, Newton's divided difference interpolation Numerical differentiation interpolation approach, Solution of differential equations by Euler's method, modified Euler's method and Runge-Kutta Method of 4^{th} order, Numerical integration Trapezoidal rule, Simpson's 1/3 rule.

Unit-III:

Laplace transforms: Introduction to Laplace transforms, sufficient condition for existence of Laplace transform, Laplace transform of derivatives, Laplace transform of integrals Translation theorems(I & II Shifting theorems), differentiation of Laplace transform(Multiplication by t), integration of Laplace transform(Division by t) convolution theorem, solving initial value problems using Laplace transform.

Unit-IV:

Fourier transforms: Introduction, Fourier integrals, Fourier sine and cosine integrals complex form of Fourier integral, Fourier transform, Fourier sine and cosine transforms, Finite Fourier sine and cosine transforms, properties of Fourier transforms, convolution theorem for Fourier transforms.

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Unit-V:

Z- Transform: Introduction, basic theory of Z- Transforms, Z-Transforms of standard sequences, existence of Z- Transform, linearity property, translation theorem, scaling property, initial and final value theorems, differentiation of Z- Transform, convolution theorem, solution of difference equations using 2- Transforms.

Suggested Reading:

1. R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publication, 4th Edition, 2014.

2. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publications, 43 Edition, 2014

3. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, 2012.

4. Vasishtha, Gupta, "Integral Transforms", Krishnan Prakashan Publications, 2014

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PC 301 EE	ELECTRICAL CIRCUITS – I					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	45 Marks	CIE		30 Marks	

Course Objectives:

- To acquire knowledge in electrical circuits and to understand the fundamentals of derived circuit laws.
- To acquire knowledge in steady state analysts of single-phase AC circuits.
- To understand network theorems
- To acquire knowledge in Transient analysis of circuits.

Course Outcomes:

After the completion of this course, the students shall be able to

- Apply source transformation, star-delta transformation, and mesh & node analysis to analyze networks.
- Evaluate steady state behavior of single-phase AC networks and design the series and parallel RLC circuits for the required bandwidth, resonant frequency and quality factor.
- Analyze electric circuits using network theorems for AC and DC networks.
- Evaluate steady state behavior of three-phase AC networks and analyze the coupled circuits.
- Evaluate transient and steady response of networks for various excitations by solving differential equations

UNIT I :

Network Elements & Laws: Active elements, Independent and dependent sources. Passive elements — R, L and C, Energy stored in inductance and capacitance, Kirchhoff's laws, Source transformations, Star-delta transformations, Node voltage method, Mesh current method including super node and super mesh analysis

UNIT II :

Single-Phase Circuits: RMS and average values of periodic sinusoidal and non-sinusoidal waveforms, Phasor representation, Steady-state response of series, parallel and series-parallel circuits. Impedance, Admittance, Current locus diagrams of RL and RC series and parallel circuits with variation of various parameters. Resonance: Series and parallel circuits, Band-width and Q-factor.

UNIT III:

Network theorems: Superposition theorem, Thevinin's theorem, Norton's theorems, Maximum power transfer theorem, Tellegen's theorem, Compensation theorem, Milliman's theorem and Reciprocity theorem. (AC & DC)

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UNIT IV:

Poly-phase Circuits: Analysis of balanced and unbalanced 3-phase circuits, Star and delta connections, Measurement of three-phase power for balanced and unbalanced loads.

Coupled circuits: Concept of self and mutual inductance, Dot convention, Coefficient of coupling, Analysis of circuits with mutual inductance.

UNIT V :

Transient analysis: Transient response of RLC circuits, Formulation of integral differential equations, Initial conditions, Response of RL, RC and RLC networks subjected to internal energy, Response to impulse, step, ramp, exponential and sinusoidal excitations.

Suggested Reading:

1. Van Valkenburg M.E., Network Analysis, Pearson education , 3rd Edition, 2019.
2. William Hayt H, Kimmerly Jack E, Steven Durbin M, Engineering Circuit Analysis, McGraw Hill, 7th Edition, 2006.
3. Jagan N.C, Lakshrninarayana C., Network Analysis, B.S. Publications, 3rd Edition, 2019.
4. Chakravarthy A., Circuit Theory Analysis and Synthesis, Dhanpat Rai & Co.Seventh Edition, 2018

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PC302EE	ELECTRICAL MACHINES - I					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	45 Marks	CIE		30 Marks	

Course Objectives:

- To study and understand different types of DC machines and their performance evaluation through various testing methods.
- To understand the operation of single and ploy-phase Transformers
- To analyze the performance of transformers through various testing methods

Course Outcomes:

After learning the contents of this paper the student must be able to Identify different parts of a DC machines & understand their operation.

- Carry out differentexcitation, starting speed control methods and testing of DC machines
- To analyze the performance of transformers through various testing methods

UNIT-I:

D.C. GENERATORS: Principle of operation – Action of commutator – constructional features – armature windings – lap and wave windings – simplex and multiplex windings – use of laminated armature – E. M.F Equation.

Armature reaction – Cross magnetizing and de-magnetizing AT/pole – compensating winding – commutation – reactance voltage – methods of improving commutation.

Methods of Excitation – separately excited and self-excited generators – build-up of E.M.F - critical field resistance and critical speed - causes for failure to self-excited and remedial measures. Load characteristics and applications of shunt, series and compound generators.

UNIT-II:

D.C MOTORS: Principle of operation – Back E.M.F. - Torque equation – characteristics and application of shunt, series and compound motors – Armature reaction and commutation.

Speed control of D.C. Motors - Armature voltage and field flux control methods.

Motor starters (3-point and 4-point starters) Testing of D.C. machines - Losses – Constant & Variable losses – calculation of efficiency – condition for maximum efficiency.

UNIT-III:

TESTING OF DC MACHINES: Methods of Testing – direct, indirect, and regenerative testing – Brake test – Swinburne's test – Hopkinson's test – Field's test - separation of stray losses in a D.C. motor test.

UNIT-IV:

SINGLE PHASE TRANSFORMERS: Types - constructional details-minimization of hysteresis and eddy current losses- EMF equation - operation on no load and on load - phasor diagrams and Applications.

Equivalent circuit - losses and efficiency – regulation - All day efficiency - effect of variations of frequency & supply voltage on iron losses.

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UNIT-V:

TESTING OF TRANSFORMERS AND POLY-PHASE TRANSFORMERS:

Open Circuit and Short Circuit tests - Sumpner's test - predetermination of efficiency and regulation-separation of losses testparallel operation with equal and unequal voltage ratios - auto transformers-equivalent circuit - comparison with two winding transformers.

Poly-phase transformers – Poly-phase connections - Y/Y, Y/Δ, Δ/Y, Δ/Δ and open Δ, Scott connection and Applications.

Suggested Reading:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010
3. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
4. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
5. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
6. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

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PC303EE	ELECTRO MAGNETIC FIELDS					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	45 Marks	CIE		30 Marks	

Course Objectives:

The course is taught with the objectives of enabling the student to:

- To be able to understand the concepts of electrostatic fields, magneto static fields.
- To understand the concepts of electromagnetic wave propagation in different

Course Outcomes :

On completion of this course, the student will be able to:

- Understand the basic concept of electrostatic field and formulate problems
- Derive expression for the energy stored in electrostatic field, electrostatic
- Understand the basic concept of magnetic field and formulate problems
- Derive expression for Maxwell's equations, energy stored in electric and magnetic field.
- Application of EM wave propagation and calculate the reflection and refraction coefficient of electromagnetic field

UNIT – I:

Review of Vector Analysis: Coulomb's Law, Electric field intensity, Electric field due to different charge distributions. Electric field due to line charge, Sheet charge, Volume charge distribution, Electric flux density, Gauss's law, Divergence theorem. Potential, Potential gradient, Potential field of different charge distributions, Applications of above laws.

UNIT - II :

Energy in electrostatic field: Poisson's and Laplace equations, Uniqueness theorem, Solution of Laplace's equation, Conductors, Conductor properties, Dielectric, Dielectric properties and Boundary conditions, Calculation of capacitance, Boundary conditions for conductors and perfect dielectric materials.

UNIT - III :

Steady magnetic field: Biot-Savart's law, Ampere's law, Stoke's theorem, Magnetic scalar and vector potential, Faraday's law, Self and Mutual inductances, Force on moving charge, Force on differential elements, Magnetic boundary conditions, Magnetic circuits, Analogy with electrical circuits, Applications of above laws.

UNIT - IV :

Maxwell's equations: In Integral form, differential forms, Line and surface integrals, Boundary conditions, Continuity equation, Field equations in vector forms, energy storage in electric and magnetic fields.

UNIT - V :

EM waves: In homogeneous medium solutions for free space conditions,Uniform plane wave propagation, Poisson's and Laplace's equations, Sinusoidally time varying uniform plane waves in free space, Uniform plane waves in dielectrics and conductors, Poynting vector, Power dissipation, Reflection of uniform plane waves, Introduction to method of moments,

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Suggested Reading:

1. Matthew Sadiku N.O., Elements of Electromagnetics, Oxford University Press, 7th Edition, 2018.
2. William. Hayt H, Buck John A., Engineering Electromagnetics, Tata McGraw Hill, 7th Edition, 2003.
3. Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, PHI, New Delhi, 5th Edition, 2002. Matthew Sadiku N.O., Elements of Electromagnetics, Oxford University Press, 4th Edition, 2006.

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PC304EE	POWER SYSTEMS – I					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	45 Marks	CIE		30 Marks	

Course Objectives:

The course is taught with the objectives of enabling the student:

- To introduce the economic aspects of power generation and tariff methods and understand the concepts of A.C. and D.C. distribution.
- To understand the working of conventional power plants like Thermal, Hydel and Nuclear
- To understand the basic working principles of renewable power plants like Solar, Wind and Gas Turbine power plants.
- To understand about various overhead line components and cables
- To familiarize with transmission line parameter calculations.

Course Outcomes:

On completion of this course, the student will be able to:

- Evaluate various economic aspects of power generation like depreciation fund calculations and Tariffs and perform A.C. and D.C. distribution calculations.
- Understand the operation of conventional power plants.
- Understand the basic working principle of renewable power plants like Solar, Wind, and Gas turbine plants.
- Evaluate the performance of overhead line insulators and underground cables and to perform sag calculations.
- Determine the electrical circuit parameters of transmission line.

UNIT – I

Economics of Power Generation: Load Curve, Load Demand and Diversified factors, Base Load and Peak load operation, Types of costs and depreciation fund calculations, Methods of power factor improvement, Economics of power factor improvement, Tariffs, **Distribution:** 2 wire and 3 wire distributors, Ring mains, AC distribution calculations.

UNIT – II

Steam Power Stations: Choice of site, Layout & various parts of station, Boilers, Turbines, Super Heaters, Economizers, Air pre-heaters etc. and their Pulverized fuel, Coal handling.

Hydro-Electric Power plants: Estimation Hydrograph, Flow duration curve, Mass curve, Storage and pondage, Types electric plants and layouts, Prime movers for hydroelectric plants.

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UNIT – III

Nuclear Power Plants: Fissile materials, working principle of nuclear plants and reactor control, Shielding, Types of reactors. **Non-Conventional Energy Sources:** Basic principles of Wind, solar and gas turbines.

UNIT – IV

Over-Head Lines: Supports sag and tension calculations, Effect of wind and ice, Erection conditions, Insulators: Types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, Testing of insulators. **Insulated Cables:** Conductors for cables, Insulating materials, Mechanical protection, Low voltage cables, Grading of cables, Three phase high voltage cables and Super voltage cables, Capacitance of three-core cables.

UNIT – V

Inductance and Capacitance of Transmission Lines: Inductance and capacitance of overhead line conductors, Single phase and three phase with symmetrical composite conductors, GMR and GMD Spacing, Transposition, Bundled conductors, Effect of earth capacitance.

