METHODIST COLLEGE OF ENGINEERING & TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

Accredited by NBA & NAAC with A+ Grade

Approved by AICTE, New-Dehli. Affiliated to Osmania University, Hyderabad.
Abids, HYDERABAD-500001, Telangana.

M21 - SCHEME OF INSTRUCTIONS and SYLLABI of III - VIII Semesters for B.E. Four Year Degree Programme in Electrical and Electronics Engineering

(With Effect from the Academic Year 2024-25)

(As approved in Academic Council Meeting)

Empower Youth - Architects of Future World

Scheme of Instruction & Examination
B.E. SECOND YEAR, III SEMESTER
ELECTRICAL AND ELECTRONICS ENGINEERING
Semester - III

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			Hours per week				Maximum Marks		
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	4BS303HS	Numerical Methods and Fourier Series	3	1	-	4	40	60	4
2	4PC301EE	Electro Magnetic Fields	3	-	-	3	40	60	3
3	4PC302EE	Electrical Circuits-I	3	-	-	3	40	60	3
4	4ES304CS	Programming for Problem Solving	3	-	-	3	40	60	3
5	4PC303EE	Analog and Digital Electronics	3	-	-	3	40	60	3
6	4HS302HS	Human Values & Professional Ethics	2	-	-	2	40	60	2
7	4MC302HS	Essence of Indian Traditional knowledge	2	-	-	2	40	60	-
Laboratories									
8	4PC351EE	Analog and Digital Electronics Lab	-	-	2	2	40	60	1
9	4ES354CS	Programming for Problem Solving Lab	-	-	2	2	40	60	1
		Total	**19**	**1**	**4**	**24**	**360**	**540**	**20**

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science MC: Mandatory Course PC: Professional Core
L: Lecture T:Tutorial P:Practical D:Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ.Exam) EE: Electrical Engg.

Note:
1. Each contact hour is a clock hour.
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Course Code	Course Title	Core/Elective					
4BS303HS	NUMERICAL METHODS AND FOURIER SERIES	Core					
		L	T	P/D	Credits	CIE	SEE
		3	1	-	4	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To learn an alternative methods and analytical methods in mathematical concepts.
2. To apply numerical techniques in solving ordinary differential equations.
3. To study Interpolation and numerical methods to fit a curve
4. To study Fourier series and its applications to partial differential equations.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Find the solution of algebraic and transcendental equations using numerical methods.
2. Apply numerical techniques to solve ordinary differential equations and definite integrals.
3. Apply numerical methods to interpolate values and fit different curves from given data.
4. Expand function as a Fourier series.
5. Apply the solution of partial differential equations to physical problems.

UNIT-I

Numerical Solutions of Algebraic and Transcendental Equations: Introduction, Bisection Method, Regula-False method, Iteration method and Newton Raphson method. Solving linear system of equations by Gauss-Jacobi and Gauss-Seidel method.

UNIT-II

Numerical integration : Trapezoidal Rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ Rule.

Numerical solutions of Ordinary Differential Equations : Solution of ordinary differential equations by Taylor's Series, Picard's method of Successive approximations, Euler's and Modified Euler's methods, Fourth Order Runge-Kutta Method.

UNIT-III

Interpolation : Lagrange's interpolation, Newton's divided difference interpolation, Newton's Forward and Backward difference interpolations

Curve Fitting : Fitting a linear, second degree, exponential curve by method of least squares for the discrete data.

UNIT-IV

Fourier Series : Fourier series, Fourier series expansions of even and odd functions, convergence of Fourier series, and Fourier half range series.

UNIT-V

Applications to Partial Differential Equations: Classification of linear second order partial differential equations, separation of variables method (Fourier method), Fourier series solution of one dimensional heat and wave equations, Two dimensional Laplace's equation.

TEXT BOOKS :

1. Dr.B.S Grewal, Higher Engineering Mathematics, 45th Edition, Khanna Publishers. (Unit 1-5)
2. B.V.Ramana,Higher Engineering Mathematics, 3rd Edition 2015
3. Computation, 6th Edition, New Age International Publishers. 2020-2021 (Unit 1-3)
4. S.S.Sastry, Introductory Methods of Numerical Analysis, 5th Edition, PHI Learning Pvt. Ltd. (Unit 1-3)

REFERENCES/SUGGESTED READING :

1. R.K. Jain & S.R.K. Iyengar, Advanced Engineering Mathematics, 5th Edition, Narosa Publishers,6th Edition, 2021
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, 2012.

Course Code	Course Title	Core/Elective					
4PC301EE	ELECTROMAGNETIC FIELDS	Core					
		L	T	P/D	Credits	CIE	SEE
		3	-	-	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and inmaterials.
2. To understand the coupling between electric and magnetic fields through Faraday's law, displacement currentand Maxwell's equations.
3. To understand wave propagation in lossless and in lossy media.
4. To be able to solve problems based on the above concepts.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand the vector calculus for electromagnetism.
2. Apply the electric fields for simple configurations under static conditions.
3. Analyze the static magnetic fields.
4. Analyze Electrical Circuits with the concept of magnetic field.
5. Understand Maxwell's equation in different forms and different media.
6. Understand the propagation of EM wave.

UNIT- I

Review of Vector Analysis

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl, integral theorems of vectors. Conversion of a vector from one coordinate system to another, stokes theorem

UNIT-II

Electrostatics -I : Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, potential difference, Calculation of potential

differences for different configurations. Electric dipole, Electrostatic Energy and Energy density, dipole, dipole moment, potential due to dipole, polarization, numerical problems.

UNIT - III

Electrostatics - II : Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations with single variable, numerical problems.

UNIT - IV

Magneto statics-I : Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors, Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances, Faraday's law for Electromagnetic induction, numerical problems.

UNIT - V

Magneto statics-II & Electromagnetic waves : Integral & differential form of Maxwell's equations, Motional Electromotive forces. Electrical and Magnetic boundary conditions, Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem

TEXT BOOKS :

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014. (Unit 1-5)
2. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009 (Unit 1-5)
3. W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980. (Unit 1-5).
4. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012 (Unit 1-5)

REFERENCES/SUGGESTED READING:

1. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
2. G.W. Carter, "The electromagnetic field in its engineering aspects", Longmans
3. W.J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
4. E.G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University
5. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.

Course Code	Course Title	Core/Elective					
4PC302EE	ELECTRICAL CIRCUITS - I	Core					
		L	T	P/D	Credits	CIE	SEE
		3	-	-	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Familiarize with AC fundamentals and solve electrical circuits when excited by AC Supply.
2. Understand the concept of electrical resonance and network theorems for reducing complex networks.
3. Familiarize with three phase AC fundamentals and measure active and reactive power.
4. Understand the concept of transients and its analysis in electrical circuits.
5. Familiarize with the concept of network parameters and its calculations.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand and analyze the electrical circuit when excited with AC supply.
2. Explain electrical resonance and analyze complex electrical circuits with the help of different networktheorems.
3. Understand and explain the fundamentals of three phase AC supply.
4. Apply the concepts of Magnetic circuits and Analyze them.
5. Analyze electrical circuits under transient conditions.

UNIT-I

Single Phase A.C. Circuits : R.M.S. and Average values for different periodic wave forms, J-notation, Complex and Polar forms of representation, Steady State Analysis of R, L and C (in Series, Parallel and Series Parallel Combinations) with Sinusoidal Excitation, Concept of Reactance, Impedance, Susceptance and Admittance, Phase and Phase difference, Concept of Power Factor, Real and Reactive powers, Complex power.

UNIT-II

Resonance & Network Theorems for AC Excitations : Resonance-Series and Parallel Resonance, Bandwidth and Q- factor, Theorems-Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorems.

UNIT - III

Three - Phase AC Circuits : Phase sequence- Star and delta connection, Relation between line and phase voltages and currents in balanced systems, Analysis of balanced and unbalanced 3 phase circuits - Measurement of active and reactive power.

UNIT - IV

Magnetic Circuits : Introduction, Self and Mutual Inductance, Dot Convention, Coefficient of coupling, Analysis of magnetic circuits, comparison of Electrical and Magnetic circuits, numerical.

UNIT - V

D.C & A.C Transient Analysis : Transient response of R-L, R-C, R-L-C circuits (Series and parallel combination) for D.C and A.C excitation-Initial conditions, solution method using differential equation and Laplace transforms.

TEXT BOOKS :

1. Fundamentals of Electric Circuits, Charles k. Alexander and Matthew N. O. Sadiku, Tata McGraw Hills Education, Edition 3, 2013. (Unit 1-3)
2. Electrical Circuit Analysis, William H Hayt and Jack Kemmerly, 8th Edition, 2014 (Unit 1-3)
3. Circuit Theory Analysis and Synthesis by Abhijit Chakrabarti, Dhanpat Raj & Co., 2018. (Unit 1-3)

REFERENCES/SUGGESTED READING :

1. Fundamentals of Electrical Engineering and Electronics", J.B.Gupta, S.K.Kataria & Sons Publications, 2002.
2. C.L. Wadhwa, "Electrical Circuit Analysis including Passive Network Synthesis", New Age International, 2 nd Edition, 2009.
3. David A Bell, "Electric circuits", Oxford University Press, 7th Edition, 2009.
4. E.Hughes, "Electrical and Electronics Technology", Pearson Education, 2010.

Course Code	Course Title	Core/Elective					
4ES304CS	PROGRAMMING FOR PROBLEM SOLVING	Core					
		L	T	P/D	Credits	CIE	SEE
		3	-	-	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To introduce the basic concepts of Computing environment, algorithms and flowcharts.
2. To acquire knowledge about the basic concept of writing a program.
3. To understand modular and structured programming constructs in C.
4. To learn the usage of structured data types, data handling and memory management using pointers.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Formulate algorithms and learn fundamental program methodologies of C programming.
2. Understand control statements and interpret derived data types with mathematical and engineering problems.
3. Develop modular programming techniques to solve searching, sorting and file system problems
4. Recognize pre-processor directives and user defined usage.

UNIT - I

Introduction to Computers : Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Algorithm, Flowchart / Pseudo code with examples Introduction to C Language: History of C, Features, Structure of C program, Character set, Tokens ,Variables, Data types, I/O statements, Type conversion Syntax and Logical Errors in compilation, object and executable code.

UNIT – II

Operators and Control Structures : Operators, Operator precedence, Arithmetic expressions, Conditional Branching and Loops, Writing and valuation of conditionals and consequent branching.

Arrays : Arrays (1-D, 2-D), Strings and its library functions.

UNIT – III

Basic Algorithms : Searching, Basic Sorting Algorithms (Bubble and Selection).

Functions: Functions, storage classes, Parameter passing techniques Passing arrays to functions, Recursion Concept, Command line arguments.

UNIT – IV

Pointers : Idea of pointers, Defining pointers, array of pointers, pointer arithmetic, dynamic memory allocation, Structure: Structures, Defining structures and Array of Structures, self – referential structures, Unions concept, Functions and structures, Enum, Bit fields.

UNIT - V

Pre-processor Directives : File Inclusion, Macros Substitutions, Conditional Compilation.

File Handling : Introduction to File Handling, Types of files, File operations, File input/output statements.

TEXT BOOKS :

1. Computer Science A structured programming approach using C, Behrouz A. Forouzan and Richard F. Gilberg, Cengage Learning , 2007, Third Edition (Unit 1-5)
2. Schaum's Outline of Programming with C, Byron Gottfried, McGraw-Hill , 2019, Fourth Edition\
3. Data Structures and Program Design in C, Robert Kruse, Bruce Leung, Tondo, Pearson, II Edition.

REFERENCES/SUGGESTED READING:

1. C Programming Language, Brian W Kenningham, Dennis M Ritchie, Pearson, II Edition.
2. How to solve it by Computer, R.G.Dromey, Pearson Edition.

Course Code	Course Title	Core/Elective					
4PC303EE	ANALOG AND	Core					
	DIGITAL	L	T	P/D	Credits	CIE	SEE
	ELECTRONICS	3	-	-	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Understand the concept of transistors and analyze the feedback oscillators.
2. Study and understand the various power amplifiers, operation of OPAMP and its applications.
3. Apply combinational digital circuits for logic functions.
4. Analyze Logic gates, memory flip-flops, arrays, and programmable logic.
5. Design tools, both manual and computerized, for design, optimization, and test of logic circuits.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Illustrate the characteristics of various power amplifiers, operation of OPAMP and its applications,
2. Understand the concept of transistors and feedback oscillators,
3. Understand various logic gates and use the logic gates for combinational digital circuits and logic functions,
4. Understand sequential logic circuits and analyze the same,
5. Understand various A/D and D/A converters and programmable logic devices and arrays.

UNIT - I

Transistors : BJT VI characteristics, JFET VI characteristics small signal model of BJT and JFET , analysis of BJT as amplifier, estimation of voltage gain, current gain, input resistance, output resistance.

Transistor biasing : fixed bias, collector bias, self- bias, thermal stability, heat sinks.

Concept of feedback : positive negative feedback, feedback topologies: voltage series, current series, voltage shunt, current shunt, effect of feedback on gain bandwidth etc., concept of stability only qualitative treatment.

UNIT - II

Oscillators : Bark hausen criterion, RC oscillators (phase shift, weinbridge), L oscillators (Hartley, colpitts), crystal oscillators (qualitative treatment only), **power amplifiers:** various classes of operation, efficiency and distortion (qualitative treatment only), **OPAMP:** block diagram, ideal OP AMP, DC and AC characteristics, inverting and non-inverting amplifiers Applications: peak detector, sample and hold circuit and precision rectifiers clipping and clamping circuits, wave generation and basic compensators.

UNIT - III

Combinational circuits : Number systems, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Dont care conditions. **Circuits:** Multiplexer, De-Multiplexer, Adders, Subtractors , BCD arithmetic, carry look ahead adder, serial adder, digital comparator, parity checker/generator, code converters, encoders, decoders.

UNIT - IV

Sequential Circuits and Systems: Introduction , SR latch, the clocked SR flip flop, J, K, T and D-type flip flops, **applications of flip flops :** shift registers, applications of shift registers: serial to parallel converter, parallel to serial converter, ring counter, sequence generator, counters: ripple(Asynchronous) counters, synchronous counters, mod n counters design , applications of counters

UNIT - V

A/D and D/A Converters : Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter, analog to digital converters : quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, example of A/D converter.

Semiconductor memories and Programmable logic devices : Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), ROM as a PLD, Programmable logic array, Programmable array logic, introduction to : complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA)

TEXT BOOKS :

1. Jacob Millman, Christos C. Halkias, and Satyabrata Jit, Electronic Devices and Circuits, 3rd ed., McGraw Hill.
2. Education, 2010. 2. David A. Bell, Electronic Devices and Circuits, 5th ed., Oxford University Press, 2009. 3. S.
3. Salivahanan, N Kumar, and A Vallavaraj, Electronic Devices and Circuits , 2nd ed., McGraw Hill Education, 2007.
4. M. M. Mano, Digital logic and Computer design, Pearson Education India, 2016.
5. A. Kumar, Fundamentals of Digital Circuits, Prentice Hall India, 201

REFERENCES/SUGGESTED READING:

1. Jacob Millman, Christos Halkias, Chetan Parikh, Integrated Electronics, 2nd ed., McGraw Hill Education (India) Private Limited, 2011.
2. Donald L Schilling & Charles Belove, Electronics Circuits, Discrete & Integrated , 3rd ed., McGraw Hill Education (India) Private Limited, 2002
3. R. P. Jain, Modern Digital Electronics, McGraw Hill Education, 2009.