Suggested Reading:

1. Wadhwa C.L., Electrical Power Systems, New Age International (P) Ltd., 8th Edition, 2022.
2. Wadhwa C.L., Generation, Distribution and Utilization of Electrical Energy, New Age International (P) Ltd., 4th Edition, 2017.
3. Singh S.N., Electrical Power Generation, Transmission and Distribution, Prentice Hall of India, Pvt. Ltd., New Delhi, 2nd Edition, 2008.
4. V.K. Mehta, Principles of Power Systems, S. Chand and Co., 7th Edition, 2021.

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ES305ME	PRIME MOVERS AND PUMPS					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	45 Marks	CIE		30 Marks	

Course Objectives:

- To acquire knowledge of fluid mechanics and governing equations.
- To understand the working principal of hydraulic turbines and pumps.
- To understand the working principle of steam and gas power plants.
- To be able to estimate the power developed in the engine, turbines.

Course Outcomes:

- Knowledge regarding various theories dealing with the flow phenomenon of fluid.
- Ability to define the nature of a fluid, viscosity effects on flow and characteristics of Newtonian and non-Newtonian fluids
- Understanding of basics of the hydraulic, steam and gas turbines, and their components, functions and applications
- Knowledge of different types of boilers, turbines and pump
- Recognize typical designs of turbines and pumps.

UNIT-I

Fluid Mechanics: Properties of fluids, Newtonian and non-Newtonian fluids. Continuity, Momentum and Energy equations. Bernoulli's equation and its applications. Laminar and Turbulent flows. Basic Concept of Boundary layer theory and boundary layer thickness.

UNIT-II

Hydraulic Turbines: Layout of Hydroelectric power plant. Working principle of Pelton, Francis and Kaplan turbines. Draft tube in Reaction turbine. Velocity diagrams for impulse and Reaction turbines. Blade angles and dimensions for Reaction turbines. Work done, power output and efficiencies. Simple problem on Pelton, Francis and Kaplan turbines. Selection of turbines for electric power generation, Specific speed and its ranges for Pelton, Francis and Kaplan turbines. Unit quantities. Performance and characteristics curves. Cavitation and its effects.

UNIT-III

Pumps: Reciprocating Pumps - Working of single and double acting types. Functions and use of Air vessels. Problems on pressure head, work done, power required without and with air vessels. Centrifugal Pumps: Parts and working of CF pumps. Need for priming, pump installation. Velocity diagrams and vane angles. Types of impellers. Work and power required. Manometric and other efficiencies. Simple problems for single stage pumps, Principles of similarity, specific speed and unit quantities. Performance and characteristic curves

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UNIT-IV

Basic Steam Engineering: Generation, properties and dryness fraction of steam. Functions of aboiler. Working of a simple vertical type and Babcock and Wilcox type boilers with simple sketches Boiler Mountings and Accessories and their functions. Rankine cycle, re-heat and regeneration cycles

UNIT-V

Steam & Gas Power Plants: Layout of simple steam power plant and working of its individual units Classification and compounding of steam turbines. Velocity diagrams for single stage impulse andreaction turbines. Simple problems on work done, blade angles, Power output and thermal efficiencies of turbines. Working of reheat and bleeding cycles.

Suggested Readings:

1. Ballaney P.L, "Thermal Engineering", Khanna Publishers, 19th Edition-2003.
2. Yadav R. "Steam and gas Turbines", Galgotia Publishers, 6ª Edition-1992.
3. Rajput," Thermal Engineering", Laxmi Publications (P) Ltd, New Delhi.
4. Bansal R.K," Fluid Mechanics and Hydraulic Machines", Laxmi Publictions (P) Ltd, New Delhi.
5. Kumar D.S. Fluid Mechanics and Fluid Power Engineering", S.K. Kataria & Sons, 6ª Edition-2003

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PC 306 EE	ANALOG ELECTRONICS					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	45 Marks	CIE		30 Marks	

Course Objectives:

The course is taught with the objectives of enabling the student to:

- To understand the diode characteristics.
- To study the input and out characteristics of different Transistor configurations.
- To understand the design concepts FET and amplifier.
- To understand the concepts of Feedback
- To understand the Applications of Oscillator

Course Outcomes:

On completion of this course, the student will be able to:

- Understand the characteristics of diodes and, Rectifiers
- Design and analyze amplifier circuits
- To be able analyze characteristics of FETS and MOSFET.
- Analyzing of +ve and negative feedback circuits
- Design sinusoidal oscillators.

UNIT – I

Semiconductors & diodes: Energy bands, Intrinsic and Extrinsic Semiconductors, Mobility and Conductivity, Band structure of PN Junction, Volt – Amp Characteristics, Temperature Dependence, Transition and Diffusion Capacitance of PN Junction, Zener Diode, **Diode circuits**: Diode as a rectifierHalf-wave, Full-wave and Bridge Rectifiers, types of Filters, Capacitor and inductor filter, zener diode as a voltage regulator, Ripple Factor and Regulation Characteristics.

UNIT- II

Bipolar Junction Transistor: NPN and PNP junction Transistors, Transistor current componentsCB, CE and CC Configurations and their Characteristics, Saturation, Cutoff and Active Regions Comparison of CE, CB and CC Configurations, Maximum voltage rating, the operating point, fixed bias, emitter stabilized bias circuits, Voltage-divider bias, Stabilization, Thermal Runaway, Therma Stability, High frequency model of a Transistor. The h parameters of the three transistor configurations, Analysis of Transistor Amplifier Circuits using h–parameters.

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UNIT- III

Field Effect Transistors: The Junction field effect transistor, Pinch off Voltage, Volt-ampere characteristics, Drain Saturation Current, Small Signal model of FET, MOSFET – Enhancement and Depletion Modes. The low Frequency common source and common drain amplifiers, FET biasing.

UNIT - IV

Concept of Feedback, Feedback Amplifier Configurations, Circuits,
Advantages of Negative feedback, Analysis of Simple feedback amplifiers using BJT and FET

UNIT - V

Barkhausen Criterion, RC Oscillators: Wien Bridge, Phase shift, LC Oscillators: Hartley and Colpitt's Oscillators, Crystal Controlled Oscillators (analysis of oscillators using BJTs only), stability of oscillators

Suggested Reading:

1. Millman J., Halkias C.C. and Satyabrata Jit, Electronic Devices and Circuits, 3rd edition,Tata McGraw-Hill, 2011.
2. S Salivahanan, N Kumar, and A Vallavaraj, Electronic Devices and Circuits, 2nd ed., McGraw Hill Education, 2007.
3. Millman J., Halkias C.C. and Parikh C, Integrated Electronics, 2nd edition, Tata
4. JB Gupta, Electronic Devices and Circuits, S.K Kataria & sons, 5th Edition, 2012

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PC 351 EE	ELECTRICAL MACHINES LABORATORY – I					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	30 Marks	CIE			20 Marks

Course Objectives:

- To expose the students to the operation of DC Generators
- To know the operation of various types of DC Motors.
- To examine the performance of Single and Three Phase Transformers.

Course Outcomes:

After learning the contents of this paper the student must be able to ❑ Start and control the Different DC Machines.

- Assess the performance of different machines using different testing methods
- Evaluate the performance of different Transformers using different testing methods

The following experiments are required to be conducted compulsory experiments:

1. Magnetization characteristics of DC shunt generator (Determination of critical field resistance and critical speed)
2. Load test on DC shunt generator (Determination of characteristics)
3. Load test on DC series generator (Determination of characteristics)
4. Hopkinson's test on DC shunt machines (Predetermination of efficiency)
5. Swinburne's test and speed control of DC shunt motor (Predetermination of efficiencies)
6. Brake test on DC compound motor (Determination of performance curves)
7. OC and SC Test on Single Phase Transformer
8. Three Phase Transformer: Verification of Relationship between Voltages and
9. Currents (Star-Delta, Delta- Delta, Delta-star, Star-Star)

In addition to the above eight experiments, at least any two of the experiments from the following list are required to be conducted:

1. Brake test on DC shunt motor (Determination of performance curves)
2. Load test on DC compound generator (Determination of characteristics.
3. Fields test on DC series machines (Determination of efficiency)
4. Retardation test on DC shunt motor (Determination of losses at rated speed)
5. Separation of losses in DC shunt motor.
6. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
7. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation)

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TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
4. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

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PC352EE	DIGITAL ELECTRONICS AND LOGIC LABORATORY					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	30 Marks	CIE			20 Marks

Course Objectives:

The course is taught with the objectives of enabling the student to:

- To verify the operations of various logic gates
- To understand the concepts of code converters
- To impart how to design the switching circuits
- To learn about shift registers and counters
- To know the function of analog-to-digital and digital-to-analog converters

Course Outcomes:

- On completion of this course, the student will be able to :
- Identify and differentiate various logic gates
- Develop the combinational logic circuits
- Design and test the sequential logic circuits
- Realize the shift registers and counters using memory elements
- Analyze the various analog-to-digital and digital-to-analog converters

LIST OF EXPERIMENTS

1. Implementation of Truth Tables of various Logic Gates
2. Implementation of Logic Gates using Universal Gates
3. Implementation of Adders and Subtractors
3. Implementation of Adders and Subtractors
4. Implementation of BCD to Excess- 3 Code Converter
5. Implementation of a 4-bit Shift Register
6. Implementation of a 4-bit Up Counter and Down Counter
7. Implementation of a 4-bit Synchronous and Asynchronous Counter
8. Implementation of a 4-bit Magnitude Comparator
9. Implementation of 8:1 Multiplexer and 2:4 De-Multiplexer
10. Implementation of Encoder and Decoder
11. Implementation of a 4-bit R-2R Digital-to-Analog Converter
12. Implementation of a 8-bit Successive Approximation Analog-to DigitaConverter

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ES 353 ME	MECHANICAL TECHNOLOGY LABORATORY					
Pre-requisites	-		L	T	P	C
			3	-	-	3
Evaluation	SEE	30 Marks	CIE			20 Marks

Course Objectives:

To gain knowledge of working of pelton and diesel engines.

- To be able to estimate the power developed in the engine.
- To understand the working principle of hydraulic turbines and pumps.
- understand the performance of turbines using characteristic curves
- To gain the knowledge of various flow meters and the concept of fluid mechanics

Course Outcomes:

The students will be able to:

- Knowledge regarding components and functioning of engines
- Ability to calculate the power developed, losses in the engines.
- Understanding of viscosity of oils.
- Knowledge of flash and fire point of oils, and its importance
- Knowledge of estimating the power of turbines and pumps.

A) **Thermal Engineering Laboratory:**

1. Determination of heat transfer coefficient under natural convention
2. Determination of thermal conductivity of a composite wall.
3. Determination of volumetric efficiency of multi stage reciprocating air compressor.
4. Performance test on Multi cylinder petrol/ diesel engine.
5. Determination of flash and fire points in lubricants.

B) **Thermal Engineering Laboratory:**

6. Measurement of discharge by Venturi meter.
7. Measurement of discharge by Orifice meter.
8. Measurement of discharge by Rotameter.
9. Measurement of velocity by Pitot tube.
10. Performance test on Pelton wheel turbine.
11. Characteristic curves test on Pelton wheel turbine.
12. Performance test on Francis wheel turbine.
13. Characteristic curves test on Francis turbine.
14. Performance and characteristics of Reciprocating pump.
15. Performance and characteristics of Centrifugal pump.

C) **Study of Construction details of Gear Box,**

Note: At least ten experiments should be conducted in the Semester

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Scheme of Instruction, Evaluation

For Four year B.Tech program In Electrical & Electronics Engineering

With effect from Academic Year 2023-24

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING & TECHNOLOGY

MAHATMA GANDHI UNIVERSITY

Nalgonda – 508 001, TS, INDIA

SCHEME OF INSTRUCTION AND EVALUATION

B.Tech (Electrical and Electronics Engineering) w.e.f. 2023-24

I– Semester

S.No.	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P					
Theory										
1	BS 101 MT	Engineering Mathematics – I	3	-	-	3	3	30	45	3
2	BS 102 PH	EngineeringPhysics	3	-	-	3	3	30	45	3
3	ES 101 CS	Programming for Problem Solving	3	-	-	3	3	30	45	3
3	PC 101 EE	Electrical& Electronics Engineering Material	3	-	-	3	3	30	45	3
5	PC 102 EE	Electrical Wiring Estimation and Automation	3	-	-	3	3	30	45	3
Practicals										
5	BS 151 PH	Engineering Physics Lab	-	-	3	3	3	20	30	1.5
6	ES 151 CS	Programming for Problem Solving Lab	-	-	2	2	3	20	30	1
7	ES 152 ME	Workshop Lab	-	-	6	6	3	25	50	3
Total			15	-	11	26	24	215	335	20.5

SCHEME OF INSTRUCTION AND EVALUATION

B.Tech (Electrical and Electronics Engineering) w.e.f. 2023-24

II SEMESTER

S.No.	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P					
Theory										
1	BS 201 MT	Engineering Mathematics II	3	-	-	3	3	30	45	3
2	BS 201 CH	Engineering Chemistry	3	-	-	3	3	30	45	3
3	HS 201 CS	Communicative English	3	-	-	3	3	30	45	3
4	PC 201 EE	Digital Electronics & Logic Design	3	-	-	3	3	30	45	3
Practicals										
5	BS 251 CH	Engineering Chemistry Lab	-	-	3	3	3	20	30	1.5
6	HS 251 EG	Communicative English Lab	-	-	2	2	3	20	30	1
7	PC 251 EE	Computer Aided Electrical Drawing Lab	-	-	2	2	3	20	30	1
8	ES 251 ME	Engineering Graphics Lab	2	-	4	6	3	20	30	4
Total			14	-	11	25	24	200	300	19.5

SCHEME OF INSTRUCTION AND EVALUATION

B.Tech (Electrical and Electronics Engineering) w.e.f. 2023-24

III – Semester

S.No.	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P					
Theory										
1	BS 301 MT	Mathematics III	3	-	-	3	3	30	45	3
2	PC 301 EE	Electrical Circuits – I	3	-	-	3	3	30	45	3
3	PC 302 EE	Electrical Machines – I	3	-	-	3	3	30	45	3
4	PC 303EE	Electromagnetic Fields	3	-	-	3	3	30	45	3
5	PC 304 EE	Power systems I	3	-	-	3	3	30	45	3
6	ES 305 ME	Prime movers & Pumps	3	-	-	3	3	30	45	3
7	PC 306 EC	Analog Electronics	3	-	-	3	3	30	45	3
Practicals										
8	PC 351 EE	Electrical Machines I Lab	-	-	2	2	3	20	30	1
9	PC 353 EC	Digital Electronics &Logic Design Lab	-	-	2	2	3	20	30	1
10	PC 353 EC	Mechanical Technology Lab	-	-	2	2	3	20	30	1
Total			21	-	6	27	30	270	405	24

SCHEME OF INSTRUCTION AND EVALATION

B.Tech (Electrical and Electronics Engineering) w.e.f. 2025-26

IV – Semester

S.No.	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P					
Theory										
1	PC 401 EE	Electrical Circuits - II	3	-	-	3	3	30	45	3
2	PC 402 EE	Electrical Machines II	3	-	-	3	3	30	45	3
3	PC 403 EE	Power Systems - II	3	-	-	3	3	30	45	3
4	PC 404 EE	Micro Processors & Micro Controllers	3	-	-	3	3	30	45	3
5	PC 405 EE	Power electronics	3	-	-	3	3	30	45	3
6	PC 406 EE	Signals &Systems	3	-	-	3	3	30	45	3
7	MC 407 HS	Environmental Studies	3	-	-	3	3	30	45	3
Practicals										
8	PC 451 EE	Electrical Circuits Lab	-	-	2	2	3	20	30	1
9	PC 452 EE	Electrical Machines Lab – II	-	-	2	2	3	20	30	1
10	PC 453 EE	Analog Electronics Lab	-	-	2	2	3	20	30	1
Total			21	-	6	27	30	270	405	21

SCHEME OF INSTRUCTION AND EVALUATION

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V– Semester

S.No	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	PC 501 EE	Linear Control Systems	3			3	3	30	45	3
2	PC 502 EE	Switchgear and Protection	3			3	3	30	45	3
3	PC 503 EE	Electrical Measurements & Instrumentation	3	-	-	3	3	30	45	3
4	PC 504 EE	Linear Integrated Circuits	3	-	-	3	3	30	45	3
5	PC 505 EE	Python Programming & Applications	3	-	-	3	3	30	45	3
6	Professional Elective I									
	PE 511 EE	Electrical Distribution Systems	3	-	-	3	3	30	45	3
	PE 512 EE	Renewable Energy Sources								
	PE 513 EE	Reliability Engineering								
PRACTICALS										
7.	PC 551 EE	Micro processors &Micro Controllers Lab	-	-	2	2	3	20	30	1
8.	PC 552 EE	Power Electronics Lab	-	-	2	2	3	20	30	1
TOTAL			18		4	22	24	220	330	20

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Course Code	Course Title					Course Type
PC 501 EE	LINEAR CONTROL SYSTEMS					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE
	3	-	-	3	30	45	3

Course Objectives:

- **To develop basic skills of utilizing mathematical tools needed to analyze and design classical linear control systems.**
- **To understand and develop the state space representation of control systems.**

Course Outcomes:

1. **Develop Mathematical modeling of Electrical and Mechanical systems.**
2. **Determine Transient and Steady State behavior of systems using standard test**
3. **Analyze the system in time domain using Routh's stability criterion and root locus.**
4. **Analyze the system in frequency domain using Nyquist stability criterion and Bode plot.**
5. **Design controllers to meet desired specifications.**
6. **Develop state space models for control systems.**

UNIT– I

Introduction to Control Systems: Classification of control systems. Feed-Back Characteristics, Effects of feedback - Transfer function- Transfer function of Potentiometer, synchro, AC servo motor, DC servo motor - Block diagram reduction technique - Signal flow graph, Mason's gain formula

UNIT- II

Time Domain Analysis: Standard test signals - Time response of first order systems - Transient response of second order system for unit step input, Time domain specifications - Steady state response - Steady state errors and error constants - Effects of P, PD, Pl and PID controllers on system performance.

UNIT- III

Stability Analysis in S-Domain: The concept of stability - Routh's stability Criterion, Absolute stability and relative stability- limitations of Routh's stability.

Root Locus Technique: The root locus concept - construction of root loci- Effects of adding poles and zeros on the root loci.

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UNIT- IV

Frequency Response Analysis: Introduction to frequency response - Frequency domain specifications - Bode plot - Stability analysis from Bode plots - Determination of transfer function from the Bode Diagram - Polar Plots, Nyquist Plots, Stability Analysis, Gain margin and phase margin.

Introduction to Lag, Lead and Lag-Lead Compensator

UNIT- V

State Space Analysis: Concepts of state, State variables and state model, Derivation of state models of linear time invariant systems - Controllable, Observable and Diagonal state models - State transition matrix - Concepts of Controllability and Observability.

Suggested Reading:

1. Nagrath I.J. & Gopal.M - Control System Engineering, Wiley Eastern, 2003.
2. B.C.Kuo - Automatic Control Systems, Wiley India edition, 7th Edition, 2002.
3. K.Ogata - Modern Control System, Prentice Hall of India, 4th edition, 2002.
4. N.C.Jagan - Control Systems, B.S Publications, 2nd edition,2008.
5. S.Palani. Anoop K Jairath - Automatic Control System, Ane books Pvt. Ltd, 2013
6. Anand Kumar, Control Systems, PHI Learning Private Limited, 2011

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Course Code	Course Title					Course Type
PC 502 EE	SWITCHGEAR AND PROTECTION					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To be able to understand the need of protection in power system and protection with conventional relays.
- To understand the operation of static and distance relays.
- To understand the protection of transformers and generators.
- To understand the construction and operation of various types of circuit breakers.
- To understand the operation of the components of Gas Insulated Substation and the protection against over voltages.

Course Outcomes:

1. Acquire the knowledge on construction, working principles of different electromagnetic, induction and static relays and their applications in Feeder protection.
2. Draw block diagrams of various static over current relays and also obtain the characteristics of various distance relays with their applications in transmission line protection.
3. Choose a proper relay for protection of generator and transformer.
4. Explain the working principle, construction, rating and applications of different types of circuit breakers used in power system networks.
5. Understand the constructional details, advantages and disadvantages of Gas Insulated Substations and also choose a suitable protection for Transmission lines and the power system equipment against direct lightning strokes.

UNIT–I: Introduction to Protective Relays

Need for protection: primary and backup protection, Zones of protection, Definitions: pick-up and reset values of relays, Classification of relays, Operating principles and construction: Electromagnetic relays, Induction-type relays. Types of relays: Over-current, Over-voltage, Directional, Universal relay torque equation.

Protection schemes: Over-current protection for radial feeders and ring mains, Protection of parallel lines, Relay settings for over-current relays, Earth fault and phase fault protection

UNIT–II: Static Relays and Distance Protection

Static relay types: Instantaneous over-current relay, Definite time over-current relay, Inverse time over-current relay, Directional over-current relay (block diagram approach).

Distance protection: RX diagram characteristics of two-input distance relays, Input characteristics of various types of distance relays. Three-step distance protection.

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UNIT–III: Transformer and Generator Protection

Differential relays and percentage differential protection, Protection of transformers and generators: Percentage differential scheme, Split-phase protection, Overheating, loss of excitation, Buchholz relay.

UNIT–IV: Circuit Breakers

Need and components of circuit breakers, Trip coil circuit, Arc properties and quenching principles, Arc interruption theories, Recovery and restriking voltages, Circuit breaker ratings

Symmetrical and asymmetrical breaking current, making current, breaking capacity, rated voltage,frequency, Current chopping, resistance switching

Derivation and calculation of: Rate of Rise of Restriking Voltage (RRRV), Maximum RRRV, recovery voltage, Types of circuit breakers: Oil, Minimum Oil, Air, Air Blast, SF_6, Vacuum, MCBs.

UNIT–V: Over voltage Protection

Transmission line protection against lightning: Ground wires, protection angle, protection zone, Tower footing resistance and its effects

Equipment protection: Rod gaps, arcing horns, Lightning arresters: types and construction, Surge absorbers, Peterson coil, Insulation coordination.

Suggested Reading:

1. Wadhwa C.L. - Electrical Power System, Wiley Eastern Ltd., 3rd Edition-2002.
2. Badriram & Viswakarma-Power System Protection & Switchgear, Tata McGraw Hill, 2003.
3. Sunil S. Rao - Switchgear & Protection, Khanna Publications, 2000.
4. M.S. Naidu - Gas Insulated Substations, I.K. int. Publishing House Pvt. Ltd. -2008.

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Course Code	Course Title					Course Type
PC 503 EE	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE SEE	3
	3	-	-	3	30 45	

Course Objectives:

- To learn and understand the fundamental concepts, principle of operation and applications.
- To understand various types of Bridges in measurement of resistance, inductance, capacitance.
- To understand the operation and applications of Ballistic Galvanometer, Flux meter and DC/AC Potentiometer.
- To understand the application of CRO for measurement of Amplitude and Phase

Course Outcomes:

1. Choose the suitable instrument like Ammeter, Voltmeter for AC/DC applications.
2. Select suitable Bridge for measurement of electrical parameters and quantities.
3. Use of CRO for the measurements.

UNIT– I

Instruments: indicating, Recording and Integrating instruments, Ammeter, Voltmeter, Expression for torque of moving coil, moving iron, Dynamometer, induction type and electrostatic instruments. Extension of range of instruments, Wattmeter Torque expression for dynamometer instruments, Reactive power measurement.

UNIT- II

Meters: Energy meters, single phase and 3-phase, Driving torque and braking torque equations, Errors and testing compensation, Maximum demand indicator, Power factor meters.

UNIT- III

Bridge Methods and transducers: Measurement of inductance, capacitance and resistance using Bridges, Maxwell's, Hay's. bridge, Anderson, Wein, Desauty's, Schering's bridges, Kelvin's double bridge, Megger, Loss of charge method, Wagner's earthing device, Transducers - Analog and digital transducers, Strain gauges and Hall eff ect transducers.