Course Code	Course Title	Core/Elective					
4MC302HS	HUMAN VALUES &	Core					
	PROFESSIONAL	L	T	P/D	Credits	CIE	SEE
	ETHICS	2	-	-	2	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To create an awareness on Human Values and Engineering Ethics.
2. To move from discrimination to commitment.
3. To understand social responsibility of an engineer.
4. To appreciate ethical dilemma while discharging duties in professional life.
5. To encourage students to discover what they consider valuable in life.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand the significance of value inputs in a classroom and start applying them in their life and profession.
2. Assess their own ethical values and the social context of problems.
3. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
4. Understand the role of a human being in ensuring harmony in society and nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

UNIT - I

Introduction to Value Education

1. Value Education, Definition, Concept and Need for Value Education
2. The Content and Process of Value Education
3. Self-Exploration as a means of Value Education
4. Happiness -Sukh, Suvidha, Sanyam &Swasthya.

UNIT-II

Harmony in the Human Being

1. Human Being is more than just the Body
2. Harmony of the Self ('I') with the Body

3. Understanding Myself as Co-existence of the Self and the Body.
4. Understanding Needs of the Self and the Needs of the Body.

UNIT - III

Harmony in the Family and Society and Harmony in Nature.

1. Family as a basic unit of Human Interaction and Values in Relationships.
2. The Dynamics of Mutual respect in Today's World – Affection, Care, Guidance, Reverence, Gratitude and Love.
3. Comprehensive Human Goals: The Five dimensions of Human Endeavour – Justice, Trust, Competence, Right Attitude and Mutual Tolerance.

UNIT - IV

Social Ethics

1. The Basics for Ethical Human conduct.
2. Challenges to ethical conduct in existence.
3. Holistic perception of Harmony in existence.
4. Social Hierarchy - Ethical Conduct and Mutual Co-existence.

UNIT - V

Professional Ethics

1. Sanctity of Human values.
2. Definitiveness of Ethical Human Conduct.
3. Basics for Humanistic Education.

TEXT BOOKS :

1. A.N Tripathy, "Human Values", New Age International Publishers, 2003.
2. Bajpai. B. L., Indian Ethos and Modern Management, New Royal Book Co., Lucknow, Reprinted, 2004.
3. Bertrand Russell Human Society in Ethics & Politics, Taylor and Francis, 2007.

REFERENCES/SUGGESTED READING :

1. Corliss Lamont, Philosophy of Humanism, Humanist Press, 1997.
2. Gaur. R.R. , Sangal. R, Bagaria. G.P, A Foundation Course in Value Education, Excel Books, 2009.
3. Gaur. R.R. , Sangal. R , Bagaria. G.P, Teachers Manual Excel Books, 2009.
4. Mortimer. J. Adler, – Whatman has made of man, Hardcover, 2007.

Course Code	Course Title	Core/Elective					
4ES304HS	ESSENCE OF INDIAN	Core					
	TRADITIONAL	L	T	P/D	Credits	CIE	SEE
	KNOWLEDGE	2	-	-	-	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To reinforce the students understanding with the pan-Indian heritage in terms of culture, traditions and knowledge.
2. To impart understanding of the importance of the roots of the traditional knowledge and types.
3. To impart basic knowledge on the evolution of the multiple languages that highlight India's diversity.
4. To know Indian Languages, Philosophies, Religion, Literature, Fine arts and Technology.
5. To explore the Ancient Science & Scientists, in Medieval and Modern India; the education system

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand the concepts of Indian culture and Traditions and their importance.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of Ancient, Medieval and Modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras; interpret the concepts and the importance to protect Intellectual property of the nation.

UNIT - I

Introduction to Culture: Civilization, Culture and Heritage .General characteristics of culture, importance of culture in human literature. Indian Culture, Ancient India, Medieval India, Modern India

UNIT - II

Indian Languages, Culture and Literature:

Indian Languages and Literature-I: the evolution and role of Sanskrit, Prakrit,

significance of scriptures to current society Indian philosophies, other Sanskrit literature, literature of south India (Tamil).

Indian Languages and Literature-II: Northern Indian languages & literature

UNIT - III

Religion and Philosophy: Religion and Philosophy in Ancient India (Buddhism, Jainism and Shatdarshanas).

Religion and Philosophy in Medieval India. Religious reform movements in Modern India (Brahma Samaj & Arya Samaj)

UNIT - IV

Fine Arts in India (Art, Technology& Engineering):

Indian Painting, Indian handicrafts Music : Divisions of Indian classical music, modern Indian music Dance and Drama.

Indian Architecture - Ancient (Harrappa and Mohenjodaro, Buddhist sculpture, Ashokan rock cut pillars, Iron Pillar of Mehrauli); Medieval- Bruhadeshwara temple, Ramappa Temple, Vijayanagara, Hampi) and Modern Architecture.

Science and Technology in India :

Development of science in Ancient, Medieval and Modern India. Their relation in terms of modern scientific perspective.

Science and Scientists of Ancient, Medieval and Modern India, Protection of traditional knowledge, significance, value to economy: role of government in protection of indigenous knowledge and technology; protection of traditional knowledge bill, 2016.

UNIT - V

Education System in India :

Education in Ancient, Medieval and Modern India, Aims of education- Universities in Ancient India, Women Education in Ancient, Medieval and Modern India, National Education Policy-2020.

TEXT BOOKS :

1. Indian Knowledge Systems (2 Vols-Set),Kapil Kapoor and Avadhesh Kumar Singh, ISBN 10: 8124603367 / ISBN 13: 9788124603369, Published by D K Print world, Publication Date: 2007
2. Basanta Kumar Mohanta and Vipin K. Singh, Traditional Knowledge System and Technology in India, Book Originally published: 2012 Publication Date: 2012; ISBN 10: 8177023101 ISBN 13: 9788177023107.

3. Nitin Singhania,Indian Art and Culture, 4th Edition, ISBN : 9354601804 • 9789354601804, © 2022 | Published: December 20, 2021.
4. S. Narain, Education and Examination Systems in Ancient India, written/ authored/edited by S. Narain', published 2017, English- Hardcover, ISBN 9789351282518 publisher: Kalpaz Publications.

REFERENCES/SUGGESTED READING

1. Science in Samskrit, Samskrita Bharati, Published by Samskrita Bharati, New Delhi, India, 2007; ISBN 10: 8187276339 / ISBN 13: 9788187276333.
2. 1.7-Position paper, National Focus Group on Arts, Music, Dance and Theatre NCERT, March 2006, ISBN 81-7450-494-X, NCERT, New Delhi, 2010.
3. Founders of Sciences in Ancient India,Satya Prakash, Vijay Kumar Publisher, New Delhi, 1989.

Course Code	Course Title	Core/Elective					
4PC351EE	ANALOG AND DIGITAL ELECTRONICS LAB	Core					
		L	T	P/D	Credits	CIE	SEE
		-	-	2	1	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Designing of wave shaping circuits using diodes.
2. Designing of single and multistage amplifier circuits.
3. Demonstrate negative feedback in amplifiers circuits and positive feedback in oscillators.
4. Explain the principle concepts of Digital Logic Design.
5. Distinguish between the Sequential and Combinational Logic Circuits.
6. Design the Logic Circuit using Combinational and Sequential Circuits

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Analyze feedback amplifiers and op amp oscillators.
2. Design single and multi-stage amplifier, wave shaping and controller circuits
3. Understand working of logic gates.
4. Understand Combinational and Sequential logic circuits and its applications using Multisim.
5. Understand the process of Analog to Digital conversion and Digital to Analog conversion. And also Use PLCs to implement the given logical problem.

LIST OF EXPERIMENTS

ANALOG

1. Static characteristics of MOSFET in CS configuration.
2. Frequency response of single and two stage BJT amplifier in CE configuration.
3. Inverting and non -inverting amplifier using OP AMP.
4. RC phase oscillator and Wein Bridge oscillator using OP AMP.
5. Clipping and clamping circuits.
6. Generation of triangular and square wave using OP AMP.
7. Design of lead lag compensator using OP AMP.

DIGITAL

1. Realization of different logic gates.
2. Verification of multiplexer operation.
3. Half adder, full adder and subtractor and realization of combinational logic.
4. Synchronous counters and Asynchronous counters.
5. A / D converters and D / A converters.
6. Simulation of error detecting codes using VHDL/Verilog/Multisim.
7. Simulation of flip/flops using VHDL/Verilog/Multisim.
8. Simulation of encoders and decoders using VHDL/Verilog/Multisim.
9. Experiment on programmable logic devices (ROM/RAM/PLA/PAL/FPG).

Note : At Least 5 Experiments From Each Section Should Be Performed .

REFERENCES/SUGGESTED READING :

1. Paul B. Zbar, Albert P. Malvino, Michael A. Miller, Basic Electronics, A text-Lab Manual, 7 thEdition. Mc- Graw- Hill Higher Education 2001.
2. R. P. Jain, Modern Digital Electronics, McGraw Hill Education, 2009.
3. M. M. Mano, Digital logic and Computer Design, Pearson Education India, 2016.

Course Code	Course Title	Core/Elective					
4ES354CS	PROGRAMMING	Core					
	FOR PROBLEM	L	T	P/D	Credits	CIE	SEE
	SOLVING LAB	-	-	2	1	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Understand the fundamentals of programming in C Language.
2. Write, compile and debug programs in C.
3. Formulate solution to problems and implement in C.
4. Effectively choose programming components to solve computing problems

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Choose appropriate data type for implementing programs in C language.
2. Design and implement modular programs involving input output operations, decision making and loopingconstructs.
3. Apply derived data types and implement programs to store data in structures and files.
4. Develop confidence for self-education and ability towards lifelong learning need of computer languages.

LIST OF EXPERIMENTS

1. Finding maximum and minimum of given set of numbers, finding roots of quadratic equation.
2. Sin x and Cos x values using series expansion.
3. Generating Pascal triangle, pyramid of numbers.
4. Factorial, Fibonacci, GCD recursive and non-recursive procedures.
5. Linear search and binary search using recursive and non-recursive procedures.
6. Bubble sort and selection sort.
7. Matrix addition and multiplication using arrays.
8. Programs on pointers: pointer to arrays, pointer to functions.
9. Programs on structures, union, enum and string manipulations.
10. File handling programs (Reading, Writing, Copying files).
11. Program illustrating using Command Line Arguments

Note : A minimum of Ten experiments to be performed.

Scheme of Instruction & Examination
B.E. SECOND YEAR, IV SEMESTER
ELECTRICAL AND ELECTRONICS ENGINEERING
Semester - IV

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			Hours per week				Maximum Marks		
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	4HS403BM	Managerial Economics & Financial Accounts	3	-	-	3	40	60	3
2	4PC404EE	Power Systems-I	3	-	-	3	40	60	3
3	4PC405EE	Electrical Machines-I	3	-	-	3	40	60	3
4	4PC406EE	Control Systems	3	-	-	3	40	60	3
5	4PC407EE	Electrical Circuits-II	3	1	-	4	40	60	4
6	4ES405CS	Python Programming	3	-	-	3	40	60	3
7	4MC403HS	Indian Constitution	2	-	-	2	40	60	-
Laboratories									
8	4PC452EE	Electrical Circuits Lab	-	-	2	2	40	60	1
9	4PC453EE	Control Systems Lab	-	-	2	2	40	60	1
10	4ES455CS	Python Programming Lab	-	-	2	2	40	60	1
Total			**20**	**1**	**6**	**27**	**400**	**600**	**22**

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science

MC: Mandatory Course PC: Professional Core

L:Lecture T:Tutorial P:Practical D:Drawing

CIE: Continuous Internal Evaluation

SEE: Semester End Evaluation (Univ. Exam) EE: Electrical Engg.

Note:

1. Each contact hour is a clock hour.
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Course Code	Course Title	Core/Elective					
4HS403BM	MANAGERIAL ECONOMICS & FINANCIAL ACCOUNTS	Core					
		L	T	P/D	Credits	CIE	SEE
		3	-	-	3	40	60

COURSE OBJECTIVES :

To understand responsibilities of a manager of a business undertaking

1. To analyze various determinants influencing demand and price.
2. To understand the principles of accounting and prepare Journal, Ledger, Trial Balance & Final accounts.
3. To understand Financial statement Analysis.
4. To evaluate &analyze the long term investments.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Determine the responsibilities & decision making in the Organization.
2. Understand various factors influencing demand & market structure.
3. Understand the principles of Accounting & solve the problems.
4. Analyze the Financial performance.
5. Understand the capital structure& to take decision on selection of projects.

UNIT - I

Introduction to Managerial Economics its Scope, Importance and relation to other sciences, its usefulness to Engineers- Basic concepts of Managerial Economics - Theory of firm.

UNIT - II

Demand Analysis : Introduction to demand, determinants, law of demand, its assumptions, Elasticity of demand-price, income and cross elasticity, demand forecasting, Market competitive structure, price & output determination under perfect competition and Monopoly.

UNIT - III

Basics of Accounting : Financial Accounting–Definition- Accounting Cycle - Journal - Ledger and Cash book - Trial Balance Book- Preparation of final accounts with simple adjustments (including Problems).

UNIT - IV

Financial statement Analysis : Importance-Users-Ratio Analysis-liquidity, solvency, turnover and profitability ratios.

UNIT - V

Capital management : Significance determinates and estimation of fixed and working capital requirements, sources of capital. Introduction to capital budgeting, **Time Value of money - Methods :** Non-Discounted cash flow methods(pay back, ARR) , Discounted (NPV, PI, IRR) with problems.

TEXT BOOKS :

1. Mehta P.L., Managerial Economics, Sultan Chand & Sons Publishers.
2. Managerial Economics - A Problem Solving Approach , by Luke M Froeb.
3. I.M.Panday Financial Management, Vikas Publishing House.
4. Maheswari S.N. Introduction to Accountancy. Vikas Publishing House.

REFERENCES/SUGGESTED READING :

1. C .L.Varshney, K.L.Maheshwari, Managerial Economics, Sultan Publishers.
2. D.M.Mithani, Managerial Economics, Himalaya Publishing House.
3. Mukherjee, Hanif, Financial Accounting, Tata McGraw Hill.
4. Ramachandran, Kakani, Financial Accounting for Management, Tata McGraw Hill.

Course Code	Course Title	Core/Elective					
4PC404EE	POWER SYSTEMS - I	Core					
		L	T	P/D	Credits	CIE	SEE
		3	-	-	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Have a fair knowledge about the fundamentals of various conventional power plants like Thermal, Hydel, Nuclear and Gas.
2. Acquire the knowledge of different types of Non conventional energy generation methods like Solar, Wind, Ocean Thermal Energy Conversion (OTEC), Tidal and Geo thermal.
3. Understand the Economics of Power Generation, Types of costs, Depreciation, methods of P.f. improvement, Tariffs
4. Have the knowledge of construction of Over head lines, materials, Supports, insulators and Underground cables.
5. General aspects of AC & DC distribution systems.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Analyze economic aspects of power generation.
2. Demonstrate the Layout and operation of Hydel and Thermal power plants.
3. Explain the layout, operation and importance of renewable energy sources and Nuclear power plants.
4. Understand the different types of DC and AC distribution and its calculations.
5. Analyze the mechanical design of transmission lines and concept of underground cables Analyze the Inductance and Capacitance calculations of Transmission lines.

UNIT - I

Steam Power Stations : Selection of site, operation, Layout & various parts of station: Economizer, super heater, Air pre-heater, Electrostatic precipitator, turbine, cooling towers, Coal handling and ash handling, Types of Boilers. Advantages and disadvantages of Steam power generation.

Hydro-Electric Power plants : Selection of site, Types of hydro-electric plants and layouts, Hydrograph, Flow duration curve, Mass curve. Advantages and disadvantages of Hydro electric power generation.

UNIT - II

Alternate Power Sources : Nuclear Power : Fissile materials, Nuclear Fission and Chain reaction Layout and types of nuclear reactors, Advantages and disadvantages, Solar power: selection of site, working principle, types of solar collectors. Wind power: selection of site, working principle and layout. Gas power plants: working principle and layout, waste to energy.

UNIT - III

Economics of Power Generation: Load Curve, Load Duration curve, Average load, Load factor, Demand factor, Diversified factors, plant capacity factor and plant use factor - Numerical problems. Base Load and Peak load operation, Types of costs and types of tariffs, Methods of power factor improvement, Most economical p.f. for constant KW load and constant KVA type loads.

Distribution : General aspects of AC and DC distribution systems.

DC Systems : Ring main, Radial, Voltage drop calculations, Distributor fed at one end, Distributor fed at both ends. Numerical problems

UNIT - IV

Inductance and Capacitance of Transmission Lines : Calculation of resistance, inductance and capacitance of transmission lines, single phase and 3-phase lines with symmetrical and asymmetrical spacing, composite conductors, GMR and GMD Spacing, transposition, bundled conductors, Numerical problems.

UNIT - V

Over-Head Lines : Construction of Overhead lines - Overhead line materials, Equation of Sag for equal and unequal supports, sag and tension calculations, Effect of wind and ice on sag - Numerical problems.

Insulators : Types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, Testing of insulators. Numerical problems.

Underground Cables : Conductors for cables, Insulating materials, Mechanical protection, LV, HV and EHV cables, Grading of cables, Capacitance of three-core cables.

TEXT BOOKS :

1. L.Wadhwa, Electrical Power Systems, Wiley Eastern Ltd. 5th Edition, 2005. (Unit 1-4).
2. C.L.Wadhwa, Generation, Distribution and Utilization of Electrical Energy, Wiley Eastern Ltd., 5th Edition, 2005. (Unit 1, 2).
3. S.N.Singh - Electrical Power Generation, Transmission and Distribution- Prentice Hall pvt. ltd. New - 2003. (Unit1-5).
4. Principles of Power Systems - V.K Mehta and Rohit Mehta S.Chand & Company Ltd, New Delhi 2004. (Unit 1-5).

REFERENCES/SUGGESTED READING :

1. Power System Engineering - R. K. Rajput.
2. Power System Engineering - Kothari & Nagrath.

Course Code	Course Title	Core/Elective					
4PC405EE	ELECTRICAL MACHINES - I	Core					
		L	T	P/D	Credits	CIE	SEE
		3	-	-	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To introduce the concepts of magnetic circuits.
2. To impart knowledge on working and applications of DC machines.
3. To gain an understanding on analysis and performance of DC Machines and Transformers.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Analyze the concepts of energy conversion principles.
2. Analyze the operation and control of DC machines.
3. Analyze single phase transformers circuits.
4. Identify proper type of motors suitable for given application.
5. Understand the configurations of auto transformers and 3-phase transformers.

UNIT - I

Electromechanical Energy Conversion Principles : Principles of energy conversion, single excited and doubly excited magnetic systems, singly excited electric field systems, Faraday's law, Lenz's law.

UNIT - II

DC Machines : Constructional features and principle of operation of DC machines as Generator and Motor, Simplex and multiplex lap and wave windings; Separately excited, series and shunt, cumulatively and differentially compound excited motoring and generating mode of operation and their characteristics, applications of DC machines; Armature reaction, demagnetizing and cross magnetizing ampere-turns, compensating windings, commutation process and methods of commutation, role of inter poles and compensating winding. Problems on emf equation, torque equation and armature reaction.

UNIT - III

Speed Control of DC Motors : Speed control of shunt & series motors, losses in DC machines and calculation of efficiency. Need for starters and Starters for DC series

shunt and compound motors. Testing of DC Motors: No-load test, load tests and regenerative tests such as Swinburne's Test, Direct load test, Hopkinson's test, Field's test and Retardation test. Calculation of efficiency based on all the above tests.

UNIT - IV

Single-Phase Two Winding Transformers : Construction, principle of operation, E.M.F. equation, phasor diagrams; Equivalent circuit, determination of equivalent circuit parameters, Predetermination of performance equivalent circuit parameters and Sumpner's test. Losses, separation of no-load losses, calculation of efficiency and regulation by direct and indirect methods, conditions for maximum efficiency. Concept of all-day efficiency. Parallel operation of transformers and Load sharing.

UNIT - V

Auto Transformers and 3-Phase Transformers: Principle of operation of Auto Transformers, saving of copper compared to two-winding transformer and its application. Three-Phase Transformers: Merits of three phase Transformers over three phase transformer bank Type of connections such as Delta-Delta, Delta-Star, Star-Delta, Delta-Star, V-V connection and T-T Connections.

TEXT BOOKS :

1. Electrical Machinery, Theory: Performance & Applications, Dr. P. S. Bimbhra, Khanna Publishers, 2021.
2. Fitzgerald and Kingsley's electric machinery by Stephen D. Umans–TMH Publishers, 7th Edition, 2020.
3. Nagarath & D.P.Kothari: ElectricalMachines,TMH Publishers, 5th edition 2017.
4. Theory& Performance of Electrical Machines by J.B. Gupta, S.K. Kataria & Sons, 5th Edition, 2013.
5. The Performance and Design of Direct Current Machines, A.E .Clayton & NN Hancock, CBS Publishers, 2004. 3. Electric Machines, P. S Bimbhra - 2nd Edition, Khanna Publishers,2017.

REFERENCES/SUGGESTED READING :

1. A. E. Fitzgerald and C. Kingsley, Electric Machinery, McGraw HillEducation, 6th Edition, 2005.
2. M. G. Say, Performance and design of AC machines, CBS Publishers, 2002.
3. A. S. Langsdorf, Theory of Alternating current machinery, 2nd Edition, McGraw Hill Education, 1984.

Course Code	Course Title	Core/Elective					
4PC406EE	CONTROL SYSTEMS	Core					
		L	T	P/D	Credits	CIE	SEE
		3	-	-	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Efficient in modeling of electrical and mechanical systems, using differential equations, transfer functions, block diagrams, and state variables.
2. Analyze of properties of control systems, such as sensitivity, stability, controllability, tracking, in time and frequency domains.
3. Design of feedback controllers, such as PID, lead and lag compensation.
4. Understand and develop the state space representation of control systems.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Analyze the concept of control systems, feedback, Mathematical modeling of Electrical and Mechanical systems
2. Analyze the time domain and frequency response analysis of control systems
3. Apply the knowledge of various analytical techniques used to determine the stability of control systems and Analyze the stability of systems and understand the importance of compensators
4. Demonstrate controllability and observability of modern control systems

UNIT - I

Introduction to Control Systems: Classification of control systems, Feed-Back Characteristics, Effects of feedback, Error sensing devices -Transfer function- Potentiometers, F-I and F-V analogous systems, synchros, AC-DC servo motors- Block diagram reduction technique, Transfer function and impulse response, Signal flow graph, Mason's gain formula.

UNIT - II

Time Response Analysis: Standard test signals - Time response of first order systems - Transient response of second order system for unit step input, Time domain specifications- Types of system- Order of a system-Steady state response –Steady state errors and error constants – PID controllers.

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, Nyquist stability criterion, Principle of argument.

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

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, Gain margin and phase margin, Compensation: Lead, Lag, Lead – Lag Compensation using bode plot.

UNIT - V

State Space Analysis: Concepts of state, State variables and state model, Derivation of state models from transfer functions and differential equations. Controllable, Observable and Diagonal state models - State transition matrix - Solution of state equations by time domain method - Concepts of Controllability and Observability.

TEXT BOOKS :

1. Control System Engineering, I.J. Nagrath, M. Gopal, New Age International (P) Limited publishers, 2008.
2. Control System Principles and Design, M. Gopal, Tata McGraw Hill, 2nd Edition, 2003.
3. Control systems, A.NagoorKani, RBA publications, 3rd Edition, 2015.
4. Automatic control systems, S.Hasan saeed, KATSON Books, 8th Revised Edition, 2014.

REFERENCES/SUGGESTED READING:

1. "Modern Control Systems", K. Ogata Prentice Hall of India, 4th Edition,2002.
2. "Automatic control systems", B.C.Kuo, Wiley India, 7th Edition, 2002.
3. "Control systems", N.C.Jagan, B.S Publications, 2nd Edition, 2008.

Course Code	Course Title	Core/Elective					
4PC407EE	ELECTRICAL CIRCUITS-II	Core					
		L	T	P/D	Credits	CIE	SEE
		3	1	-	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To understand Magnetic Circuits, Network Topology.
2. To evaluate Network parameters of given Electrical network.
3. To analyze various types of filters and attenuators.
4. To study the aspects of network synthesis and analysis of two port networks.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Knowledge about different network parameters and their relations.
2. Analyze the Electrical Circuits with the concept of Network topology.
3. Determine the parameters for the design of various filters.
4. Find network functions and two port parameters.
5. Represent the transfer function for the given network.

UNIT - I

Network Parameters : Two port network parameters – Z, Y, ABCD and hybrid parameters and their relations. Cascaded networks, concept of transformed network – two-port network parameters using transformed variables.

UNIT - II

Network Functions : The concept of Complex Frequency, Physical Interpretation of Complex Frequency, Transform Impedance and Transform Circuits, Series and parallel Combination of Elements, Terminal Pairs or Ports, Networks Functions for the One-port and Two-port, Poles and Zeros of Network Functions, Significance of poles and Zeros, Properties of Driving Point Functions, Properties of Transfer Functions, Necessary Conditions for Driving Point Functions, Necessary Conditions for Transfer Functions, Time Domain Response from Pole Zero Plot.

UNIT-III

Network Synthesis : Hurwitz polynomials, Positive Real Functions, Frequency Response of Reactive One-ports, Synthesis of Reactive One-ports by Foster's

Method, Synthesis of Reactive One-ports by Cauer Method, Synthesis of RL network by Foster's Method, Synthesis of RL network by Cauer's Method, Synthesis of RC network by Foster's Method, Synthesis of RC network by Cauer's Method.

UNIT - IV

Graph Theory : Definitions, Incidence matrix, Properties of Incidence matrix, Incidence matrix and KCL, Tie-Set matrix, Tie-Set matrix and link currents, Cut-Set matrix, Cut-Set matrix and Branch Voltages, Mesh Analysis, Nodal Analysis.

UNIT - V

Filters and Attenuators : Classification of filters- Low Pass, High Pass, Band Pass, Band Elimination filters, Filter networks, equation of filter networks, Prototype filter design. Attenuators- classification.

TEXT BOOKS :

1. M E Van Valkenberg, "Network Analysis", PHI, 3rd Edition, 2014.
2. Fundamentals of electric circuits by Charles K.Alexander and N.O.Sadiku, Fifth Edition.

REFERENCES/SUGGESTED READING :

1. John Bird, "Electrical Circuit Theory and Technology", Newnes, 2nd Edition, 2003.
2. C.L.Wadhwa, "Electrical Circuit Analysis including Passive Network Synthesis", New Age International, 2 nd Edition, 2009.
3. David A Bell, "Electric circuits", Oxford University Press, 7th Edition, 2009.
4. E Hughes, "Electrical and Electronics Technology", Pearson Education, 2010.
5. A Chakrabarthy, "Electric Circuits", Dhanipat Rai & Sons, 6th Edition, 2010

Course Code	Course Title	Core/Elective					
4ES405CS	PYTHON PROGRAMMING	Core					
		L	T	P/D	Credits	CIE	SEE
		3	-	-	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To be able to introduce core programming basics and program design with functions using Python programming language.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand the high-performance programs designed to strengthen the practical expertise.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. Demonstrate proficiency in handling Strings and File Systems.
3. Create, run and manipulate Python Programs using core data structures like Lists, Tuples and Dictionaries.
4. Interpret the concepts of Object-Oriented Programming as used in Python.
5. Create and animate a variety of shapes and develop an application with graphical user interface (GUI).
6. Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

UNIT - I

Introduction to Python: installing Python, basic syntax, interactive shell, editing, saving, and running a script. The concept of data types, variables, assignments, immutable variables, numerical types, arithmetic operators and expressions, comments in the program, understanding error messages. Conditions, Boolean logic, logical operators, ranges, Control statements.

UNIT - II

Strings and Files : Strings and text files, manipulating files and directories, os and

sys modules, text files: reading/writing text and numbers from/to a file, creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string, strings and number system: converting strings to numbers and vice versa.

Lists, tuples, and dictionaries

basic list operators, replacing, inserting, removing an element, searching and sorting lists, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries

UNIT – III

Design with functions : Hiding redundancy, complexity, arguments and return values, formal vs actual arguments, named arguments. Program structure and design. Recursive functions.

Classes and OOP : Classes, objects, attributes and methods, defining classes, design with classes, data modeling, persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_, _str_, etc), abstract classes, exception handling, try block.

UNIT - IV

Simple Algorithms and Data structures: Search Algorithms, Sorting Algorithms, Hash Tables.

Simple Graphics and Image Processing : "turtle" module, simple 2d drawing - colors, shapes, digital images, image file formats, image processing Simple image manipulations with 'image' module (convert to bw, greyscale, blur, etc).

UNIT - V

Graphical user interfaces: Event-driven programming paradigm, tkinter, module, creating simple GUI, buttons, labels, entry fields, dialogs, widget attributes - sizes, fonts, colors layouts, nested frames

Multithreading, Networks, and Client/Server Programming: Introduction to HTML, interacting with remote HTML server, running html-based queries, downloading pages, CGI programming, programming a simple CGI form

TEXT BOOKS :

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2nd Edition, 2017, Cengage Learning.
2. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India.

REFERENCES/SUGGESTED READING:

1. Mark Summerfield. - Programming in Python 3: A Complete introduction to the Python Language, Addison-Wesley Professional, 2009..
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/O, Reilly Publishers, 2016.
3. NPTEL Course, Programming, Data Structures and Algorithms using Python, Link: https://nptel.ac.in/courses/106106145.
4. NPTEL Course, The Joy of Computing using Python, Link: https://nptel.ac.in/courses/106106182 5.FOSSEE, Python, Link: https://python.fossee.in/

Course Code	Course Title	Core/Elective					
4MC403HS	INDIAN CONSTITUTION	Core					
		L	T	P/D	Credits	CIE	SEE
		2	-	-	-	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To create awareness and relevance of the Indian Constitution, its directive principles.
2. To impart understanding of the role, powers and functions of administration at the Central, State and local levels.
3. To create awareness and understanding of Fundamental Rights, State Policy and Duties of Ideal citizen.
4. To expose students to the relations between Central/Federal, State and Provincial units, divisions ofexecutive, legislative and judiciary in them.
5. To impart knowledge about the statutory institutions and their role.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Have a general knowledge and back ground about the Constitution of India and its importance.
2. Will distinguish and understand the working of the Central, state and provincial levels of administration.
3. Will be conscious about the fundamental duties, responsibilities and rights as an ideal citizen of India
4. Will be able to perceive and interpret the functioning and distribution of resources between centre and state.
5. Have awareness and relate to the existing hierarchy of the social structure, election.