UNIT- IV

Instrument transformers – Current and potential transformers, ratio and phase angle errors of CT's and PT's.

UNIT- V

Potentiometers: Crompton's DC and AC polar and coordinate types, Applications, Measurements of impedance, Calibration and ammeter voltmeter and wattmeter. Use of oscilloscope in frequency, phase and amplitude measurements

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Suggested Reading:

1. Shawney A.K., Electrical and Electronics Measurements and Instruments, Dhanpatrai & Sons, Delhi, 2000.
2. Umesh Sinha, Electrical, Electronics Measurement & Instrumentations, Satya Prakashan, New Delhi.
3. Golding E.W., Electrical Measurements & Measuring Instruments, Sir Issac& Pitman & Sons Ltd., London.
4. U.A.Bakshi, A.V.Bakshi, Electrical and Electronic Instrumentation, Technical publications

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Course Code	Course Title						Course Type
PC 504 EE	LINEAR INTEGRATED CIRCUITS						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives

- **To introduce the basic building blocks of linear integrated circuits.**
- **To understand the different linear and non-linear applications of op-amp.**
- **To understand the voltage regulators and active filters by using op-amps.**
- **To acquire the basic knowledge of special function ICs.**
- **To understand the concepts of waveform generation using op-amps.**

Course Outcomes:

1. **Design and use op-amps for various linear and non-linear applications.**
2. **Design and use voltage regulators and active filters.**
3. **Design and analyze multivibrator circuits using op-amp**
4. **Design and analyze the various applications of 555 timer.**
5. **Ability to design practical circuits that perform the desired operations.**

UNIT – I

Operational amplifiers: Characteristics, Open loop voltage gain, Output impedance, Input impedance, Common Mode Rejection Ratio, Offset balancing techniques Slew rate, Frequency response, Basic applications, Inverter summer, Analog integrator, Differentiator, Current to voltage converter, Voltage to current converter, Voltage follower, a.c. amplifier.

UNIT – II

Circuits using Op-amps: Voltage limiter, Clipper and damper, Precision rectifier-full wave and half wave, Peak detector, Comparator, Zero crossing detector, Schmitt trigger, Monostable, astable and bistable multivibrators, Multiplier, Divider, Difference amplifier, Instrumentation amplifier.

UNIT – III

Waveform generation using Op-amps: Sine, Square, Triangular and Quadrature oscillators, 555 timer - Functional diagram, Operation as monostable and astable, Voltage to frequency converter using 555, 565.

UNIT – IV

Voltage regulators using Op-amp: Series voltage regulators, Shunt regulators using Op-amp - Switching regulators using Op-amp, Regulators using IC 723, Dual voltage regulator, Fixed voltage regulators, Current sensing and current fold back protection.

UNIT – V

RC active filters: Butterworth, First order, Second order for low pass, High pass, Band pass, Band reject, Notch, State variable filter, Switched capacitor filter, Universal filter, Monolithic power amplifier features.

Suggested Reading:

1. Gayakwad W.A. Op-Amps and Linear Integrated Circuits, 4th Edition, Prentice Hall of India, 2002.
2. Malvino Albert Paul, Electronic Principles, 6th Edition, Tata McGraw Hill, 1999.
3. Roy Choudhury, Shail Jam - Linear integrated Circuits, New Age International, 2nd Edition, 2003.
4. William D. Stanley, OP Amps with Linear Integrated Circuits, Pearson, 2000.

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Course Code	Course Title						Course Type
PC 505 EE	PYTHON PROGRAMMING AND APPLICATIONS						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To know the basics of Programming
- To convert an algorithm into a Python program
- To structure a Python Program as a set of functions
- To use Python data structures-lists, tuples, dictionaries.
- To do input/output with files in Python.
- To construct Python programs as a set of objects.

Course Outcomes:

1. Develop algorithmic solutions to simple computational problems.
2. Develop simple Python programs for solving problems.
3. Structure a Python program into functions.
4. Represent compound data using Python lists, tuples, dictionaries.
5. Read and write data from/to files in Python Programs

UNIT - I

Introduction to Computing and Problem-Solving: Fundamentals of Computing — Computing Devices — Identification of Computational Problems — Pseudo Code and Flowcharts — Instructions — Algorithms — Building Blocks of Algorithms.
Introduction to Python Programming: Python Interpreter and Interactive Mode- Variables and Identifiers — Arithmetic Operators — Values and Types — Statements, Reading Input, Print Output, Type Conversions, The type () Function and Is Operator, Dynamic and Strongly Typed Language.
Control Flow Statements: The if, The if...else, The if...else if...else Decision Control Statements, Nested if Statement, The while Loop, The for Loop. The continue and break Statements.

UNIT - II

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, and Command Line Arguments.
Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as a return value; Dictionaries: operations and methods; advanced list processing - list comprehension

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UNIT-III

Files and **Exception:** Text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.
Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings
Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.
Functional Programming: Lambda. Iterators, Generators, List Comprehensions.

UNIT- IV

Algorithm Analysis: Time and Space complexity analysis, Linear Search and Binary Search; sorting algorithms: Bubblesort, Selection sort, Insertion sort, Merge sort and Quick sort. **Data Structures:** Linked Lists, Stack and Queue.

UNIT-V

GUI Programming: Graphical User Interfaces, Using the Tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

Suggested Reading:

1. Richard L. Halterman,"Learning To Program With Python", Copyright fi 2011.

2. Dr Charles R,"Pythonfor Everybody, Exploring Data UsingPython 3",Severance. 2016.

3. Gowrishankar S., Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.

4. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition,

5. Updated for Python 3, Shroff/O'Reilly Publishers, 2016

6. (http://greenteapress.com/wp/think- python/)

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Course Code	Course Title						Core / Elective
PE511EE	Electrical Distribution System (Professional Elective – I)						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	45	3

Course objectives:

- To understand the concepts and Importance of different loads characteristics, Design of Sub-Transmission Lines, Sub-Stations and Feeders.
- To make the students understand about importance of Power Quality and Applications of capacitors in distribution systems.

Course outcomes:

1. Understand the concept of different factors used in design of distribution system components..
2. Explain the different types of secondary distribution systems and their performances.
3. Acquire the knowledge of various components, functions and applications of distribution automation and SCADA.

UNIT-I

Introduction, Load characteristics. Diversified demand. Non coincidence demand. Coincidence factor, contribution factor Problems. Rate structure, customer billing, types of distribution transformers.

UNIT-II

Design of Sub-transmission lines and distribution sub-stations. Substation bus schemes, rating of distribution substation, service area with multiple feeders, percent voltage drop Calculations.

UNIT-III

Design considerations of primary systems, radial type, loop type primary feeder, primary feeder loading, uniformly distributed load application to a long line. Design considerations of secondary systems. Secondary banking. Secondary networks. Network transformers, unbalanced loads and voltages.

UNIT-IV

Voltage drop and power loss calculations, 3-phase, non 3-phase primary lines - Single phase two wire laterals with ungrounded neutral, single phase two wire ungrounded laterals. Voltage fluctuations, measures to reduce flickering.

UNIT-V

Application of capacitors to distribution systems, Effect of series and shunt capacitors, power factor correction, economic justification for capacitors. Best capacitor location-Algorithm. Distribution Automation: Definitions, Components of distribution SCADA.

Suggested Reading

1. Turan Gonen, Electric Power Distribution Engineering, Mc Graw Hill Book Co., International Student Edition. 1986.
2. A.S. Pabla, Electric Power Distribution, Tata McGraw Hill Publishing Company Ltd., 1997.

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Course Code	Course Title						Core / Elective
PE512EE	RENEWABLE ENERGYSOURCES (Professional Elective – I)						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	45	3

Course Objectives:

- To understand the concepts and Importance of renewable energy sources such as solar, wind, biomass, tidal power.
- To make the students understand the advantages and disadvantages of different renewable energy sources.

Course Outcomes:

1. Undrstand the concepts and applications of different conventional and non conventional sources.
2. Aquire the knowledge of various components,principles of operation and present scenario of different conventional and non conventional sources.

UNIT-I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2 °2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells — Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT-III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations - Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT-IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-thermal Energy - Types of Go-thermal Energy Systems - Applications of Geo-thermal Energy.

UNIT-V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass -Biomass gasifiers.

Suggested Reading:

1. Rai G.D, Non-Conventional Sources of Energy, Khandala Publishers, New Delhi, 1999.
2. M.M.El-Wakil, Power Plant Technology. McGraw Hill, 1984.

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Course Code	Course Title						Core / Elective
PE512EE	RELIABILITY ENGINEERING (Professional Elective – I)						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	45	3

Course Objectives

- To understand the concepts of different types of probability distributions. importance of reliability evaluation of networks.
- To make the students understand about Reliability, availability model of Power Systems and markov modeling of Power Plants. with identical and nonidentical units

Course outcomes

1. Understand the meaning of discrete and continuous random variables and their significance, causes of failures of a system.
2. Acquire the knowledge of different distribution functions and their applications.
3. Able to develop reliability block diagrams and evaluation of reliability of different systems.

UNIT- I

Discrete and continuous random variables. Probability density function and Cumulative distribution function. Mean and variance. Binomial, Poisson, Exponential and Weibul I distributions.

UNIT - II

Failure and causes of failure. Failure rate and failure density. Reliability function and MTTF. Bath tub curve for different systems. Parametric methods for above distributions. Non - Parametric methods from field data.

UNIT- III

Reliability block diagram. Series and parallel systems. Network reduction technique, Examples. Evaluation of failure rate, MTTF and reliability, Active and Standby Redundancy, r out of n configuration. Non-series - parallel systems. Path based and cut set methods.

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UNIT- IV

Availability, MTTR and MTBF, Markov models and State transition matrices. Reliability models for single component, two components, Load sharing and standby systems. Reliability and availability models of two unit parallel system with repair and standby systems with repair.

UNIT-V

Repairable Systems, maintainability, Preventive maintenance, Evaluation of reliability and JITTF. Overhauling and replacement. Optimum maintenance policy.

Markov model of a power plant with identical units and non-identical units. Capacity outage probability table. Frequency of failures and Cumulative frequency.

Suggested Reading:

1. Charles E. Ebeling. Reliability and Maintainability Engineering, McGraw Hill International Edition, 1997.
2. Balaguruswamy, Reliability Engineering, Tata McGraw Hill Publishing Company Ltd, 1984.
3. R.N. Allan. Reliability Evaluation of Engineering Systems, Pitman Publishing, 1996.
4. Endrenyi. Reliability Modeling in Electric Power Systems. John Wiley & Sons, 1978.

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Course Code	Course Title						Course Type
PE 551 EE	MICROPROCESSORS & MICROCONTROLLERS LAB						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	2	3	20	30	1

Course Objectives:

- To provide solid foundation in assembly language programming of 8086 Microprocessor and 8051 Micro controllers.
- To provide the knowledge of interfacing the external devices to the Microprocessor and Micro controller according to the user requirements to create novel products and solutions for the real time problems.

Course Outcomes:

1. Familiarize with the instruction set of 8086.
2. Write programs for given task using different addressing modes.
3. Interface various I/O devices using 8255 PPI and 8051.
4. Understand the instruction set of 8051 and its application.
5. Write the assembly language programs of microcontroller for a given

LIST OF PROGRAMS:

8085 assembly language programs:

1. Programs to transfer data from one memory location to another location.
2. Signed/unsigned addition, subtraction, multiplication, and division.
3. Finding average, largest, square root, etc.,
4. Sorting set of numbers.
5. Code conversion like BCD numbers into binary.
6. 8255 PPI for interfacing LEDs.
7. 8255 PPI for interfacing to generate triangular wave using DAC.

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8051 assembly language programs:

1. Data transfer – block move, exchange, sorting, finding largest element in array.
2. Arithmetic instructions: addition, subtraction, multiplication, and division.
3. Boolean & logical instructions (Bit manipulations).
4. Programs to generate delay, programs using serial port and on chip timer/counter.
5. Use of JUMP and CALL instructions.
6. Square wave generation using timers.
7. Interfacing of keyboard and 7-segment display module.
8. DAC interfacing for generation of sinusoidal wave.