UNIT - I

Introduction to Constitution - Meaning, reasons for having a constitution. **Evolution of the Indian Constitution :** History, 1909 Act,1919 Act and 1935 Act and Permeable **Constituent Assembly :** Composition and Functions;

UNIT - II

Government vs Governance :

Union Government : Political Executive-President, Prime Minister, Council of Ministers, Bureaucratic Executive.

State Government : Executive: Governor, Chief Minister, Council of Ministers.

Local Government: Panchayat Raj Institutions, Rural and Urban local bodies-composition

UNIT - III

Rights and Duties : Fundamental Rights, Directive principles of State Policy, Fundamental Duties of a good citizen

Public Interest Litigation.

UNIT - IV

Relation between Federal and Provincial units :

Union -State relations : Administrative, Legislative and Financial, Inter-State council, NITI Ayog, Finance Commission of India.

UNIT - V

Constitutional and Statutory Bodies :

Election Commission and Electoral Reforms, National Human Rights Commission, National Commission for Women,

National Commission for Minorities, National Commission for Protection.

TEXT BOOKS :

1. Durga Das Basu, "Introduction to the Constitution of India", English - Hardcover –: Lexis Nexis, New Delhi.
2. Dr. B.L. Fadia, Dr. Kuldeep Fadia , "Indian Government and Politics", Sahithya Bhavan Publications, Agra.
3. M . Lakshmikanth, "Indian polity', Tata McGraw Hill.

REFERENCES/SUGGESTED READING :

1. M.V. Pylee, "Indian Constitution".
2. Khattar, "Indian Political System".
3. Constitution of India, Telugu Academy.

Course Code	Course Title	Core/Elective					
4PC452EE	ELECTRICAL CIRCUITS LAB	Core					
		L	T	P/D	Credits	CIE	SEE
		-	-	2	1	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Apply the theoretical knowledge in doing practical experiments and acquire skills to handle instruments.
2. Understand the behavior of electrical elements, circuits.
3. Understand the practical verification of different laws and theorems.
4. Understand the behavior of electrical circuits Using MATLAB/SIMULINK/ PYTHON.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Explain common electrical components and their ratings.
2. Understand and apply basic laws to analyze an electrical circuit.
3. Apply the concepts of theorems to analyze the electricalcircuits.
4. Analyze performance of DC and AC electrical circuits.
5. Design and analyze the behavior of circuits in MATLAB/SIMULINK/ PYTHON.

LIST OF EXPERIMENTS

1. CRO- applications, measurements of R, L, C using LCR meter, color coding method.
2. Verification of KVL and KCL
3. Verification of Superposition and Reciprocity theorem.
4. Verification of Thevinin's and Norton's thoerem.
5. Verification of Maximum power transfer theorem.
6. Verification of Milliman's and Tellegen's theorem.
7. Analysis of series RL & RC Circuits with AC excitation.
8. Calculation of Z and Y parameters for a given two port network.
9. Calculation of h and ABCD parameters for a given two port network.

10. Verification of Phase and Line relations for voltages and currents in a three-phase network.
11. Series Resonance- Calculation of Bandwidth and Q-Factor.
12. Simulation of series RL and RC Circuits to analyze transient behavior using MATLAB/SIMULINK/PYTHON.
13. Simulation of series and parallel resonance circuit using MATLAB/ SIMULINK/PYTHON.
14. Simulation of electrical circuits for Mesh and Nodal analysis using MATLAB/ SIMULINK/PYTHON.

Note: A minimum of Ten experiments to be performed.

REFERENCES/SUGGESTED READING :

1. Fundamentals of Electric Circuits, Charles k. Alexander and Matthew N. O. Sadiku, Tata McGraw Hills Education, Edition 3, 2013.
2. Electrical Circuit Analysis, William H Hayt and Jack Kemmerly , 8th Edition, 2014.
3. Circuit Theory Analysis and Synthesis by Abhijit Chakrabarti, Dhanpat Raj & Co., 2018.
4. Fundamentals of Electrical Engineering and Electronics", J.B. Gupta, S. K. Kataria & Sons Publications, 2002.

Course Code	Course Title	Core/Elective					
4PC453EE	CONTROL SYSTEMS LAB	Core					
		L	T	P/D	Credits	CIE	SEE
		-	-	2	1	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Develop transfer function of various control system plants practically by conducting the experiments.
2. Understand the various controllers.
3. Programming and control system concepts using MATLAB/PYTHON

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. To develop transfer function of various control system plants practically by conducting the experiments.
2. Study the Performance of P, PI and PID Controllers and Analyze the concepts to A.C and D.C position control system.
3. Design lag and lead compensation networks.
4. Apply the concepts of control systems in developing Program using MATLAB/PYTHON
5. Determine the time response of second order system and Determine frequency response of compensating networks.

LIST OF EXPERIMENTS

1. Characteristics of D.C. and AC. Servomotors.
2. Characteristics of synchro's.
3. Frequency response of compensating networks.
4. Step response of second order system.
5. D.C. Position control system.
6. A.C. Position control system.
7. Performance of P, PI and PID Controller on system response.
8. Design of lag and lead compensation for the given plant.

9. Temperature control systems.
10. Simulation of Root locus, Nyquist plot, Bode plot using MATLAB/ SIMULINK/PYTHON.
11. Time response of Second order system using MATLAB//SIMULINK/ PYTHON.
12. Conversion of state to transfer function and transfer function state spaceusing MATLAB//SIMULINK/PYTHON.
13. Design of lead and lag compensators using MATLAB/SIMULINK/PYTHON.
14. Frequency response characteristics and relative stability analysisusing MATLAB//SIMULINK/PYTHON.

Note : A minimum of Ten experiments to be performed.

REFERENCES/SUGGESTED READING :

1. Automatic control systems, S.Hasan saeed, KATSON Books, 8th Revised Edition, 2014.
2. Control System Principles and Design, M. Gopal, Tata McGraw Hill, 2nd Edition, 2003.
3. Control System Engineering, I.J. Nagrath, M. Gopal, New Age International (P) Limited publishers, 2008.
4. Control systems, A.NagoorKani, RBA publications, 3rd Edition, 2015.

Course Code	Course Title	Core/Elective					
4ES455CS	PYTHON PROGRAMMING LAB	Core					
		L	T	P/D	Credits	CIE	SEE
		-	-	2	1	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To learn how to design and program using lists, tuples, and dictionaries.
2. To learn how to use indexing and slicing to access data in Python programs.
3. To learn structure and components of a Python and to read and write files.
4. To learn how to design object-oriented programs with Python classes and Exception handling techniques.
5. To learn how to design and build the GUI applications usingpython.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Develop solutions to simple computational problems using Python programs.
2. Solve problems using conditionals and loops in Python.
3. Develop Python programs by defining functions and calling them.
4. Use Python lists, tuples and dictionaries for representing compound data.
5. Develop Python programs for GUI applications.

LIST OF EXPERIMENTS

1. Develop program to demonstrate different number data types in python.
2. Develop program to understand the control structures of python.
3. Develop program on String manipulation.
4. Develop program to perform various operations on files.
5. Develop programs to learn different types of structures (list, dictionary, tuples) in python.
6. Develop programs to learn concept of functions scoping, recursion and list mutability.
7. Develop program to demonstrate classes and OOP principles.

8. Develop programs for data structure algorithms using python – searching, sorting and hash tables.
9. Develop programs to understand working of exception handling and assertions.
10. Draw graphics using Turtle.
11. Develop event driven GUI programs.
12. Develop Program for demonstration client server communication.

Note : A minimum of Ten experiments to be performed.

REFERENCES/SUGGESTED READING :

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2nd Edition, 2017, Cengage Learning.
2. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India.

Scheme of Instruction & Examination
B.E. THIRD YEAR, V SEMESTER
ELECTRICAL AND ELECTRONICS ENGINEERING
Semester - V

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			Hours per week				Maximum Marks		
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	4PC508EE	Electrical Machines –II	3	1	0	4	40	60	4
2	4PC509EE	Power Electronics	3	0	0	3	40	60	3
3	4PC510EE	Power Systems –II	3	0	0	3	40	60	3
4	4PC511EE	Electrical Measurements and Instrumentation	3	0	0	3	40	60	3
5	4HS504HS	Effective Technical Communication	2	0	0	2	40	60	2
6	4PE5—EE	Professional Elective-I	3	0	0	3	40	60	3
7	4OE5--	Open Elective-I	3	0	0	3	40	60	3
Laboratories									
8	4PC554EE	Electrical Machines-I Lab	0	0	2	2	40	60	1
9	4PC555EE	Electrical Measurements and Instrumentation Lab	0	0	2	2	40	60	1
		Total	**20**	**1**	**4**	**25**	**360**	**540**	**23**

Professional Elective		
1	4PE501EE	Electrical Safety and Standards
2	4PE502EE	Renewable Energy Sources
3	4PE503EE	Digital Control Systems

Open Elective		
1	1OE501AD	Artificial Intelligence (Not for CSE , AIDS &AIML)
2	2OE501CE	Disaster management (Not for CE)
3	3OE501CS	OOPS using Java (Not for CSE , AIDS &AIML)
4	4OE501EE	Renewable Energy Systems (Not for EEE)
5	5OE501EC	Basics of Electronic Communication (Not for ECE)
6	6OE501ME	Startup Entrepreneurship (Not for ME)

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science

MC: Mandatory Course PC : Professional Core

PE: Professional Elective OE: Open Elective

L:Lecture T:Tutorial P:Practical D:Drawing

CIE: Continuous Internal EvaluationS

EE: Semester End Evaluation (Univ. Exam) EE: Electrical Engg.

Note:

1. Each contact hour is a clock hour.
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Course Code	Course Title	Core/Elective					
4PC508EE	ELECTRICAL MACHINES –II	Core					
		L	T	P/D	Credits	CIE	SEE
		3	1	0	4	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To understand the construction and operating characteristics of Induction motor, synchronous machines and fractional KW machines.
2. To Analyze the Induction motor and Synchronous machine performance for different loading conditions, as well operating in parallel.
3. To know Different starting methods of Induction motor, Synchronous motor and Special motors.
4. To identify different speed control methods and various tests to assess the performance of AC Machines.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Analyze the construction and operating characteristics of 3-phase Induction machines, synchronous machines and Special Machines
2. Analyze the Induction motor and Synchronous machine performance for different loading conditions, as well as operating in parallel.
3. Understand different speed control methods and various tests toassess the performance of AC Machines.
4. Identify and design the suitable AC machine for the desiredapplication based on their characteristics.
5. Analyze different starting methods of AC Machines.

UNIT - I

Poly-Phase Induction Motors : Poly-phase Induction motors construction details of cage and wound rotor machines – production of a rotating magnetic field-principle of operation-rotor EMF and rotor frequency-rotor reactance, rotor current and pf at standstill and during operation. Rotor power input, rotor copper loss and mechanical power developed and their inter relation-torque equation –deduction from torque equation-expressions for maximum torque and starting torque-torque slip

characteristic-double cage and deep bar rotors-equipment circuit – phasor diagram-crawling and cogging.

UNIT - II

Circle Diagram & Speed control of Induction Motors:

Circle Diagram: No load and blocked rotor tests –predetermination of performance-methods of starting and starting current and torque calculations.

Speed control: Change of frequency; change of poles and methods of consequent poles; cascade connection; Injection of EMF into rotor circuit (Qualitative treatment only)-Induction generator-principle of operation, applications.

UNIT - III

Synchronous Generators : Constructional features of cylindrical rotor& Salient pole machines, armature windings- Integral Slot and Fractional Slot, distributed and concentrated, full pitch and short pitch windings. Pitch factor, distribution factor, winding factor and EMF equation, numerical problems. Harmonics in generated EMF, suppression of harmonics, Armature reaction, Leakage reactance, Synchronous reactance &synchronous Impedance-Experimental determination of synchronous reactance, Phasor diagram. Voltage regulation by synchronous impedance method, MMF method, ZPF method and ASA methods. Salient pole.

Alternators - Two reaction theory, Experimental determination of Xd & Xq, Phasor diagram, regulation of salient pole alternator, numerical problems.

UNIT - IV

Parallel operation of Synchronous generators : Synchronization methods, synchronizing power, torque, parallel operation and Load sharing. Effect of change of excitation and mechanical power input, Analysis of short circuit current waveform-determination of sub-transient, transient and steady state reactance, numerical problems.

Synchronous Motors :

Theory of operation, Phasor diagram, variation of current and power factor with excitation, synchronous condenser, mathematical analysis for power developed, hunting and its suppression. Methods of starting, numerical problems.

UNIT - V

Single phase induction motors and Special motors:

Constructional features, double revolving field theory, equivalent circuit-determination of parameters split phase starting methods, stepper motor, BLDC motor, Applications, numerical problems

TEXTBOOKS :

1. P. S. Bimbhra, Electrical Machinery, 7th Edition, Khanna Publishers, 2011.
2. J.B. Gupta. Theory & Performance of Electrical Machines Publishedby S.K. Kataria& Sons, 2015 Edition.
3. I. J. Nagrath and D. P. Kothari, Electric Machines, 5th Edition, Mc Graw Hill Education, 2017.

REFERENCES/SUGGESTEDREADING :

1. A. E. Fitzgerald and C. Kingsley, Electric Machinery, 6th Edition, McGraw Hill Education, 2005.
2. M. G. Say, Performance and design of AC machines, CBS Publishers, 2002.
3. A. S. Langsdorf, Theory of Alternating Current Machinery, 2nd Edition, McGraw Hill Education, 1984.

Course Code	Course Title	Core/Elective					
4PC509EE	POWER ELECTRONICS	Core					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Familiarize with various power electronic converter topologies and their application.
2. Create an awareness of the general nature of power electronic equipment.
3. Understand the key features of the principal power electronicdevices.
4. Get an idea about which device to choose for particular application, base drive and protection of PE devices and equipment common to most varieties.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Explain the operation & characteristics of power semiconductor devices.
2. Explain the triggering and commutation techniques of thyristor.
3. Analyze uncontrolled and controlled rectifiers.
4. Analyze chopping circuits & AC voltage controllers.
5. Analyze cycloconverter and inverter circuits.

UNIT – I

Power Semi Conductor Devices and Commutation Circuits:

Thyristors – Silicon Controlled Rectifiers (SCR's) – Basic theory of operation of SCR – Static & Dynamic characteristics of SCR, other thyristor devices, two transistor analogy of SCR, Turn on methods of SCR, Gate firing methods-R, RC, UJT firing circuits –Commutation methods, Series and parallel connections of SCRs – Snubber circuit details – Specifications and Ratings of SCR, introduction to Integrated gate drives and wide band gap devices.

UNIT – II

AC-DC Converters :

Phase control technique – Single phase Line commutated converters – Half wave controlled converters with Resistive, RL load and RLE load without and with Freewheeling Diode – Numerical problems Single Phase Fully Controlled Converters:

Fully controlled converters, Midpoint and Bridge connections with Resistive, RL loads and RLE load, semi-converters, Effect of source inductance –Numerical problems.

Three phase converters – Three pulse and six pulse converters and bridge connections with R, RL load voltage and current with R and RL load and RLE loads – Semi Converters, Effect of Source inductance–Dual converters Waveforms – Numerical Problems

UNIT – III

DC-DC Converters : Choppers – Time ratio control and Current limit control strategies – Step down chopper, Step up Chopper, step up/down chopper– load voltage expression, Jones chopper, AC Chopper, Problems.

UNIT – IV

AC-AC Converters : Single phase AC voltage with R and RL loads ,Triac with R and RL loads - wave forms , Numerical problems

Cyclo-converters – Single phase mid - point cyclo-converters with R and RL loads-waveforms, Bridge configuration of single phase cyclo-converter– Waveforms.

UNIT – V

DC-AC Converters: Inverters – Single phase inverter – Basic series, parallel inverter –operation and Waveforms – Three phase inverters (180, 120 degrees conduction modes of operation)-Voltage control techniques for inverters, Pulse width modulation techniques – Numerical.

TEXTBOOKS :

1. Power Electronics: Circuits, Devices, and Applications' by M. H. Rashid, Pearson Education India, 2014.
2. Power Electronics: Converters, Applications and Design by N. Mohan and T.M. Undeland, John Wiley & Sons, 2007.

REFERENCES/SUGGESTEDREADING :

1. Fundamentals of Power Electronics by R.W. Erickson and D. Maksimovic, Springer Science & Business Media, 2007.
2. Power Electronics: Essentials and Applications by L. Umanand, WileyIndia, 2009.
3. Power Electronics by Dr. P.S Bimbhra, Khanna Publishers, 2013.

Course Code	Course Title	Core/Elective					
4PC510EE	POWER SYSTEMS-II	Core					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Learn and understand the performance analysis of transmission lines and cables.
2. Comprehend analysis of symmetrical and unsymmetrical faults in the power system.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Calculate and compare the performance (Constants A, B, C & D, voltage regulation & efficiency) of different types of Transmission lines.
2. Explain the reasons for voltage variation, importance of maintaining constant voltage in power system and different voltage control methods.
3. Calculate the P.U quantities in power system and analyze symmetrical fault (LLL Fault) and calculate S.C capacity of a Bus.
4. Draw the diagram of Sequence networks of different components and compute the Unsymmetrical Fault (LG, LL, LLG& LLLG) current value & MVA values.
5. Acquire the knowledge of natural impedance of transmission line and significance in the operation of power system network.

UNIT - I

Transmission Line Theory : Performance of short, medium, long lines - Line calculations - Tuned lines, Power circle diagram and their applications. Corona - Causes - Disruptive and Visual critical voltages - Power loss - Minimization of corona effects.

UNIT - II

Symmetrical Faults : Use of per unit quantities in power systems, advantages of per unit system. Symmetrical Three-phase Faults, Transients in RL series circuits - Short circuit currents - Reactance's of synchronous machines - Symmetrical fault calculations, Short circuit capacity of bus.

UNIT-III

Unsymmetrical Faults: Symmetrical components of unsymmetrical phasors - Power in terms of symmetrical components - Sequence impedance and sequence networks, Sequence networks of unloaded generators - Sequence impedances of circuit elements - Single line to ground, line to line and double line to ground faults on unloaded generator - Unsymmetrical faults of power systems, Open circuit faults.

UNIT-IV

Voltage Control : Phase modifiers, Induction Regulators -Tap changing Transformers, Series and Shunt Capacitors, Reactive Power requirement calculations, Static VAR compensators - Thyristor Controlled reactor, Thyristor switched capacitor.

UNIT-V

Travelling Wave Theory : Causes of over voltages - Travelling wave theory - Wave equation - Open circuited line - The short circuited line - Junction of lines of different natural impedances - Reflection and Refraction Coefficients - Junction of cable and overhead lines - Junction of three lines of different natural impedances- Bewley Lattice diagram.

TEXTBOOKS :

1. CLWadhwa - Electrical Power Systems, New Age International, 4th Edition, 2018.
2. Grainger and Stevenson - Power System Analysis, Tata McGraw Hill, 4th Edition, 2003.
3. Nagarath and Kothari - Modern Power System Analysis, Tata McGraw Hill, 4th Edition, 2012.

REFERENCES/SUGGESTEDREADING :

1. Principles of power systems by VK.Metha, Rohit Mehta, S.Chand & Company Ltd, 8th Edition.
2. A course in Power Systems by J.B.Gupta, S.K.Kataria & sons 11th Edition 2016.

Course Code	Course Title	Core/Elective					
4PC511EE	ELECTRICAL	Core					
	MEASUREMENTS AND	L	T	P/D	Credits	CIE	SEE
	INSTRUMENTATION	3	0	0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To learn and understand the fundamental concepts, principle of operation and applications of various electrical measuring instruments.
2. To understand various types of Bridges in measurement of resistance, inductance, capacitance and frequency.
3. To understand the operation and applications of Ballistic Galvanometer, Flux meter and DC/AC Potentiometer.
4. To understand the application of CRO for measurement of Amplitude, Phase and frequency of sinusoidal signals.

COURSE OUTCOMES :

After completing this course, the student will be able to:

1. Understand the fundamental concepts, principle of operation and applications of various electrical measuring instruments.
2. Understand various types of Bridges in measurement of resistance, inductance, capacitance and frequency.
3. Understand the operation and applications of Ballistic Galvanometer, Flux meter.
4. Analyze the potentiometer operation for voltage measurements
5. Analyze the CTs & PTs operation for voltage ,current measurements

UNIT – I

Instruments :

Indicating, Recording and Integrating instruments, Ammeter, Voltmeter, Expression for torque of moving coil, moving iron, Dynamometer, induction and electrostatic instruments. Extension of range of instruments, Wattmeter Torque expression for dynamometer instruments, Reactive power measurement, Percentage error, Accuracy calculations.

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, Frequency meters, Electrical resonance and Weston type of synchro scope. Concept of digital energy meter

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, Wagners earthing device, Transducers - Analog and digital transducers, Strain gauges and Hall effect transducers, LVDT..

UNIT - IV

Magnetic Measurements and instrument transformers:

Ballistic galvanometer, Calibration by Hibbert' s magnetic standard flux meter, Lloyd-Fischer square for measuring iron loss, Determination of B-H curve and Hysteresis loop using CRO, 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 wattmeters. Use of oscilloscope in frequency, phase and amplitude measurements.

TEXTBOOKS :

1. Shawney A.K., Electrical and Electronics Measurements and Instruments, Dhanpat rai & Sons, Delhi, 2000.
2. Umesh Sinha, Electrical, Electronics Measurement and Instrumentations, Satya Prakashan, New Delhi.

REFERENCES/SUGGESTED READING :

1. Golding E.W., Electrical Measurements and Measuring Instruments, Sir Issac& Pitman & Sons Ltd., London.
2. U.A.Bakshi, A.V.Bakshi, Electrical and Electronic Instrumentation, Technical publications.

Course Code	Course Title	Core/Elective					
4HS504HS	EFFECTIVE	Core					
	TECHNICAL	L	T	P/D	Credits	CIE	SEE
	COMMUNICATION	3		0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To understand the process, features and barriers of Communication.
2. To learn the aspects of communication and Presentation.
3. To comprehend the types of official and business correspondence.
4. To analyze the techniques of Report Writing Aspects of data transfer andpresentation.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Handle Technical Communication effectively by overcoming barriers of communication.
2. Use different types of Professional correspondence to communicate effectively.
3. Use different types of Business and Inter Office Correspondence.
4. Acquire adequate skills to draft reports efficiently.
5. Enhance their skills of information transfer.

UNIT - I

Introduction to Communication: Definition, process and Channels of Communication. ABC of Technical communication Barriers to communication Differences between general and Technical writing.

UNIT - II

Aspects of Communication : Importance of listening and types of Listening, Types of Technical communication (Oral and Written), Features of technical communication (Precision, relevance, format, style & Use of visual aids),Persuasive Techniques.

UNIT - III

Technical Writing-I: Emails, IOM, Business Letters - enquiry and response;

compliant and Adjustment; placement of order; Cover letters/Job Application & Resume Writing, Business Proposals.

UNIT - IV

Technical Writing –II : Types of technical Reports (Informative, analytical, periodic, Special, formal and Informal) Formal Elements of a Report, Feasibility, Project, Progress and Evaluation reports.

UNIT - V

Information Transfer and Presentations: Non-verbal to verbal, Verbal to Non – Verbal, Important aspects of Oral and Visual Presentations.

TEXTBOOKS :

1. Raman, Meenakshi & Sharma, Sangeeta. (2015). Technical Communication: Principles and Practice (3rd Ed.). New Delhi. OUP.
2. Rizvi, Ashraf, M (2017). Effective Technical Communication (2nd Ed.) New Delhi, Tata McGraw Hill Education.
3. Sharma, R. C, & Mohan, Krishna. (2017). Business Correspondence and Report Writing: A Practical approach to business & technical communication (4th ed.) New Delhi, Tata McGraw Hill Education.

REFERENCES/SUGGESTEDREADING :

1. Tyagi, Kavita &Misra, Padma. (2011). Advanced Technical Communication. New Delhi, PHI Learning.
2. Jungk, Dale. (2004). Applied Writing for technicians. Newyork, McGraw Hill Higher Education.

Course Code	Course Title	Core/Elective					
4PE501EE	ELECTRICAL SAFETY AND STANDARDS (PROFESSIONAL ELECTIVE – I)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

1. To provide a comprehensive exposure to electrical hazards.
2. To understand various grounding techniques and safety procedures
3. To know about various electrical maintenance techniques

COURSE OUTCOMES :

After completing this course, the student will be able to:

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 IErule

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 shop.

UNIT - II

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 - III

Electrical Safety during Installation, Testing and Commissioning, Operation and Maintenance: Preliminary preparations –safe sequence –risk of plant and equipment –safety documentation –field quality and safety -personal protective equipment – safety clearance notice –safety precautions –safeguards for operators –safety.

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's for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/ enclosure for hazardous locations.

UNIT - V

Fire Extinguishers : Fundamentals of fire-initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system;CO2and Halogen gas schemes; foam schemes.

TEXTBOOKS :

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988
2. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth Company, 1978.
3. John Codick, "Electrical safety hand book", McGraw Hill Inc., New Delhi, 2000.

REFERENCES/SUGGESTEDREADING :

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Wadhwa, C.L., "Electric Power Systems", New Age International, 2004.

Course Code	Course Title	Core/Elective					
4PE502EE	RENEWABLE ENERGY SOURCES (PROFESSIONAL ELECTIVE – I)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

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

COURSE OUTCOMES :

At the end of the course students will be able to

1. Understand theadvantages, disadvantages and applications of different non-conventional sources.
2. Analyze principle of operation and applications of different Fuelcells.
3. Analyze the principles of Solar and Wind Energy sources and its applications.
4. Understand the principles of OTEC and GTE.
5. Analyze the biomass conversion technologies , Biogas generation and Biogas plants.

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 °2Cell - 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, V-I and P-V curves and the concept of MPPT.

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 Geo-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.

TEXTBOOKS :

1. Rai G.D, Non-Conventional Sources of Energy, Khandala Publishers, New Delhi, 2011.
2. David M Buchla and Thomas E Kissell ,Renewable Energy Systems, 1st Edition by, Pearson India.

REFERENCES/SUGGESTEDREADING :

1. M.M.El-Wakil, Power Plant Technology, McGraw Hill, 1984.
2. JohnTwidell, Tony Weir, Renewable Energy R73esources, 3rd Edition, Taylor and Francis.

Course Code	Course Title	Core/Elective					
4PE503EE	DIGITAL CONTROL SYSTEMS (PROFESSIONAL ELECTIVE-I)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To impart knowledge in the significance and features of design of discrete-time control system.
2. To review on the different transform techniques for digital control system design.
3. To impart knowledge on the techniques to analyze the system performance in the discrete-time domain.
4. To impart knowledge in discrete state space controller design.

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Understand the various issues related to digital control systems such as effects of sampling andquantization, discrete time signals and models.
2. Represent a discrete-time control system using state spacetechnique.
3. Design discrete control systems via pole placement.
4. Design observers for discrete control systems.
5. Analyze the stability of a discrete-time controlsystem.

UNIT - I

Introduction to digital control Configuration of basic digital control system: discrete transfer function, discrete model sampled data systems using z- transform, transfer function model, signal analysis and dynamic response, zero-order hold equivalent, introduction to first-order-hold equivalent, transformation between splane, z-plane and w-plane, z-Domain description of sampled continuous-time systems. Controller design Controller Design using transform techniques: Root locus and frequency domain analysis compensator design.

UNIT-II

State space theory Control system analysis using state variable method: vector and matrices, state variable representation, conversion of state variable to transfer function and vice versa, conversion of transfer function to canonical state variable models, system realization, solution of state equations. Solution of discrete-time state equation. Computational methods.

UNIT-III

State space design using state-space methods: controllability and observability, control law design, pole placement, pole placement design using computer aided control system design (CACSD).

UNIT-IV

Observer design: Full order and reduced order discrete observer design - Kalman filter and extended Kalman filter design.

UNIT-V

Stability improvement by state feedback: Stability analysis and Jury's stability criterion, Lyapunov stability analysis to linear systems and discrete systems, Stability Improvement by state feedback.

TEXTBOOKS:

1. K. Ogata, Discrete Time Control Systems, Prentice Hall India, 2nd edition, 2005.
2. M. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, 4th edition., 2017.

REFERENCES/SUGGESTEDREADING:

1. R. Isermann, Digital Control Systems Vol .1&2, Springer-Verlag, 1991.
2. B. C. Kuo, Digital Control System, Oxford University Press, 2nd edition., 2007.

Course Code	Course Title	Core/Elective					
1OE501AD	ARTIFICIAL	Elective					
	INTELLIGENCE	L	T	P/D	Credits	CIE	SEE
	(OPEN ELECTIVE-I)	3		0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To introduce the AI techniques to solve problems and search strategies to find optimal solution paths from start to goal state.
2. To introduces different knowledge representation methods in AI Programs.
3. To introduce different design techniques for Game Playing Programs.
4. To introduce the AI Agents their design, planning and learning techniques.
5. To introduce the natural language processing and expert systems

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand fundamental AI concepts and identify a range of symbolic and non symbolic AI techniques.
2. Demonstrate an understanding of various searching algorithms such as adversarial search and game-playing commonly used in artificial intelligence software.
3. Use different knowledge representation techniques used in AI Applications.
4. Demonstrate an understanding of agent based AI architectures, planning and logic based agents.
5. Exploring Expert systems.

UNIT - I

Introduction : Artificial Intelligence and its applications, Artificial Intelligence Techniques.