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Course Code	Course Title						Course Type
PC 551 EE	POWER ELECTRONICS LAB						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	2	3	20	30	1

Course Objectives:

- To be able to understand R, RC and UJT firing circuits.
- To be able to understand choppers and Rectifiers.
- To be able to understand PWM methods for single phase inverters.
- To be able to understand AC voltage controllers and Cycloconverters.
- To be able to understand various converters through simulation.

Course Outcomes:

1. To analyze R, RC and UJT firing circuits through experiment.
2. To analyze Choppers and Rectifiers through experiment.
3. To analyze PWM methods for single phase inverters through experiment.
4. To analyze AC voltage controllers and Cyclo converters through experiment.
5. To analyze various converters through simulation.

Any eight experiments should be conducted

1. Study of Characteristics of SCR, MOSFET & IGBT,
2. Gate firing circuits for SCR's
3. Single Phase AC Voltage Controller with R and RL Loads
4. Single Phase half controlled &fully controlled bridge converter with R and RL loads
5. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E)
6. Single Phase Cyclo-converter with R and RL loads
7. Single Phase series& parallel inverter with R and RL loads
8. Single Phase Bridge inverter with R and RL load

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Course Code	Course Title						Course Type
PC 551 EE	POWER ELECTRONICS LAB						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	2	3	20	30	1

Course Objectives:

- **To be able to understand R, RC and UJT firing circuits.**
- **To be able to understand choppers and Rectifiers.**
- **To be able to understand PWM methods for single phase inverters.**
- **To be able to understand AC voltage controllers and Cycloconverters.**
- **To be able to understand various converters through simulation.**

Course Outcomes:

1. **To analyze R, RC and UJT firing circuits through experiment.**
2. **To analyze Choppers and Rectifiers through experiment.**
3. **To analyze PWM methods for single phase inverters through experiment.**
4. **To analyze AC voltage controllers and Cyclo converters through experiment.**
5. **To analyze various converters through simulation.**

Any eight experiments should be conducted

1. Study of Characteristics of SCR, MOSFET & IGBT,
2. Gate firing circuits for SCR's
3. Single Phase AC Voltage Controller with R and RL Loads
4. Single Phase half controlled &fully controlled bridge converter with R and RL loads
5. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E)
6. Single Phase Cyclo-converter with R and RL loads
7. Single Phase series& parallel inverter with R and RL loads
8. Single Phase Bridge inverter with R and RL load

Any two experiments should be conducted

1. DC Jones chopper with R and RL Loads
2. Three Phase half-controlled bridge converter with R-load
3. Single Phase dual converter with RL loads

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Any two experiments should be conducted

1. DC Jones chopper with R and RL Loads
2. Three Phase half-controlled bridge converter with R-load
3. Single Phase dual converter with RL loads
4. (a)Simulation of single-phase Half wave converter using R and RL loads (b)Simulation of single-phase full converter using R, RL and RLE loads (c)Simulation of single-phase Semi converter using R, RL and RLE loads
5. (a)Simulation of Single-phase AC voltage controller using R and RL loads (b)Simulation of Single phase Cyclo-converter with R and RL-loads
6. Simulation of Buck chopper
7. Simulation of single-phase Inverter with PWM control
8. Simulation of three phase fully controlled converter with R and RL loads, with and without freewheeling diode. Observation of waveforms for Continuous and Discontinuous modes of operation.
9. Study of PWM techniques

Suggested Learning

1. M. H. Rashid, Simulation of Electric and Electronic circuits using PSPICE – by M/s PHI Publications.
2. User's manual of related software's

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Mahatma Gandhi University

Scheme of Instruction
Evaluation

For Four year B.Tech program
In Electrical & Electronics Engineering
With effect from Academic Year 2023-24

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING & TECHNOLOGY

MAHATMA GANDHI UNIVERSITY

Nalgonda – 508 001, TS, INDIA

SCHEME OF INSTRUCTION AND EVALUATION

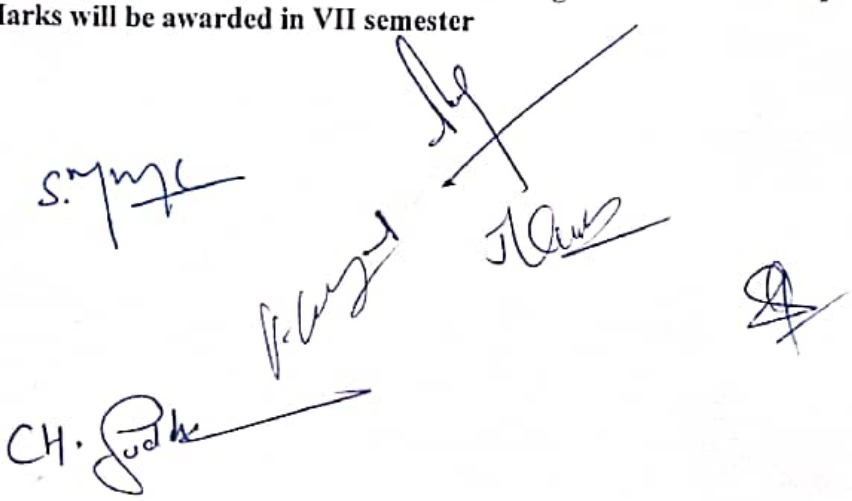
B.Tech (Electrical and Electronics Engineering) w.e.f. 2025-26

VI SEM

S.No	Code	Course Title	Scheme of Instruction			Contact Hrs/ Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	PC 601 EE	Utilization of Electrical Energy	3	-	-	3	3	30	45	3
2	PC 602 EE	Hybrid Electric Vehicles	3	-	-	3	3	30	45	3
3	PC 603 EE	Digital Signal Processing & Application	3	-	-	3	3	30	45	3
4	HS601MGT	Managerial Economics & Accountancy	3	-	-	3	3	30	45	3
5	Professional Elective II		3	-	-	3	3	30	45	3
	PE 621 EE	Electrical Energy Conservation & Auditing								
	PE 622 EE	IoT Applications in Electrical Engineering								
	PE 623 EE	Programmable Logic Controllers								
6	Open Elective I		3	-	-	3	3	30	45	3
	OE 601 EC	Electronic Instrumentation								
	OE 602 EC	Principles Of Electronic Communication Systems								
	OE 603 CS	Machine Learning								
	OE 604 CS	Basics of Python Programming								
	OE 605 ME	Material Handling								
	OE 606 EE	Electrical Safety Management								
	OE 607 EE	Applications of Electrical Energy								

PRACTICALS										
7.	PC 651 EE	Electrical Measurements Lab	-	-	2	2	3	20	30	1
8.	PC 652 EE	Control Systems Lab	-	-	2	2	3	20	30	1
9	PW 651 EE	Mini Project	-	-	4	4	-	50	-	2
TOTAL			18		8	29	27	270	330	22

Note:At the end of VI semester students should undergo summer internship during summer vacation.Marks will be awarded in VII semester



Course Code	Course Title						Course Type
PC 601 EE	UTILIZATION OF ELECTRICAL ENERGY						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To introduce the students and understand Utilization of electrical energy for various applications like industrial heating, welding etc
- To understand various types of control circuits for three phase induction motors.
- To understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
- To understand the basic principle of electric traction including speed-time curves of different traction services.
- To understand systems of train lighting and also various types of batteries.

Course Outcomes:

1. Identify a suitable heating/welding scheme for a given application.
2. Design control circuits for the reliable operation of three phase induction motors.
3. Classify types of electric light sources based on nature of operation and their objectives, performance and reliability.
4. Determine the speed-time characteristics of various traction services and also estimate the energy consumption levels at various modes of operation.
5. Select proper train lighting scheme according to the requirement and analyze various batteries.

UNIT - I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens, Design of heating element. High frequency heating, Induction Heating, Induction furnaces, Core type, Coreless furnaces, Dielectric heating. Electric Arc furnaces, Direct Arc furnace, Indirect Arc furnaces.

Electric Welding: Classification of Electric welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

UNIT - II

Schematic Utilization and Connection Diagrams for Motor Control: Two supply sources for 3 phase Induction motors. Direct reversing, remote control operation, and jogging operating of Induction motor. Contactor control circuit. Push button control stations. Over load relays, limit switches, float switches. Interlocking methods for reversing control.

CH. Sudha S.M.M.L

UNIT-III

Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inverse square law and cosine law, Solid angle, Lighting calculations, Determination of M.S.C.P, Rousseau"s construction, Discharge lamps, Sodium vapour and Mercury vapour lamps, LED lamps, Fluorescent lamps, Starting and power factor corrections, Stroboscopic effects, Neon signs.

UNIT- IV

Electric Traction: System of Electric Traction, Transmission of drive, Systems of track electrification, Traction mechanics, Speed time curves, Tractive effort, Power of Traction motor, Specific energy consumption, Mechanics of train movement, Coefficient of adhesion.

Traction Motors: Desirable characteristics, DC series motors, AC series motors 3-phase induction motors.

UNIT-V

Train Lighting: Systems of train lighting, Special requirements of train lighting, Methods of obtaining unidirectional polarity, Methods of obtaining constant output, Single battery system, Double battery parallel block system, Principal equipment of double battery system, Coach wiring, Dynamo.

Suggested Reading:

1. Partab H, Art and Science of Utilization of Electric Power, Dhanpat Rai & Sons, 1997.
2. K.B. Raina & S.K. Bhattacharya, Electrical Design, Estimatingand Costing, Wiley Eastern Ltd., 1991.
3. Partab H, Modern Electric Traction, Dhanpat Rai & Sons, 2000.
4. B.L.Theraja, A Text Book of Electrical Technology, S.Chand& Company Ltd, Vol-I.

Course Code	Course Title					Course Type
PC 602EE	HYBRID ELECTRIC VEHICLES					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To understand the basics of electric and hybrid electric vehicles and their working
- To understand the basics of batteries and their role for electric/hybrid vehicle applications
- To obtain the knowledge of various types of electric/hybrid vehicles
- To understand the real time challenges in the implementation of this technology
- To understand the concepts and methods of power transmission in hybrid and electrical vehicle.

Course Outcomes:

1. Understand basics of electric and hybrid electric vehicles both conceptually and mathematically so that clear understanding from basics physics is achieved.
2. Have the knowledge of battery behavior for electric vehicle application.
3. Understand different types of Electric/Hybrid vehicles technologies available and their applications.
4. Analyze challenges in implementing electric/hybrid vehicle technology by looking into various charging topologies and their impact on distribution systems.
5. Analyze various electric drives suitable for hybrid electric vehicles.

UNIT- I

Introduction to Electric Vehicles: Sustainable Transportation - EV System – EV - Advantages - Vehicle Mechanics - Performance of EVs - Electric Vehicle drive train - EV Transmission Configurations and components-Tractive Effort in Normal Driving - Energy Consumption .

UNIT-II

Electric Vehicle Modelling - Consideration of Rolling Resistance – Transmission Efficiency - Consideration of Vehicle Mass - Tractive Effort - Modelling Vehicle Acceleration - Modelling Electric Vehicle Range -Aerodynamic Considerations - EV Motor Sizing .

UNIT- III

Introduction to electric vehicle batteries - electric vehicle battery efficiency – electric vehicle battery capacity - electric vehicle battery charging - electric vehicle battery fast charging - electric vehicle battery discharging - electric vehicle battery performance .

CH. Rudd S.M.M.K

UNIT-IV

Hybrid Electric Vehicles - HEV Fundamentals -Architectures of HEVs- Interdisciplinary Nature of HEVs - State of the Art of HEVs - Advantages and Disadvantages - Challenges and Key Technology of HEVs - Concept of Hybridization of the Automobile-Plug-in Hybrid Electric Vehicles - Design and Control Principles of Plug-In Hybrid Electric Vehicles - Fuel Cell Hybrid Electric Drive Train Design .

UNIT-V

EV Charging - Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles
Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks – Sizing Ultra capacitors for Hybrid Electric Vehicles.