Problem solving techniques: State space search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hill climbing, best first search, A* search, AO* search, Constraint satisfaction problem, Agenda Driven Search, Mean-end analysis, Min- Max Search, Alpha-Beta Pruning, Iterative Deepening.

UNIT - II

Knowledge representation : Mapping between facts and representations, Approaches to knowledge representation, procedural vs. declarative knowledge, Forward vs. Backward reasoning, Matching, conflict resolution, Weak and Strong filler structures.

UNIT - III

Non Monotonic and Statistical Reasoning : on monotonic Logic, Default Logic, Circumscription, Bayes Theorem, Bayesian Network, Dempster Shafer Theory, Fuzzy sets, Fuzzy Logic, Defuzzification.

UNIT - IV

Planning and Learning Agents: Intelligent Agents, Nature and structure of Agents, Learning Agents, Introduction to different Forms of Learning, The Planning problem, planning with state space search, partial order planning, planning graphs, planning with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning.

UNIT - V

Introduction to Learning and Expert system : Expert systems, Expert system examples, Expert System Architectures, Rule base Expert systems, Non Monotonic Expert Systems, Decision tree base Expert Systems.

TEXTBOOKS :

1. AI: A Modern Approach Stuart J. Russel, Peter Norvig Pearson Education Latest Edition, 2012.
2. Artificial Intelligence Elaine Rich, Knight McGraw Hill Third Edition 2010.
3. Artificial Intelligence, Saroj Kaushik Cengage Learning, First Edition 2011.

REFERENCES/SUGGESTEDREADING :

1. Artificial Intelligence, Partick Henry Winston Addison Wesley Latest Edition 2012.
2. Artificial Intelligence George Luger Pearson Education Latest Edition 2010.

Course Code	Course Title	Core/Elective					
2OE501CE	DISASTER MITIGATION (OPEN ELECTIVE-I)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3		0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. Define disaster and explain the different types of disasters.
2. Describe the disaster management cycle and the role of NDMA in disaster management.
3. Analyze the legal aspects of disaster management.
4. Develop disaster mitigation plans.
5. Participate in disaster response and recovery activities.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Demonstrate the concepts of disaster management.
2. Identify different types of disasters.
3. Explain the disaster management cycle.
4. Illustrate the role of NDMA in disaster management.
5. Explain the development of disaster mitigation plan.

UNIT - I

Introduction to Disaster Management: Definition of disaster, Types of disasters, History of disaster management in India, National Disaster Management Authority (NDMA) and its role in disaster management, Disaster management cycle.Case studies of disasters in India and the world.

UNIT - II

Disaster Mitigation : Mitigation measures for different types of disasters, Use of technology in disaster mitigation, Disaster risk assessment, Disaster preparedness, Exercises and simulations on disaster mitigation.

UNIT - III

Disaster Response : Search and rescue operations, Medical relief, Food and shelter, Restoration of essential services, Rehabilitation and reconstruction.

UNIT - IV

Disaster Law and Policy: Disaster management acts of India, Disaster management policies of India, Legal aspects of disaster management.

UNIT - V

Disaster Communication and Public Awareness: Importance of communication in disaster management, Methods of disaster communication, Public awareness programs, Case studies of disaster communication and public awareness in India and the world.

TEXTBOOKS :

1 R.Subramanian, Disaster Management, Vikas Publishing House, 2018.

2 M. M. Sulphey, Disaster Management, PHI Learning, 2016.

REFERENCES/SUGGESTEDREADING :

1 S. C. Sharma, Disaster Management: Concepts, Approaches and Techniques, Khanna Book Publishing House, 2017.

2 G. K. Ghosh, Disaster Management: Theory and Practice, APH Publishing Corporation, 2018.

Course Code	Course Title	Core/Elective					
3OE501CS	OOPS USING JAVA (OPEN ELECTIVE-I)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3		0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. The Java programming language: its syntax, idioms, patterns and styles
2. Object oriented concepts in Java and apply for solving the problems.
3. How exception handling and multithreading makes Java robust.
4. Explore java Standard API library such as io, util, applet,awt.
5. Building of applications using Applets and Swings.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand the concept of OOP and analyze relationships among classes, objects.
2. Develop programs using concepts like inheritance, packages, interfaces, Java I/O streams and strings
3. Utilize exception handling and Multithreading concepts to develop Java programs
4. Interpret the Java Collection API, Java utility classes, concept of files and serialization
5. Design GUI applications using concepts like AWT controls and Swings and client server programs using networking concepts

UNIT - I

Object Oriented Programming : Principles, Benefits of Object Oriented Programming. Introduction to Java: Java buzzwords, byte code. Java Programming Fundamentals: Applet and Application program using simple java program, data types, variables, arrays, operators, expressions, control statements, type conversion and casting, concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, introducing access control, static, final, nested and inner classes, exploring string class, using command-linear arguments.

Inheritance: Inheritance concept, types of inheritance, Member access rules, use of super and final. Polymorphism - dynamic binding, method overriding, abstract classes and methods.

UNIT - II

Interfaces : Defining an interface, implementing interfaces, extending interface. **Packages:** Defining, Creating and Accessing a Package, importing packages

Exception handling : Benefits of exception handling, classification, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, re throwing exceptions, built in exceptions, creating own exception sub classes Multith reading: Java Thread Model, The Main Thread, creating a Thread, creating multiple threads, using is Alive and join, thread priorities, synchronization, inter thread communication, deadlock

UNIT - III

Collections: Overview of Java Collection frame work, commonly used Collection classes – Array List, Linked List, Hash Set, Tree Set, Collection Interfaces – Collection, List, Set. Accessing Collection via iterator, working with Map. Legacy classes and interfaces – Vector, Hash table, Stack, Dictionary, Enumeration interface.

Other Utility classes: String Tokenizer, Date, Calendar, Gregorian Calendar, Scanner Java Input/Output: exploring java.io, Java I/O classes and interfaces, File, Stream classes, byte stream, character stream, serialization..

UNIT-IV

GUI Programming with java : The AWT class hierarchy, MVC architecture. **Applet Revisited:** Basics, architecture and skeleton, simple applet program. Event Handling: Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces. Handling mouse and keyboard events, Adapter classes. Database Programming using JDBC: Introduction to JDBC, JDBC Drivers & Architecture, CURD operation Using JDBC, Connecting to non-conventional Databases.

UNIT - V

Exploring Swing : JLabel, Image Icon, J Text Field, the Swing buttons, J Tab bed pane, J Scroll Pane, J List, J Combo Box. Servlet: Life cycle, using tomcat, simple servlet, servlet API, javax.servlet package, reading servlet parameters, javax.servlet. http package, handling HTTP requests and responses

TEXTBOOKS :

1. Java: The Complete Reference, X Edition, Herbert Schildt, McgrawHill.
2. Java Fundamentals: A Comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
3. Java for Programming, P.J.Dietel X Edition, PearsonEducation

REFERENCES/SUGGESTEDREADING :

1. TheJavaProgramming Language, Ken Arnold, David Holmes, James Gosling, Prakash Goteti, III Edition, Pearson 2008
2. An Introduction to OOP, T. Budd, IIIEdition, Pearson Education.
3. Introduction to Java Programming, Y. Daniel Liang, X Edition, Pearson Education

Course Code	Course Title	Core/Elective					
4OE501EE	RENEWABLE ENERGY SYSTEMS (OPEN ELECTIVE – I)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

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

COURSE OUTCOMES :

At the end of the course students will be able to

1. Understand the advantages, disadvantages and applications of different non-conventional sources.
2. Analyze principle of operation and applications of different Fuel cells.
3. Analyze the principles of Solar and Wind Energy sources and its applications.
4. Understand the principles of OTEC and GTE.
5. Analyze the biomass conversion technologies, Biogas generation and Biogas plants.

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 °2Cell - 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, V-I and P-V curves and the concept of MPPT.

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 Geo-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.

TEXTBOOKS :

1. Rai G.D, Non-Conventional Sources of Energy, Khandala Publishers, New Delhi, 2011.
2. David M Buchla and Thomas E Kissell ,Renewable Energy Systems, 1st Edition by, Pearson India.

REFERENCES/SUGGESTEDREADING :

1. M.M.El-Wakil, Power Plant Technology, McGraw Hill, 1984.
2. John Twidell, Tony Weir, Renewable Energy R73esources, 3rd Edition, Taylor and Francis.

Course Code	Course Title	Core/Elective					
5OE501EC	BASICS OF	Elective					
	ELECTRONIC	L	T	P/D	Credits	CIE	SEE
	COMMUNICATION (OPEN ELECTIVE-I)	3	0	0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To provide an introduction to fundamental concepts in the understanding ofcommunications systems.
2. To describe the network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
3. To discuss the evolution of wireless systems and current wirelesstechnologies

COURSE OUTCOMES :

At the end of the course students will be able to

1. Understand the working of analog and digital communication systems.
2. Explain the OSI network model and the working of datatransmission.
3. Describe the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.
4. Differentiate between analog and digital modulation techniques.
5. Understand the optical fiber communication link, structure, propagation and transmission properties.

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 – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/ IPv6), Transport Layer – TCP, UDP.

UNIT - IV

Telecommunication Systems : Telephones, Telephone system, **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, OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

TEXTBOOKS :

1. Louis E. Frenzel, "Principles of Electronic Communication Systems", 3rd edition, McGraw Hill, 2008.
2. George Kennedy, Bernard Davis, "Electronic Communication systems", 4th edition, McGraw Hill, 1999.

REFERENCES/SUGGESTED READING :

1. M Behrouz A. Forouzan, "Data Communications and Networking", 5th edition, TMH, 2012.
2. Rappaport T.S., "Wireless communications", 2nd edition, Pearson Education, 2010.
3. Wayne Tomasi, "Advanced Electronic Communications Systems", 6th edition, Pearson Education.

Course Code	Course Title	Core/Elective					
6OE501ME	START- UP ENTREPRENEURSHIP (OPEN ELECTIVE-I)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To motivate students to take up entrepreneurship in future.
2. To learn nuances of starting an enterprise & project management.
3. To understand project formulation and choice Technology in Enterprise.
4. To understand Intellectual properties, patents, Start-ups

COURSE OUTCOMES :

At the end of the course students will be able to

1. Understand Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Understand the concept of Intellectual Property Rights and Patents
5. Comprehend the aspects of Start-Ups.

UNIT - 1

Entrepreneurship : Definition, functions of Entrepreneurship, Characteristics and qualities of entrepreneurs, Entrepreneur vs. intrapreneur, need of innovation, Economic growth. Small Scale Industry in India, Linkage among small, medium and heavy industries.

UNIT – II

Indian Industrial Environment : Competence, Opportunities and Challenges, Emergence of First generation entrepreneurs, women entrepreneurs. Conception and evaluation of ideas and their sources. Types of enterprises. - Collaborative interaction for Technology development. Corporate Social Responsibility.

UNIT – III

Project formulation : Introduction, Elements of Business Plan and its salient features, Analysis of market demand, Financial and profitability analysis and Technical analysis.

UNIT – IV

Intellectual Property Rights : Meaning, Nature, Classification and protection of Intellectual Property, the main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of a patent, Licensing, Transfer of technology.

UNIT - V

Aspects of Start-Up : What is Start-Up, Start-up Policy, start-up strategy, Progress of startups in India, Principles of future organizations, start-up sectors and action plan for start-ups by Govt. of India.

TEXTBOOKS :

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata McGraw-Hill Publishing Company Ltd. 1995.
3. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.

REFERENCES/SUGGESTEDREADING :

1. G.S. Sudha, "Organizational Behaviour", 1996.
2. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005.
3. G.B. Reddy, Intellectual Property Rights and the Law 5th Ed. 2005 Gogia Law Agency.
4. Ajit Parulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications, Macmillan India Ltd, 2006.

Course Code	Course Title	Core/Elective					
4PC554EE	ELECTRICAL MACHINES - I LAB	Core					
		L	T	P/D	Credits	CIE	SEE
		0	0	2	1	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To gain thorough knowledge about operation and the performance of DC Machines.
2. To understand Different starting methods of DC Machines.
3. To draw the performance characteristics of DC Machines for different load conditions.
4. To understand the performance characteristics of transformers by conducting various experiments and tests.

COURSE OUTCOMES :

After completion of this course student should be able to:

1. Apply and conclude the principles of Electrical Machines through laboratory experimental work.
2. Construct the circuit to perform experiments, measure, analyze the observed data & come to a conclusion and Organize reports based on performed experiments with effective demonstration of diagrams and characteristics / graph.
3. Compare the performance characteristics of different electrical machines.
4. Demonstrate the starting & speed control of various DCmotors.
5. Determine efficiency & voltage regulation of electrical machines by varioustests.

LIST OF EXPERIMENTS

1. Magnetization Characteristics of DC Shunt Generator. Determination of its critical field resistance and critical speed.
2. Brake test on DC shunt motor.
3. Brake test on DC Compound motor.

4. Load test on DC Shunt Generator.
5. Hopkinson's Test on DC Shunt Machines.
6. Swinburne's Test on DC Machine.
7. OC & SC test on single phase transformer.
8. Separation of No Load losses in DC Shunt Motor.
9. Retardation test on DC shuntmotor.
10. Speed control of DC shunt motor.
11. Sumpner's test.
12. Hopkinsons test.
13. Load test on single phasetransformer.

Note : At least 10 experiments should be Conducted.

SUGGESTEDREADING:

1. Electrical Machinery, Theory: Performance & Applications, Dr. P. S. Bimbhra, Khanna Publishers, 2021.
2. Nagarath & D.P.Kothari: Electrical Machines,TMH Publishers, 5th edition 2017.
3. Theory & Performance of Electrical Machines by J.B. Gupta, S.K. Kataria & Sons, 5th Edition, 2013.
4. Electric Machines, P. S Bimbhra- 2nd Edition, Khanna Publishers, 2017.

Course Code	Course Title	Core/Elective					
4PC555EE	ELECTRICAL	Core					
	MEASUREMENTS AND	L	T	P/D	Credits	CIE	SEE
	INSTRUMENTATION LAB	0	0	2	1	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To determine unknown inductance, resistance, capacitance by performing experiments on D.C Bridges &A.C Bridges.
2. To determine three phase active & reactive powers using single wattmeter method practically. Measurement of parameters of choke coil
3. To calibrate LPF Watt Meter, energy meter, P.F Meter using electro dynamo meter type instrument as the standard instrument.
4. To determine the ratio and phase angle errors of current transformer and potential transformer

COURSE OUTCOMES :

After completing this course, the student will be able to :

1. Calibrate various electrical measuring/recording instruments. Get the ability to choose instruments and can test any instrument can find the accuracy of any instrument by performing experiment can calibrate PMMC instrument using D.C potentiometer.
2. Accurately determine the values of inductance and capacitance using A.C bridges Accurately determine the values of very low resistances
3. Measure reactive power in 3-phase circuit using single wattmeter
4. Determine ratio error and phase angle error of CT & amp; PT
5. Students should be able to test current transformers and dielectric strength of oil. Students should be able to calibrate LVDT.