Suggested Reading:

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles –Fundamentals, Theory and Design – Mehrdad Ehsani, UiminGao and Ali Emadi - Third Edition - CRC Press, 2014.
2. Electric Vehicle Technology Explained - James Larminie, John Lowry – John Wiley & Sons Ltd, - 2003.
3. Electric Vehicle Battery Systems – Sandeep Dhameja – Newnes - 2012.
4. Hybrid electric Vehicles Principles and applications with practical perspectives Chris Mi, Dearborn - M. AbulMasrur, David WenzhongGao - A John Wiley & Sons, Ltd., - 2011.
5. Electric & Hybrid Vehicles – Design Fundamentals-Iqbal Hussain, Second Edition, CRC Press, 2011.

Research Papers:

1. The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks: a Review and Outlook - Robert C. Green II, Lingfeng Wang andMansoorAlam - 2010 IEEE.
2. Sizing Ultracapacitors For Hybrid Electric Vehicles - H. Douglas P Pillay 2005 IEEE
3. Review of battery charger,topologies,charging power levels and infrastructure for plug in electric and electric vehicles", M.Vilmaz and P.T.Krien,IEEE Transactions on power electronics,vol 29,no.5,pp-2151-2169,may 2023

Course Code	Course Title					Course Type
PC 603EE	Digital Signal Processing & Application					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To understand processing in frequency domain with DFT and FFT
- To understand the characteristics of IIR digital filters.
- To understand the Characteristics of FIR digital filters.
- To study the digital signal processor TMS 320LF2407 architecture and instruction set.
- To understand functioning of the on-chip peripherals of TMS320LF2407 such as GPIO, interrupts.

Course Outcomes:

1. Obtain the frequency spectrum of discrete time signals using FFT.
2. Analyze and Design IIR digital filters
3. Analyze and Design FIR digital filters
4. Understand the functioning of Digital Signal Processor TMS320LF2407 and familiarize with the instruction set of TMS320C2xx processor.
5. Understand functioning of the on-chip peripherals of TMS320LF2407 such as GPIO, interrupts.

UNIT - I

Review of discrete time signals and systems, Review of Discrete time Fourier transform (DTFT) DFS, Properties- Frequency domain sampling DFT, Properties - circular convolution - Fast Fourier transforms (FFT) - Radix-2 decimation in time (DIT) and decimation in frequency (DIF) FFT Algorithms, IDFT using FFT.

UNIT - II

IIR digital filters: Analog filter approximations - Butterworth and Chebyshev filters - Design of IIR Digital filters from analog filters using Bilinear transformation, Impulse invariant and step invariant methods. Realization of IIR filters - Direct form - I, Direct form - II, Cascade and parallel form realizations

UNIT-III

FIR digital filters: Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital filters using window techniques, Linear phase realization.
Multirate signal processing: Decimation, Interpolation, Sampling rate conversion, Implementation of sampling rate conversion.

4. (a)Simulation of single-phase Half wave converter using R and RL loads (b)Simulation of single-phase full converter using R, RL and RLE loads (c)Simulation of single-phase Semi converter using R, RL and RLE loads
5. (a)Simulation of Single-phase AC voltage controller using R and RL loads (b)Simulation of Single phase Cyclo-converter with R and RL-loads
6. Simulation of Buck chopper
7. Simulation of single-phase Inverter with PWM control
8. Simulation of three phase fully controlled converter with R and RL loads, with and without freewheeling diode. Observation of waveforms for Continuous and Discontinuous modes of operation.
9. Study of PWM techniques

Suggested Reading

1. M. H. Rashid, Simulation of Electric and Electronic circuits using PSPICE – by M/s PHI Publications.
2. User's manual of related software's

UNIT- IV

TMS320LF2407 DSP Controller: Introduction, brief introduction to peripherals, types of physical memory, software tools.
TMS320C2XX DSP CPU and instruction set: TMS320C2xx DSP architecture, Memory, Addressing modes, Instruction set.

UNIT-V

GPIO functionality: Pin multiplexing (MUX) and GPIO Overview, multiplexing and GPIO control registers.
Interrupts on the TMS320LF2407: Introduction, Interrupt Hierarchy and its Control Registers.

Suggested Reading:

1. Proakis & Manolakis - Digital Signal Processing, Principles, Algorithms and Applications, Prentice Hall of India - 3rd Edition-1994.
2. Opeinheim & Schaffter - Digital Signal Processing, PHI Publications, 2002.
3. Salivahanan Valluaraj & Gnanapriya - Digital Signal Processing- Tata McGraw Hill, 2001.
4. Anand Kumar.A - Digital Signal Processing - PHI learning Private Ltd. 2013.
5. Hamid A Toliyat, DSP based Electromechanical Motion Control, Steven Campbell 2004, CRC Press.

Course Code	Course Title					Course Type
MGT 604 HS	Managerial Economics & Accountancy					HUMANITIES
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To learn important concepts of Managerial Economics and apply them to evaluate business decisions.
- To understand various parameters that determaine consumers' behaviour.
- To evaluate factors that affect production.
- To understand the concept of capital budgeting and payback period.
- To study the concept of various book-keeping methods.

Course Outcomes:

1. Demonstrate the ability to apply fundamental concepts of Managerial Economics to analyze and assess business decisions, considering economic principles and their implications .
2. Gain insights into the diverse factors influencing consumers' behaviour and decision making processes, allowing the evaluation of market demand and consumer preferences.
3. Assess the multiple determinants impacting production processes including resource allocation,technology and costs,enabling effective management decisions.
4. Understand and apply concepts related to capital budgeting,including the computation and analysis of payback periods,aiding in effective investment decision making.
5. Acquire the knowledge of various book keeping methods,comprehending their significance and application in financial record keeping and analysis for informed business decisions.

UNIT I

Meaning and Nature of Managerial Economics: Managerial Economics and its usefulness to Engineers,Fundamental Concepts of Managerial Economics-Scarcity, Marginalism Equimarginalism, Opportunity costs, Discounting, Time Perspective, Risk and Uncertainty, Profits, Case study method.

UNIT II

Consumer Behavior: Law of Demand, Determinants, Types of Demand; Elasticity of Demand (Price, Income and Cross-Elasticity); Demand Forecasting, Law of Supply and Concept of Equilibrium.

UNIT III

Theory of Production and Markets: Production Function, Law of Variable Proportion, ISO quants, Economics of Scale, Cost of Production (Types and their measurement), Concept of Opportunity Cost, Concept of Revenue, Cost-Output relationship, Break-Even Analysis, Price – Output determination underPerfect Competition and Monopoly .

UNIT IV

Capital Management: Significance, determination and estimation of fixed and working capital requirements, sources of capital, Introduction to capital budgeting, methods of payback and discounted cash flow methods with problems.

UNIT V

Book-keeping: Principles and significance of double entry book keeping, Journal, Subsidiary books, Ledger accounts, Trial Balance, concept and preparation of Final Accounts with simple adjustments Analysis and interpretation of Financial Statements through Ratios.

Suggested Reading:

1. Mehta P.L., Managerial Economics —Analysis, Problems and Cases , Sulthan Chand & Sons Educational Publishers, 2011.
2. Maheswari S.N. , introduction to accountancy ,Vikas Publishing House,2005.
3. Pandey I.M ,Financial Management, Vikas Publishing House,2005.

Course Code	Course Title						Course Type
PE 621 EE	ELECTRICAL ENERGY CONSERVATION AND AUDITING (PROFESSIONAL ELECTIVE II)						ELECTIVE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To understand the current energy scenario and importance of energy conservation.
- To understand the concepts of energy management.
- To understand the methods of improving energy efficiency in different electrical systems.
- To understand the concepts of different energy efficient devices.

Course Outcomes:

1. Identify the demand supply gap of energy in Indian scenario.
2. Analyze the concepts of energy management.
3. Draw the process flow and energy balance diagrams of energy facilities.
4. Select appropriate energy conservation method to reduce the wastage of energy.

UNIT - I

Energy Scenario: Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy security, energy conservation and its importance. Sankey diagram. Energy Conservation Act- 2001 and its features.

UNIT - II

Basics of Energy and its various forms: Potential energy, Chemical energy, Nuclear energy, Storage energy, Mechanical energy, Gravitational energy, Kinetic energy, Radiant energy, Thermal energy, Sound energy and Electrical energy. Work Energy and Power. Direct current, Alternating current, Power factor, Electrical energy, Energy units and conservation.

UNIT-III

Energy Management & Audit: Definition, energy audit, need, types of energy audit – Preliminary energy audit, Targeted energy audit, Detailed energy audit, Post audit phase, format for energy conservation recommendations. Methodology for conducting detailed energy audit. Energy audit process flow diagram. Economic feasibility. Energy audit report.

UNIT- IV

Energy Efficiency in Electrical Systems: Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

UNIT-V

Energy Efficiency in Electrical Utilities: Electrical system, Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses.

Suggested Reading:

1. Guide books for National Certification Examination for Energy Manager / Energy AuditorsBook-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy AuditorsBook-3, Electrical Utilities (available online)
3. S. C. Tripathy, —Utilization of Electrical Energy and Conservationl, McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Course Code	Course Title					Course Type
PE 622 EE	IoT APPLICATIONS IN ELECTRICAL ENGINEERING (PROFESSIONAL ELECTIVE II)					ELECTIVE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To learn about a few applications of Internet of Things.
- To distinguish between motion less and motion detectors as LOT applications.
- To know about Micro Electro Mechanical Systems (MEMS) fundamentals in design.
- To understand about applications of IOT in smart grid.
- To introduce the new concept of Internet of Energy for various applications

Course Outcomes:

1. To get exposed to recent trends in few applications of IoT in Electrical Engineering.
2. To understand about usage of various types of motionless sensors.
3. To understand about usage of various types of motion detectors.
4. To get exposed to various applications of IoT in smart grid.
5. To get exposed to future working environment with Energy Internet.

UNIT - I

Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric

UNIT - II

Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors Resistive microphones, Piezoelectric, Photo resistors.

UNIT-III

Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors

UNIT- IV

IoT for smart grid: Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home

UNIT-V

IOE-Internet of energy: Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IOE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid.

Suggested Reading:

1. Jon S. Wilson, Sensor Technology Hand book, Newnes Publisher, 2004
2. Tai Ran Hsu, MEMS and Microsystems: Design and manufacture, 1st Edition, Mc Grawhill
3. ErsanKabalci and YasinKabalci, From Smart grid to Internet of Energy, 1st Edition
4. Raj Kumar Buyya and Amir VahidDastjerdi, Internet of Things: Principles and Paradigms, Kindle Edition, Morgan Kaufmann Publisher, 2016
5. Yen Kheng Tan and Mark Wong, Energy Harvesting Systems for IoT applications: Generation, Storage and Power Management, 1st Edition, cRC Press, 2019.
6. RMD SundaramShriram, K. Vasudevan and Abhishek S. Nagarajan, Internet of Things, Wiley, 2019

Course Code	Course Title					Course Type
PE 623 EE	PROGRAMMABLE LOGIC CONTROLLERS (PROFESSIONAL ELECTIVE II)					ELECTIVE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To provide the knowledge of different components used in PLCs such as processor, input/output devices and programmer monitors.
- To make the students thorough with ladder programming of PLC.
- To train them how to use timer, counter, register, arithmetic and different conversion systems.
- To give awareness about application of different PLC features in Process control industry.
- To explain the students about different data handling functions of PLC.

Course Outcomes:

1. Understand different components of PLC.
2. Will be able to construct ladder diagrams for different industry applications.
3. Deal with applications like timer/counter, registers etc.
4. Understand the utility of different features of PLC in process industry.
5. Use data handling function in PLC programming.

UNIT - I

PLC Basics: Definition and History of PLC - PLC advantages and disadvantages - Over all PLC Systems - CPUs and Programmer Monitors - PLC input and output models - Printing PLC Information- Programming Procedures - Programming Equipment - Programming Formats- Proper Construction of PLC Diagrams - Devices to which PLC input and output modules are connected - Input on/off switching devices - Input analog devices - Output analog on/off devices and output analog devices.