LISTOFEXPERIMENTS

1. Measurement of low resistance by Kelvin's DoubleBridge.
2. Calibration of single phase energy meter and study of digital 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 Reactive power by single wattmeter method.
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 frequency of unknown sinusoidal signal with CRO.
9. Measurement of phase and amplitude using CRO.
10. Measurement of R, L, C & Q at 1KHz and 100 KHz frequency of supply by using LCR meter.
11. Displacement measurement using LVDT
12. Measurement of % ratio error and phase angle of given P.T.
13. Measurement of 3 phase power with single watt meter and 2 No's C.T.
14. Calibration of LPF meter by phantom loading.
15. Measurement of Active power by two wattmeter method.

Note : At least 10 experiments should be conducted.

SUGGESTED READING :

1. Shawney A.K., Electrical and Electronics Measurements and Instruments, Dhanpatrai& Sons, Delhi, 2000.
2. Umesh Sinha, Electrical, Electronics Measurement and Instrumentations, Satya Prakashan, New Delhi.

Scheme of Instruction & Examination
B.E. THIRD YEAR, VI SEMESTER
ELECTRICAL AND ELECTRONICS ENGINEERING
Semester-VI

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			Hours per week				Maximum Marks		
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	4PC612EE	Switch Gear and Protection	3	0	0	3	40	60	3
2	4PC613EE	Power Electronic Control of Electrical Drives	3	0	0	3	40	60	3
3	4PC614EE	Microprocessors & Micro Controllers	3	0	0	3	40	60	3
4	4ES606EC	Signals & Systems	3	0	0	3	40	60	3
5	4PE6--EE	Professional Elective-II	3	0	0	3	40	60	3
6	4OE6--	Open Elective –II	3	0	0	3	40	60	3
Laboratories									
7	4PC656EE	Electrical Machines-II Lab	0	0	3	3	40	60	1.5
8	4PC657EE	Power Electronics and Drives Lab	0	0	3	3	40	60	1.5
9	4PW601EE	Mini Project Seminar	0	0	2	2	40	60	1
10	4HS654HS	Soft Skills Lab	0	0	2	2	40	60	1
11	4PW701EE	Summer Internship*	4 weeks during summer						
Total			**18**	**0**	**10**	**28**	**440**	**660**	**23**

Professional Elective		
1.	4PE604EE	Energy Storage Systems
2.	4PE605EE	Electric Vehicles
3.	4PE606EE	Self-Study Course

Open Elective		
1.	4OE602EE	Electric Vehicle Technology (Not For EEE)
2.	3OE602CS	Software Engineering (Not For CSE , AIDS & AIML)
3.	6OE602ME	3-D Printing (Not For ME)
4.	2OE602CE	Green Building Technologies (Not For CE)
5.	1OE602AD	Deep Learning(Not For CSE , AIDS & AIML)
6.	5OE602EC	Fundamentals of IOT (Not For ECE)

HS : Humanities and Social Sciences BS : BasicScience ES : Engineering Science

MC: MandatoryCourse PC : ProfessionalCore PE : Professional Elective

OE: Open Elective PW: Project Work L:Lecture

T:Tutorial P:Practical D:Drawing

CIE: ContinuousInternal Evaluation

SEE:SemesterEndEvaluation(Univ.Exam) EE:ElectricalEngg.

Note:

1. Each contact hour is a clock hour.
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student the complete the experiment.

* Students have to undergo summer internship of 4-6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

Course Code	Course Title	Core/Elective					
4PC612EE	SWITCHGEAR AND PROTECTION	Core					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To be able to understand the need of protection in power system and protection with conventional and staticrelays.
2. To understand the protection of transformers, generators andneed of circuit breakers.

COURSE OUTCOMES :

At the end of the course students will be able to

1. Acquire the knowledge of construction, working principles and testing of different electromagnetic relays, static relays, distance relays, differential relays and circuit, breakers used to protect generators, Transformers, Transmission lines and distribution feeders.
2. Analyze the characteristics of over current, over voltage, distance and differential relays.
3. Select the ratings of relays and circuit breakers for different applications.
4. Explain the construction details, advantages and disadvantages of Gas insulated substations 5 Explain the protection methods used against over voltages.

UNIT - I

Introduction to Protective Relays : Need for protection - primary protection - backup protection Zones of protection - Definitions of relay pick up and reset values - Classification of relays - Operating principles and construction of Electromagnetic and Induction type relays. Over current relay - Over voltage – Directional relay - Universal relay torque equation. Over current protection for radial feeder and ring mains - Protection of parallel lines - Relay settings for over current relays Earth fault and phase fault protection.

UNIT - II

Static Phase and Amplitude Comparators: Characteristics of dual input comparators. Static Relays -Instantaneous over current relay - Definite time over current relay - Inverse time over current relay – Directional over current relay (Block diagram approach only) Distance protection - Characteristics of 2- input distance relays on

the RX diagram - Input characteristics for various types of distance relays - 3-step distance relays Microprocessor based / numerical over current, over voltage, under voltage relay (block diagram).

UNIT-III

Transformer and Generator Protection : Differential relays - Percentage differential relays protection of generator and transformer using percentage differential relays, Split phase protection, Overheating, Loss of excitation - Protection of transformers against magnetizing inrush - Buchholz relay - Protection of earthing transformers.

UNIT-IV

Circuit Breakers : Need for circuit breakers, Parts of circuit breaker trip coil circuit-Arc properties -Principles of arc quenching - Theories, Recovery and restriking voltages - Rating of circuit breakers – Rated symmetrical and asymmetrical breaking current - Rated making current - Rated capacity, Voltage and frequency of circuit breakers, Auto re-closure-duty cycle, Current chopping - Resistance switching - Derivations of RRRV - Maximum RRRV, Recovery voltage, Problems - Types of circuit breakers - Oil, Minimum oil, Air, Air blast, SF, Vacuum and miniature circuit breakers, Testing of circuit breakers.

UNIT-V

Gas Insulated Substations and Over Voltage Protection : Constructional details (components), Merits and demerits, Protection of lines against direct lightning strokes - ground wires - Protection angle Protection zone - Tower footing resistance and its effects.

- Equipment protection assuming rod gaps, arcing horns - Different types of lightning arresters - their construction Surge absorbers - Peterson coil – Insulation Coordination.

TEXTBOOKS:

1. Wadhwa C.L, Electrical Power System, Wiley Eastern Ltd., 2022.
2. Badriram, Viswakarma, Power System Protection and Switchgear, Tata McGraw Hill, 2003.
3. Sunil S. Rao, Switchgear and Protection, Khanna Publications, 2000.

REFERENCES/SUGGESTEDREADING:

1. M.S. Naidu, Gas Insulated Substations, I.K. int. Publishing House Pvt. Ltd. - 2008.
2. Fundamentals of Power Sytem Protection, Y.G.Paithankar, S.R.Bhide PHI Learning Private Limited - 2009.
3. Principles of power systems by VK.Metha , Rohit Mehta, S.Chand & Company Ltd, 8th Edition
4. A course in Power Systems by J.B.Gupta, S.K.Kataria & sons 11th Edition 2016.

Course Code	Course Title	Core/Elective					
4PC613EE	POWER ELECTRONIC CONTROL OF ELECTRICAL DRIVES	Core					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Apply the concepts of power electronic circuits to various motors.
2. Understand the operation of various drives.
3. Control DC motors and AC motors fed by various power electronic circuits.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Apply the concepts of rectifiers to analyze DC Motor.
2. Control DC motors with Dual converters.
3. Apply chopper concepts to analyze DC motors.
4. Apply AC voltage regulator concepts to analyze Induction motors.
5. Explain the synchronous motor operation fed by inverters.

UNIT – I

Control of DC Motors through Phase Controlled Rectifiers:

Introduction to Thyristor controlled Drives, Single Phase semi and fully controlled converters connected to DC separately excited and DC series motors – continuous current operation – output voltage and current waveforms – Speed and Torque expressions – Speed – Torque Characteristics.

Three phase semi and fully controlled converters connected to DC separately excited and DC series motors – output voltage and current waveforms – Speed and Torque expressions – Speed – Torque characteristics – Problems.

UNIT – II

Four Quadrant Operation of DC Drives through Dual Converters:

Introduction to Four quadrant operation – Motoring operations, Electric Braking – Plugging, Dynamic and Regenerative Braking operations. Four quadrant operation of DC motors by dual converters – Closed loop operation of DC motor.

UNIT - III

Control of DC Motors by Choppers :

Single quadrant, Two –quadrant and four quadrant chopper fed DC separately excited and series excited motors – Continuous current operation – Output voltage and current wave forms – Speed torque expressions – speed torque characteristics – Closed Loop operation ,Problems, BLDC Motor construction and control methods.

UNIT – IV

Control of Induction Motors :

Control of Induction Motor by AC Voltage Controllers – Waveforms – speed torque characteristics. Variable frequency characteristics: Variable frequency control of induction motor by Voltage source and current source inverter, cyclo-converters PWM control – Comparison of VSI and CSI operations – Speed torque characteristics – Closed loop operation of induction motor drives Static, problems. Rotor resistance control: Slip power recovery – Static Scherbius drive – Static Kramer Drive – their performance and speed torque characteristics – advantages applications – problems.

UNIT – V

Control of Synchronous Motors:

Separate control &self-control of synchronous motors – Operation of self-controlled synchronous motors by VSI and CSI cyclo converters. Load commutated CSI fed Synchronous Motor – Operation – Waveforms – speed torque characteristics – Applications

– Advantages and Numerical Problems – Closed Loop control operation of synchronous motor drives (Block Diagram Only), variable frequency control, Cyclo converter, PWM, VFI, CSI.

TEXTBOOKS :

1. Fundamentals of Electrical Drives , G.K Dubey, Narosa Publications.
2. Power Electronics: Circuits, Devices, and Applications' by M. H. Rashid, Pearson Education India, 2014.
3. Power Electronics byDr. P.S Bimbhra, Khanna Publishers, 2013.

REFERENCES/SUGGESTEDREADING :

1. Power Electronics: Converters, Applications and Design by N. Mohan and T.M. Undeland, John Wiley & Sons, 2007.
2. Fundamentals of Power Electronics by R.W. Erickson and D. Maksimovic, Springer Science & Business Media, 2007.
3. Power Electronics: Essentials and Applications byL. Umanand, Wiley India, 2009.

Course Code	Course Title	Core/Elective					
4PC614EE	MICROPROCESSOR AND MICRO CONTROLLERS	Core					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To be able to understand in details about 8086 microprocessor architecture, programming and interfacing.
2. To be able to understand about 8051 microcontroller architecture, an programming.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Explain the architecture of 8086.
2. Analyze the applications by writing the assembly language programs.
3. Explain the interfacing of Microprocessor.
4. Explain types of microcontrollers and their applications.
5. Knowledge on ARM Architecture.

UNIT - I

Microprocessor : Architecture of 8086 – Segmented memory, Addressing modes, Instruction set, Minimum and maximum mode operations.

UNIT-II

Introduction to Programming : Assembly language programming, Assembler directives, Simple programs using assembler, Strings, Procedures, Macros timing.

UNIT-III

Interfacing to Microprocessor : Memory and I/O interfacing, A/D and D/A interfacing, 8255(PPI), Programmable Internal Timer (8253), Keyboard and display interlace, Interrupts of 8086.

UNIT-IV

Micro Controller Architecture : Types of Micro Controllers, 8051 MC – Architecture input/output pins, Port and circuits, Internal and external memories, counters and timers, serial data input/output, Interrupts & timers.

UNIT-V

Introduction to Programming : Basic Assembly language programming, instruction cycle, Addressing modes,8051 instruction set, Classification of instructions, Simple programs.

Introduction to ARM Controller : ARM Processor fundamentals, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table.

TEXT BOOKS :

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2nd Edition 2006.
2. Microprocessors and Interfacing, D. V. Hall, MGH, 2nd Edition 2006.
3. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012.

REFERENCES/SUGGESTEDREADING :

1. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed.
2. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
3. The 8051 Microcontrollers, Architecture and Programming and Applications -K.Uma Rao, AndhePallavi, Pearson, 2009.

Course Code	Course Title	Core/Elective					
4ES606EC	SIGNALS & SYSTEMS	Core					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Analyze basic concepts related to continuous time signals and systems, mathematical representation of periodic signals.
2. Familiarize with basic operations on signals and mathematical representation of a periodic signals using Fourier and Laplace transform.
3. Analyze basic concepts related to discrete time signals and systems, mathematical representation discrete time signals.
4. Describe the concept of Z- Transform and its properties and illustrate their applications to analyze systems.
5. Define convolution operations on continuous and discrete time signals.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Define and differentiate types of signals and systems in continuous and discrete time
2. Apply the properties of Fourier transform for continuous time signals
3. Relate Laplace transforms to solve differential equations and to determine the response of the Continuous Time Linear Time Invariant Systems to known inputs
4. Apply Z-transforms for discrete time signals to solve Difference equations
5. Analyze Linear and circular Convolution on of discrete time signals with graphical representation.

UNIT-I

Introduction to continuous time signals : Elementary basic time signals, Basic operations on continuous-time signals. Classification of continuous time signals.

Introduction to discrete-time signals: Sampling and Sampling Theorem, Classification of discrete time signals.

UNIT - II

Behavior of continuous and discrete-time LTI systems: System properties: linearity: additive and homogeneity, shift- invariance, causality and stability. Linear and circular convolution, properties of convolution. System representation through differential equations and difference equations.

UNIT - III

Frequency domain representation of continuous time signals: Fourier series– Existence of Fourier series, Trigonometric and Exponential Fourier series.

Fourier Transform: The direct and inverse FT, existence of FT, Properties of FT, FT of standard signals, properties of FT.

UNIT - IV

Laplace transforms: The direct LT, Region of convergence, existence of LT, properties of LT. The inverse LT, Solution of differential equations, system transfer function.

UNIT-V

Z-Transforms: The direct Z transforms, Region of convergence, Z-plane and S-plane correspondence, Properties of Z- transforms. Inverse Z transforms System transfer function. Solution to linear difference equations,

TEXTBOOKS :

1. A. Nagoor Kani, Signals and Systems, Tata McGraw Hill, 2011.
2. P. Ramesh babu, R Ananada Natarajan, “Signals and Systems”, SCITECH, 3rd edition, 2009.

REFERENCES/SUGGESTED READING :

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, Signals and systems, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms, an Applications, Pearson, 2006.
3. H. P. Hsu, Signals and systems, Schaum‘s series, McGraw Hill Education, 2010.

Course Code	Course Title	Core/Elective					
4PE604EE	ENERGY STORAGE SYSTEMS (PROFESSIONAL ELECTIVE – II)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES:

1. Outline energy storage technologies.
2. Discuss types of energy storage systems.
3. Compare the energy storagesystems.

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Understand the need of EnergyStorage Systems.
2. Know the principles of energy managementtechnologies.
3. Analyze the features of energy storagesystems.
4. Compare the different Electrical Energy storage systems.
5. Applications of energy storagesystems.
6. Understand technologies of energy management systems.

UNIT - I

Need for Electrical Energy Storage : Need for continuous and flexible supply, Emerging needs for EES in More renewable energy, with Less fossil fuel, advantage with usage of Smart grid, EES need in Long distance between generation and consumption, EES for Decongestion of power grids for peak loads, EES need for Transmission by cable.