UNIT - II

Basic PLC Programming: Programming on/off inputs to produce on/off outputs - PLC input instructions - Outputs - Operational procedures - Contact and coil input/output programming examples - Relation of digital gate logic contact / coil logic - PLC programming and conversion examples - Creating ladder diagrams from process control descriptions - Sequence listings - Large process ladder diagram constructions.

UNIT-III

Basic PLC Functions: General Characteristics of Registers - Module addressing - Holding registers - Input registers - output registers - PLC timer functions - examples of timer functions. Industrial applications - PLC counter functions.

UNIT- IV

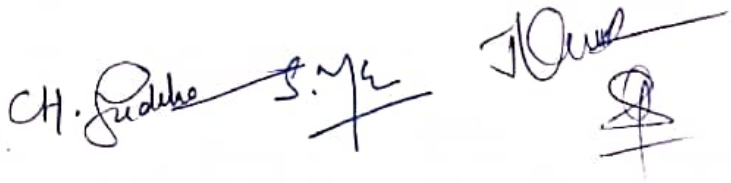
Intermediate Functions: PLC Arithmetic functions - PLC additions and subtractions - The PLC repetitive clock - PLC Multiplications, Division and Square Root - PLC trigonometric and log functions - Other PLC arithmetic functions - PLC number comparison functions. PLC basic comparison functions and applications - Numbering systems and number conversion functions - PLC conversion between decimal and BCD-Hexadecimals numbering systems.

UNIT-V

Data Handling Functions: The PLC skip and master control relay functions - Jump functions - Jump with non return - Jump with return. PLC data move Systems - The PLC functions and applications. PLC functions working with bits - PLC digital bit functions and applications - PLC sequence functions - PLC matrix functions.

Suggested Reading:

1. John W. Weff, Ronald A. Reis, Programmable Logic Controllers, Prentice Hall of India Private Limited, Fifth edition, 2003.



Course Code	Course Title						Course Type
OE 601 EC	ELECTRONIC INSTRUMENTATION (Open Elective-I)						OPEN ELECTIVE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To familiarize with various measurement parameters and Standards of measurement devices
- To learn the design principles of Ammeters, Voltmeters and Ohmmeters.
- To understand the operation and application of CRO.
- To understand the operation of various transducers.
- To understand the working principles and applications of Signal generators and Wave analyzers.

Course Outcomes:

1. Analyze the various characteristics of measurement parameters
2. Able to design various ranges of Ammeters, Voltmeters and Ohmmeters.
3. Use the CROs for various applications and explore its features.
4. Explore various types of Transducers and their characteristics.
5. Analyze the operation of various Signal generators and Wave analyzers.

UNIT- I

Measurement Parameters: Introduction of measurement system. Performance characteristics of Instruments, Static and Dynamic Characteristics. Error in Measurement, Types of Errors, Statistical analysis of errors, Limiting errors, Standards of measurement, Fundamental and Derived Units, Systems of Units, International System of Units.

UNIT-II

Voltmeters, Ammeters and Ohmmeters: Basic meter movement, Permanent Magnet Moving Coil movement, D"Arsonval movement, DC Ammeters, Ayrton Shunt, DC Voltmeters, Multi range Voltmeter, Voltmeter Sensitivity, Loading effect, Series- type Ohmmeter, Shunt-type Ohmmeter, Digital Voltmeters, Ramp type, Staircase-Ramp type, Successive approximation type, Dual- slope type (Qualitative treatment only)

UNIT- III

CRO: Basic Principle of CRT, its features, Block diagram and operation of CRO, Oscilloscope Controls, Waveform display, Measurement of frequency and Phase using Lissajous method, Applications and Advantages of CRO, Types of CRO: Dual Beam CRO, Dual Trace CRO, Sampling Oscilloscope, Storage Oscilloscope, Digital storage Oscilloscope.

UNIT- IV

Transducers: Introduction, Electrical Transducer, Factors for Selecting a Transducer, Active and Passive Transducers, Operation and applications of Resistive transducers, Strain gauges, Temperature Measurement: Thermistors, Thermocouple, Thermometer, Inductive transducers, LVDT and RVDT, Capacitive transducers, Piezo-electric Transducers and Photo- electric transducers.

UNIT-V

Signal Generators and Wave analyzers: Basic standard signal generator, Fixed and Variable AF Oscillator, AF Sine and Square wave generator, Function generator, Pulse generator, Sweep Frequency generator, Wave Analyzers, Heterodyne wave analyzer, Harmonic distortion analyzer, Spectrum analyzer (Qualitative treatment only).

Suggested Reading:

1. Albert D.Helfrick and William D.Cooper, "*Modern Electronic Instrumentation andMeasurement Techniques*", Prentice-Hall of India Private Limited, New Delhi, 1996.
2. H S Kalsi, "*Electronic Instrumentation*", *Tata* McGraw-Hill Company Limited, NewDelhi, 2004.
3. David A.Bell, "*Electronic Instrumentation and Measurements*", 2nd Edition, Prentice-Hall of India Private Limited, New Delhi, 1994.

Course Code	Course Title						Course Type
OE 602 EC	PRINCIPLES OF ELECTRONIC COMMUNICATION SYSTEMS (Open Elective-I)						OPEN ELECTIVE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives :

1. Provide an introduction to fundamental concepts in the understanding of Electronic communications systems
2. Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer
3. Provide an introduction to the evolution of wireless systems and current wireless technologies
4. Provide an introduction to fundamental concepts in the understanding of Telecommunication and optical communications systems
6. Provide an introduction to fundamental concepts in Analog and Digital Communications

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

1. Understand the working of analog and digital communication systems.
2. Understand the Data Communication and Networking
3. Understand the concepts of modulation and demodulations Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems
4. Understand the principles of optical communications systems

UNIT – I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels, Signal Transmission Concepts-Baseband transmission and Broadband transmission,Communication parameters-Transmitted power, Channel bandwidth and Noise, Need for modulation Signal Radiation and Propagation-Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT – II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK,Digital demodulation.

UNIT – III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – MediaAccess control, Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP,UDP

UNIT – IV

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony. Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables,Optical Transmitters & Receivers, Wavelength Division Multiplexing

UNIT – V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, And OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Readings:

1. Kennady, Davis, "***Electronic Communications systems***", 4e, TMH, 1999.

References:

1. Louis E. Frenzel, "***Principles of Electronic Communication Systems***", 3e, McGraw Hill publications, 2008.
2. Behrouz A. Forouzan,"***Data Communications and Networking***", 5e TMH, 2012.

Course Code	Course Title						Course Type
OE 603 CS	MACHINE LEARNING (Open Elective-I)						OE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives :

1. To introduce the basic concepts of machine learning and range of problems that can be handled by machine learning
2. To introduce the concepts of instancebased learning and decision tree induction
3. To introduce the concepts of linear separability, Perceptron and SVM
4. To learn the concepts of probabilistic inference, graphical models and evolutionary learning
5. To learn the concepts of ensemble learning, dimensionality reduction and Clustering

Course Outcomes :

On completion of this course, the student will be able to :

1. Explain strengths and weakness of different machine learning techniques
2. Select suitable model parameter for different machine learning technique
3. Design & implement various machine learning algorithms to a wide range of real world applications
4. Evaluate available learning methods to develop the research based solutions in different domains.

UNIT – I

Introduction: Learning, Types of Machine Learning, Machine Learning Examples , Decision Tree Learning
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm.
Learning with Trees: Decision Tree Learning, the Big Picture
Linear Discriminants: Learning Linear Separators , The Perceptron Algorithm , Margins

UNIT – II

Estimating Probabilities from Data, Bayes Rule, MLE, MAP
Naive Bayes: Conditional Independence, Naive Bayes: Why and How, Bag of Words Logistic Regression : Maximizing Conditional likelihood , Gradient Descent Kernels: Kernalization Algorithm, Kernalizing Perceptron,
Discriminants: The Perceptron, Linear Separability, Linear Regression
Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back Propagation.

UNIT– III

Support Vector Machines: Geometric margins, Primal and Dual Forms, Kernalizing SVM Generalization & Overfitting: Sample Complexity, Finite Hypothesis classes, VC Dimension Based Bounds

Some Basic Statistics: Averages, Variance and Covariance, The Gaussian, The Bias-Variance Tradeoff Bayesian learning: Introduction, Bayes theorem, Bayes Optimal Classifier, Naive Bayes Classifier.

Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm.

UNIT – IV

Model Selection & Regularization: Structural Risk Minimization, Regularization, k-Fold Cross validation

Linear Regression: Linear regression, minimizing squared error and maximizing data Likelihood

Neural Networks: Back Propagation,

Deep Neural Networks: Convolution, Convolution Neural Networks, LeNet-5 architecture

Boosting: Boosting Accuracy, Ada Boosting, Bagging

UNIT –V

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison.

Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis Interactive Learning: Active Learning, Active Learning, Common heuristics, Sampling bias , Safe Disagreement Based Active Learning Schemes

Semi-Supervised Learning: Semi-supervised Learning, Transductive SVM, Co-training

Reinforcement Learning: Markov Decision Processes, Value Iteration, Q-Learning

Suggested Reading:

1. Tom M. Mitchell, Machine Learning, Mc Graw Hill, 1997
2. Chistopher Bishop, Pattern recognition & Machine Learning, Springer 2006.
3. Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009.
4. Margaret H Dunham, Data Mining, Pearson Edition., 2003.
5. Margaret H Dunham, Data Mining, Pearson Edition., 2003.
6. Galit Shmueli, Nitin R Patel, Peter C Bruce, Data Mining for Business Intelligence, Wiley India Edition, 2007
7. Rajjan Shinghal, Pattern Recognition, Oxford University Press, 2006.

Course Code	Course Title						Course Type
OE 604 CS	BASICS OF PYTHON PROGRAMMING (Open Elective-I)						OPEN ELECTIVE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives :

1. To know the basics of Programming.
1. To convert an algorithm into a Python program.
2. To construct Python programs with control structures.
3. To structure a Python Program as a set of function.
4. To use Python data structures-lists, tuples, dictionaries.

Course Outcomes:

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Develop simple Python programs for solving problems.
4. Structure a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries.

UNIT – I

Introduction to Computing and Problem Solving: Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions –Algorithms Building Blocks of Algorithms.

Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output,Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: The if, The if...else, The if...elif...else Decision Control Statements,Nested if Statement, The while Loop, The for Loop, The continue and break Statements.

UNIT – II

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Charactersin String byIndex Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters;

Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort,histogram.

UNIT – III

Files and Exception: Text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs:word count, copy file. Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

UNIT – IV

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance The Polymorphism.

Functional Programming: Lambda. Iterators, Generators, List Comprehensions

UNIT – V

GUI Programming: Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

Suggested Readings:

1. Gowrishankar S., Veena A, "***Introduction to Python Programming***", CRC Press, Taylor &Francis Group, 2019.

References:

1. Richard L. Halterman, "***Learning To Program With Python***", Copyright © 2011.
2. Dr. Charles R, "***Python for Everybody, Exploring Data Using Python 3***", Severance. 2016.

Course Code	Course Title						Course Type
OE 605 ME	MATERIAL HANDLING (Open Elective-I)						OPEN ELECTIVE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To know about the working principle of various material handling equipments
- To understand the Material handling relates to the loading, unloading and movement of all types of materials
- To understand the estimation of storage space and maintenance of material handling equipments

Course outcomes

1. Able to understand various conveying systems that available in industry
2. Able to understand various bulk solids handling systems and their design features
3. Able to understand and various modern material handling systems and their integration.
4. Able to calculate number of MH systems required, storage space, cost and maintenance

UNIT I

Mechanical Handling Systems: Belt Conveyors and Desing, Bucket Elevators, Package conveyors, Chain and Flight Conveyors, Screw Conveyors, Cranes and Hoists.

UNIT II

Pneumatic and Hydraulic Conveying Systems: Modes of Conveying and High pressure conveying systems, Low Velocity Conveying System. Components of Pneumatic Conveying Systems: General Requirements, Fans and Blowers, Boots-Type Blowers, Sliding-Vane Rotary Compressors, Screw Compressors, Reciprocating Compressors, Vacuum Pumps.

UNIT III

Bulk Solids Handling: Particle and Bulk Properties. Adhesion, Cohesion and Moisture Content. Gravity Flow of Bulk Solids: Static and Dynamic Pressure Distribution in Bulk Solids. Modes of Flow: Mass Flow, Funnel Flow and Expanded Flow from Hoppers, Bins and Silos.

UNIT IV

Modern Material Handling Systems: Constructional features of (i) AGV (ii) Automated storage and retrieval systems. Sensors used in AGVs and ASRS. Bar code systems and RFID systems: Fundamentals and their integration with computer-based information systems.

UNIT V

Total MH Throughput: Calculation for no. of MH systems; storage space estimation based on no of aisles. Maintenance of MH equipment, spare parts management, cost of materials handling, cost per unit load computations.

Suggested reading:

1. Dr. Mahesh Varma, "Construction Equipment and its Planning & Application", Metropolitan Book Co.(P) Ltd., New Delhi, India 1997.
2. James M. Apple, "Material Handling Systems Design", The Ronald Press Company, New York, USA, 1972.
3. Woodcock CR. and Mason J.S., "Bulk Solids Handling: An Introduction to Practice Technology", Leonard Hill USA, Chapman and Hall, New York.
4. M P Groover et al, "Industrial Robotics", Mc Graw Hill, 1999

Course Code	Course Title					Course Type
OE 606 EE	ELECTRICAL SAFETY MANAGEMENT (Open Elective-I)					OPEN ELECTIVE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives :

- Understand electrical safety measures, the hazards associated with electric current, and voltage identify different types of electrical shocks
- Understand installation work of electrical plant and equipment. Safety during installation of outdoor switchyard equipment, safety during installation of electrical rotating machines.
- Understand procedure of domestic wirings, to handle different domestic electrical appliances, Procedure of Agricultural pump installation
- Identifies different hazardous zones, classification of equipment enclosure for various hazardous gases, importance of earthing system. Understand Management Safety Policy
- Understand standards on electrical safety, different IE Rules and Acts

Course Outcomes :

1. Explain the objectives and precautions of Electrical safety, effects of shocks and their prevention.
2. Summarize the safety aspects during installation of plant and equipment.
3. Describe the electrical safety in residential, commercial and agricultural installations.
4. Describe the various Electrical safety in hazardous areas, Equipment earthing and system neutral earthing.
5. State the electrical systems safety management and IE rules.

UNIT – I

INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION:

Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

UNIT – II

SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT:

Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a

large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

UNIT-III

ELECTRICAL SAFETY IN RESIDENTIAL,COMMERCIAL AND AGRICULTURAL INSTALLATIONS: Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT-IV

ELECTRICAL SAFETY IN HAZARDOUS AREAS: Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipment for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

UNIT-V

SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.

REVIEW OF IE RULES AND ACTS AND THEIR SIGNIFICANCE:

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and firefighting facility.
The Electricity Act, 2003, (Part1, 2, 3, 4 & 5).

Suggested Readings:

Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.

Course Code	Course Title					Course Type
OE 607 EE	APPLICATIONS OF ELECTRICAL ENERGY (Open Elective-I)					OPEN ELECTIVE
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	30	45	3

Course Objectives:

- To introduce the students and understand Utilization of electrical energy for various
- applications like industrial heating.
- To understand various techniques of electric welding and types of batteries.
- To understand the concept of illumination and study about the laws of illumination
- To know the applications of various lamps to factory lighting, street lighting etc.
- To understand the concept of electric traction including speed – time curves of different
- traction services.

Course Outcomes:

1. Identify a suitable heating scheme for a given application
2. Identify proper welding technique and various characteristics of batteries
3. Study the nature and production of light and laws related to illumination
4. Classify types of electric light sources based on nature and operation and their objectives,
5. performance and reliability
6. Determine the speed-time characteristics of various traction services and also estimate the
7. energy consumption levels at various modes of operation

UNIT I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens, Design of heating element. High frequency heating, Induction Heating, Induction furnaces, Core type, Coreless furnaces, Dielectric heating. Electric Arc furnaces,Direct Arc furnace, Indirect Arc furnaces.

UNIT II

Electric welding: Classification of electric welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

Batteries: Lead acid batteries, SMF batteries, Construction and maintenance, Charging and rating of batteries.

UNIT III

Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inverse square law and cosine law, Solid angle, Lighting calculations, Determination of M.S.C.P, Rousseau"s construction.

UNIT IV

Types of lamps - Discharge lamps, Sodium vapour lamps, Mercury vapour lamps, Fluorescent lamp and LED lamps. Starting and power factor corrections, stroboscopic effects, Application to factory lighting, Street lighting and Flood lighting

UNIT V

Electric Traction: System of Electric Traction, Transmission of drive, Systems of track electrification,Traction mechanics, Speed time curves, Tractive effort, Power of Traction motor, Specific energy consumption, Mechanics of train movement, Coefficient of adhesion

Suggested Reading:

1. Partab H, Art and Science of Utilization of Electric Power, Dhanpat Rai & Sons, 1997
2. K.B. Raina & S.K. Bhattacharya, Electrical Design, Estimating 1. and Costing, Wiley Eastern Ltd., 1991
3. Partab H, Modern Electric Traction, Dhanpat Rai & Sons, 2000
4. B.L.Theraja, A Text Book of Electrical Technology, S.Chand & Company Ltd, Vol-I

Course Code	Course Title						Course Type
PC 651 EE	ELECTRICAL MEASUREMENTS LAB						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	2	3	20	30	1

Course Objectives:

- To acquire practical knowledge for measuring resistance, inductance and capacitance using various bridges.
- To understand the usage of A.C. and D.C. potentiometers.
- To acquire knowledge about the operation of CRO and its usefulness in finding the amplitude, phase and frequency of waveforms.
- To acquire knowledge about the functionality of single phase energy meter.
- To acquire knowledge about the measurement of iron losses using Lloyd Fishers magnetic square.

Course Outcomes:

1. Measure the inductance, capacitance and resistance using various bridges.
2. Measure resistance and calibrate ammeter, voltmeters and wattmeter using A.C. and D.C potentiometers.
3. Have hands on experience on the operation of CRO.
4. Calibrate single phase energy meter using direct loading.
5. Measure iron losses using Lloyd Fishers magnetic square.

LIST OF EXPERIMENTS:

1. Measurement of low resistance by Kelvin's Double Bridge.
2. Calibration of singlephase energy meter.
3. Measurement of inductance by Maxwell's and Anderson's bridges.
4. Measurement of capacitance by Desauty's and Schering's bridges.
5. Measurement of Iron losses by Lloyd Fishers magnetic square.
6. Measurement of Resistance and calibration of Ammeter using D.C. potentiometer.
7. Calibration of voltmeter and wattmeter using D.C. potentiometer.
8. Measurement of unknown voltage and impedance using A.C. potentiometer.
9. Calculation of iron losses using B-H curve with oscilloscope.
10. Localizing Ground and short circuit faults using Murray loop test and Varley loop test.

11. Measurement of relative permittivity (Er) of a dielectric medium using Schering Bridge.
12. Measurement of frequency of unknown sinusoidal signal with CRO.
13. Measurement of phase and amplitude using CRO.
14. Calibration of given power factor meter using calibrated voltmeter, ammeter and wattmeter.

Note: At least ten experiments should be conducted in the Semester.

Suggested Reading:

1. Shawney A.K., Electrical and Electronics Measurements and Instruments, Dhanpatrai & Sons, Delhi, 2000.
2. Umesh Sinha, Electrical, Electronics Measurement & Instrumentations, Satya Prakashan, New Delhi.
3. Golding E.W., Electrical Measurements & Measuring Instruments, Sir Issac& Pitman & Sons Ltd., London.

Course Code	Course Title					Course Type
PC 652 EE	CONTROL SYSTEMS LAB					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	2	3	20	30	1

Course Objectives:

- To develop transfer function of various control system plants practically by conducting the experiments.
- To analyze systems in time-domain and frequency domain.
- To study the different types of controllers
- To simulate control system concepts using MATLAB.
- To design controllers using MATLAB

Course Outcomes:

1. Determine the transfer function of D.C servomotor and A.C servo motor.
2. Find the step response and frequency response of system.
3. Study the effects of PID controller, On-Off controller and Lead-Lag controllers
4. Study the control system concepts using MATLAB.
5. Design Lead, Lag and Lead-Lag compensators using MATLAB.

LIST OF EXPERIMENTS:

1. Characteristics of synchros.
2. Characteristics of D.C. Servomotor and their transfer function.
3. Characteristics of AC. Servomotor and their transfer function.
4. Operating characteristics of Stepper motor.
5. Step response of second order system.
6. D.C. Position control system.
7. A.C. Position control system.
8. Performance of P, PI and PID Controller on system response.
9. Frequency response of lag and lead compensators.
10. ON - OFF temperature control systems.
11. Simulation of control system concepts using MATLAB.
12. Design of Lead, Lag and Lead-lag compensators using MATLAB.

Note: At least ten experiments should be conducted in the Semester.

Suggested Reading:

1. Nagrath I.J. &Gopal.M - Control System Engineering, Wiley Eastern, 2003.

2. B.C.Kuo - Automatic Control Systems, Wiley India edition, 7th Edition, 2002.

Course Code	Course Title					Course Type
PW 651 EE	MINI – PROJECT					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	4	-	50	-	2

Course Objectives:

- Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
- Design, implement and test the prototype/algorithm in order to solve the conceived problem.
- Write comprehensive report on mini project work.

Guidelines:

1. The mini-project is a team activity having 3-4 students in a team.
2. The mini project may be a complete hardware or a combination of hardware and software.
3. Mini Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Work can be implemented using any software.
9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

Course Code	Course Title						Course Type
PW 752 EE	SUMMER INTERNSHIP						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	-	-	50	-	2

Internship Objectives:

- Will expose Technical students to the industrial environment, which cannot be simulated in theclassroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerialskills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Familiarize with various materials, processes, products and their applications along with relevantaspects of quality control.
- Promote academic, professional and/or personal development.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the workingenvironment of industrial organizations
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Internship Outcomes:

1 Understand the actual industrial environment and tuned to readily accept the works for execution.

2 Generate detail project reports and understand industry administration and finance. machines.

3 Troubleshoot problems with more confidence.

4 Design systems/products following standard procedures and norms.

5 Interact with fellow workers and manage the activities efficiently.

INTERNSHIP ACTIVITIES

During summer vacation after 6th sem.

Internship with Industry/ Govt. / NGO/ PSU/ Any Micro/ Small/ Medium enterprise/ Online Internship.

INTERNSHIP REPORT

(a) Student's diary/ daily log

The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students" thought process and reasoning abilities. The students should record in the daily training diary the day to day account of the observations, impressions,information gathered and suggestions given, if any.

It should contain the sketches & drawings related to the observations made by the students. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and got ratified on the day of his visit.
Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.
- Adequacy & quality of information recorded.
- Drawings, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

(b) Internship report

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor and Faculty

Mentor. The Internship report will be evaluated on the basis of following criteria:

i. Originality.
ii. Adequacy and purposeful write-up.
iii. Organization, format, drawings, sketches, style, language etc.
iv. Variety and relevance of learning experience.
v. Practical applications, relationships with basic theory and concepts taught in the course.

EVALUATION THROUGH SEMINAR PRESENTATION/VIVA-VOCE

The student will give a seminar based on his training report, before an expert committee constituted bythe Department as per norms of the institute. The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall also be analyzed along with theinternship report.

Seminar presentation will enable sharing knowledge & experience amongst students & teachers andbuild Communication skills and confidence in students.

*Students have to undergo summer internship of 6 Weeks duration at the end of semester VI and the credits will be awarded after evaluation in VII semester.

PRACTICALS										
7.	PC 651 EE	Electrical Measurements Lab	-	-	2	2	3	20	30	1
8.	PC 651 EE	Control Systems Lab	-	-	2	2	3	20	30	1
9	PW 651 EE	Mini Project	-	-	4	4	-	50	-	2
TOTAL			18		8	29	27	270	330	20

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