UNIT - II

Roles of Electrical Energy Storage Technologies: Characteristics of electrical energy storage system (EES) and the roles of EES, High generation cost during peak-demand periods, The roles of electrical energy storage technologies , EES roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT - III

Features of energy storage systems : Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage

(CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2), Synthetic natural gas (SNG).

UNIT - IV

Types of Electrical Energy storage systems : Ultra capacitors, Super conducting magnetic energy storage (SMES), Thermal storage systems, Standards for EES, Technical comparison of EES technologies. Electrical output characteristics (output voltage Vs output load current) of ESS. Battery charging methods.

UNIT - V

Applications : Present status of applications in Utility use (Conventional power generation, Grid operation & Service), Consumer use (Uninterruptable power supply for large consumers), Renewable energy generation, Smart grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems. power electronics based battery chargers.

TEXTBOOKS :

1. A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN - 978-1- 84919-219-4),2011.
2. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016.

REFERENCES / SUGGESTED READING :

1. Electric Power Research Institute (USA), "Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits" (1020676), December 2010.
2. Paul Denholm, Erik Ela, Brendan Kirby and Michael Milligan, "The Role of Energy Storage with Renewable Electricity Generation", National Renewable Energy Laboratory (NREL) -a National Laboratory of the U.S. Department of Energy.
3. P. Nezamabadi and G. B. Gharehpetian, "Electrical energy management of virtual power plants in distribution networks with renewable energy resources and energy storage systems", IEEE Power Distribution Conference, 2011.

Course Code	Course Title	Core/Elective					
4PE605EE	ELECTRIC VEHICLES (PROFESSIONAL ELECTIVE – II)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1 Know the history of electric hybrid electric vehicles (EV & HEV) and emphasize the need andimportance of EV-HEV for sustainable future.

2 Introduce the fundamental concepts and principles of electric and hybrid electric vehicles drivetrain topologies

3 Develop a thorough understanding of the key elements of EV/HEV: Electric Machines forPropulsion Applications and Energy Sources.

COURSE OUTCOMES :

At the end of the course students will be able to

1. To identify and describe the history and evolvement of electric & hybrid electric vehicles toemphasize on the need and importance of EV/HEV for sustainable future.
2. To identify and describe the principles of various EV/HEVs drive train topologies along with their power flow control and fuel efficiency estimation.
3. To design and select electric propulsion system components for EV/HEV drives suitability for the desirable performance and control.
4. To compare and evaluate various energy sources and energy storage components for EV and HEV applications.
5. Select various types of propulsion units and their control depending upon the application.

UNIT - I

Introduction : Basics of vehicles mechanisms, history of electric vehicles (EV) and hybrid electric vehicles (HEV), need and importance of EV and HEV, Power/Energy supplies requirements for EV/HEV applications, vehicle power source characterization, and transmission characteristics. Vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNIT - II

Drive-Train Topologies : Review of electric traction, configuration of HEV: Series, Parallel, Series -Parallel and Complex configurations, basics of hybrid traction system, various hybrid drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis.

UNIT - III

Electrical Machines and Power Converters for Hybrid and Electric Vehicles: Electric system components for EV/HEV, suitability of DC and AC machines for EV/HEV applications, AC and DC Motor drives. Permanent magnet and switch reluctance machines, configuration and control of drives. Power Converters- Converters for EV and HEV applications.

UNIT - IV

Energy Sources for EV/HEV : Requirements of energy supplies and storage in EV/HEV, Review of batteries, fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, characteristics and comparison of energy sources for EV/HEV, hybridization of different energy sources.

UNIT - V

Electric Vehicles Charging Station : Type of Charging station, Selection and Sizing of charging station, Components of charging Station and Single line diagram of charging station. Contactless inductive charging- Stationary Inductive charging, resonant and compensation circuit topologies.

TEXTBOOKS :

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiely, USA, 2012.
2. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals, 2nd Edition, CRC Press, 2011.

REFERENCES/SUGGESTEDREADING :

1. Chris Mi, M. Abdul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspective, Wiely, 2011
2. SimoraOnori, Hybrid Electric Vehicles Energy Management Strategies, Springer.

Course Code	Course Title	Core/Elective					
4PE606EE	SELF-STUDY COURSE	Elective					
	(PROFESSIONAL	L	T	P/D	Credits	CIE	SEE
	ELECTIVE – II)	3	0	0	3		

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To foster self-directed learning environments to expand students' autonomy, encourage them to completetheir weekly assignments, and provide opportunities for students with limited computer and language skills.
2. To facilitate large-scale interactive participation and open access via theweb.
3. To ensure that all students with different personal and academic characteristics are able to follow the course information.
4. To use peer and self-assessment for formative evaluation in conjunction with rubrics or other form of guidance to improve both students' learning and the accuracy of their assessments.

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Enables the student anywhere to study free in higher education.
2. To help build a communityfor the students, professors, and teaching assistants (TAs).
3. Increases students' commitment and participation.
4. Provide clear and structured assessments, and design the assessments by taking into account the students' profile.
5. Provide opportunities for students to manage their own time in order to develop their intrinsic motivation and commitment to the course.

Professional Elective :

- IoTs.
- Smart Electric Grid.
- Extra High Voltage AC and DC Transmission.
- Sensor and Transducers Technology.
- Certification through Massive Open Online Courses (MOOCs) (Min. 8 weeks)

Massive Open Online Courses (MOOCs) are online courses available for anyone to enroll. MOOCs provide an affordable and flexible way to learn new skills, advance your career and deliver quality educational experiences at scale.

Suggested MOOCS Certification Platforms (but not limited to):

- Swayam NPTEL Course
- edX (formerly MITX, created by the Massachusetts Institute of Technology (MIT) in 2001)
- Open2Study
- Coursera
- FutureLearn
- Udacity
- Udemy
- Khan Academy
- Canvas
- Open Education Europa
- The Open University

Guidelines for Registration of Self-Study Course:

1. Approval should have been obtained from Departmental HOD and Course Coordinator to enroll for the self study* in the previous semester.
2. The syllabus and evaluation methodology of the self study course shall be specified by the Departmental Committee and approved by HOD.
3. No formal lectures will be delivered for such course.
4. Three credits can be earned through self-study course, subject to the approval of HOD.
5. Registration for self-study course has to be done in the current semester along with other courses.
6. The student undergoing self study course can be evaluated through Continuous Assessments and End Semester Examination or MOOCS Certification, as approved by HOD.
7. A faculty member identified by the HOD will be responsible for the evaluation of the course.

Course Code	Course Title	Core/Elective					
1OE602EE	DEEP LEARNING (OPEN ELECTIVE – II)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Develop and Train Deep Neural Networks.
2. Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
3. Build and train RNNs, work with NLP and Word Embeddings
4. The internal structure of LSTM and GRU and the differences between them

COURSE OUTCOMES :

At the end of the course students will be able to

1. Feature Extraction from Image and Video Data
2. Implement Image Segmentation and Instance Segmentation in Images
3. Implement image recognition and image classification using a pre trained network (Transfer Learning)
4. Traffic Information analysis using Twitter Data
5. Auto encoder for Classification & Feature Extraction

UNIT - I

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modeling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT - II

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre- processing for neural networks, Feature Engineering. Over fitting and Under fitting. Hyper parameters.

UNIT - III

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers.

Dense Layers. Back propagation Through the Convolutional Layer. Filters and Feature Maps. Back propagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, Alex Net, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, and Microsoft ResNet Model. RCNN, Fast R-CNN, Faster R- CNN, Mask-RCNN, YOLO.

UNIT - IV

About NLP & its Toolkits. Language Modeling. Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip- Gram Model for Word Embedding. Part of Speech (PoS) Global Co occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation Glove. Back propagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to- Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT - V

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy GradientMethods. Actor-Critic Algorithm. About Auto encoding. Convolutional Auto Encoding. Variational.

TEXTBOOKS :

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc. 2017.
2. Learn Keras for Deep Neural Networks, JojoMoolayil, Apress, 2018.
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020.

REFERENCES/SUGGESTEDREADING :

1. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017.
2. Pro Deep Learning with Tensor Flow, Santanu Pattanayak, Apress, 2017.

Course Code	Course Title	Core/Elective					
2OE602CE	GREEN BUILDING TECHNOLOGIES (OPEN ELECTIVE-II)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To impart knowledge of the principles behind the green building technologies.
2. To know the importance of sustainable use of natural resources and energy.
3. To understand the principles of effective energy and resources management in buildings.
4. To bring awareness of the basic criteria in the green building rating systems.
5. To understand the methodologies to reduce, recycle and reuse towards sustainability.

COURSE OUTCOMES :

At the end of the course students will be able to

1. Define a green building, along with its features, benefits and rating systems.
2. Describe the criteria used for site selection and water efficiency methods.
3. Explain the energy efficiency terms and methods used in green building practices.
4. Select materials for sustainable built environment & adopt waste management methods.
5. Describe the methods used to maintain indoor environmental quality.

UNIT - I

Introduction to Green Buildings : Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT - II

Site selection and planning : Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT - III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy : Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT - IV

Building materials : Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolona cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials

Waste Management: Handling of construction waste materials, separation of household waste, on-site and off- site organic waste management

UNIT - V

Indoor Environmental Quality for Occupant Comfort and Wellbeing : Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.

Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

TEXTBOOKS :

1. Michael Bauer, Peter Mösle and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.

REFERENCES/SUGGESTEDREADING :

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. 'Alternative building materials and technologies' by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.

Course Code	Course Title	Core/Elective					
3OE602CS	SOFTWARE ENGINEERING (OPEN ELECTIVE-II)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. Describe and compare various software development methods and understand the context in which each approach might be applicable.
2. To impart knowledge on various phases, methodologies and practices of software development.
3. To apply the project management and analysis principles to software project development.
4. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metric.
5. To apply the design & testing principles to software project development.

COURSE OUTCOMES :

At the end of the course students will be able to

1. Acquired working knowledge of alternative approaches and techniques for each phase of SDLC.
2. Judge an appropriate process model(s) for software project attributes and analyze requirements for project development.
3. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting.
4. Concede product quality through testing techniques employing appropriate metrics by understanding the practical challenges associated with the development of a significant software system.
5. Apply the software engineering principles in real time project development.

UNIT - I

Introduction to Software : What is software? Types of software, Characteristics of Software Attributes of good software. Software Engineering: What is software

engineering, Software engineering costs? What are the key challenges facing software engineering, Systems engineering & software Engineering, SDLC.

Software Development Process Models: prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

UNIT - II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modelling Principles, Construction Principles, Deployment.

Software Requirement Analysis and Specification: System and software requirements, Types of software requirements, Elicitation and analysis of requirements, Requirement validation, Requirements specification, Feasibility

UNIT - III

Building the Analysis Model: Data Modelling Concepts, Object-Oriented Analysis, Scenario-based Modelling, Flo oriented Modelling, Class-based Modelling.

Design Engineering : Design Process and Quality, Design Concepts, the Design Model.

Performing User Interface Design : The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT - IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Coding: Programming languages and development tools, Selecting languages and tools Good programming practices, Coding Standards

UNIT - V

Software Testing and Quality Assurance: Verification and validation Techniques of testing Black-box and White- box testing Inspections Levels of testing Unit testing, Integration Testing, Interface testing, System testing, Alpha and beta testing, Regression testing Design of test cases, Quality management activities: Product and process quality Standards, ISO900, Capability Maturity Model (CMM), Risk management.

Debugging: Debugging Techniques, The Art of Debugging.

Current trends in Software Engineering Software Engineering for projects and products.

TEXTBOOKS:

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, VII Edition, McGraw Hill, 2009.
2. Software Engineering by Ian Sommerville, VII edition, Addison-Wesley.
3. Fundamentals of Software Engineering by Rajib Mall.

REFERENCES/SUGGESTEDREADING:

1. Ali Behforooz and Frederick J. Hudson, Software Engineering Fundamentals, Oxford University Press, 1996.
2. Pankaj Jalote, An Integrated Approach to Software Engineering, III Edition, Narosa Publishing House, 2000.

Course Code	Course Title	Core/Elective					
4OE602EE	ELECTRIC VEHICLE TECHNOLOGY (OPEN ELECTIVE – II)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1 Know the history of electric hybrid electric vehicles (EV & HEV) and emphasize the need and importance of EV-HEV for sustainable future.

2 Introduce the fundamental concepts and principles of electric and hybrid electric vehicles drive train topologies

3 Develop a thorough understanding of the key elements of EV/HEV: Electric Machines for Propulsion Applications and Energy Sources.

COURSE OUTCOMES :

At the end of the course students will be able to

1. To identify and describe the history and evolvement of electric & hybrid electric vehicles to emphasize on the need and importance of EV/HEV for sustainable future.
2. To identify and describe the principles of various EV/HEVs drive train topologies along with their power flow control and fuel efficiency estimation.
3. To design and select electric propulsion system components for EV/HEV drives suitability for the desirable performance and control.
4. To compare and evaluate various energy sources and energy storage components for EV and HEV applications.
5. Select various types of propulsion units and their control depending upon the application.

UNIT-I

Introduction : History of electric vehicles (EV) and hybrid electric vehicles (HEV), need and importance of EV and HEV, Power/Energy supplies requirements for EV/ HEV applications, vehicle power source characterization, and transmission characteristics. Vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion.

UNIT - II

Drive-Train Topologies: Series, Parallel, Series -Parallel and Complex configurations of HEV, basics of hybrid traction system, various hybrid drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis.

UNIT - III

Electrical Machines and Power Converters for Hybrid and Electric Vehicles: Electric system components for EV/HEV, suitability of DC and AC machines for EV/HEV applications, AC and DC Motor drives. Permanent magnet and switch reluctance machines, configuration and control of drives. Power Converters- Converters for EV and HEV applications.

UNIT - IV

Energy Sources for EV/HEV: Requirements of energy supplies and storage in EV/HEV, Review of batteries, fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, characteristics and comparison of energy sources for EV/HEV, hybridization of different energy sources.

UNIT - V

Electric Vehicles Charging Station: Type of Charging station, Selection and Sizing of charging station, Components of charging Station and Single line diagram of charging station. Contactless inductive charging- Stationary Inductive charging, resonant and compensation circuit topologies.

TEXTBOOKS :

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiely, USA, 2012.
2. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals, 2nd Edition, CRC Press, 2011.

REFERENCES/SUGGESTEDREADING :

1. Chris Mi, M. Abdul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspective, Wiely, 2011
2. Simora Onori, Hybrid Electric Vehicles Energy Management Strategies, Springer.

Course Code	Course Title	Core/Elective					
5OE602EC	FUNDAMENTALS OF IOT (OPEN ELECTIVE –II)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To introduce the fundamentals, applications and requisite infrastructure of IoT.
2. To describe Internet principles and communication technologies relevant to IoT.
3. To discuss hardware and software aspects of designing an IoT system.
4. To explain the concepts of cloud computing and data analytics.
5. To illustrate the business models and manufacturing strategies of IoT products.

COURSE OUTCOMES :

At the end of the course students will be able to

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT.
3. Construct simple IoT systems with requisite hardware and python programming.
4. Understand the relevance of cloud computing and data analytics to IoT.
5. Apply the business model of IoT from developing a prototype to launching aproduct.

UNIT - I

Introduction to Internet of Things: Introduction to Internet of Things: Physical Design of IoT: Things in IoT, IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and logistics, Smart Agriculture and Industry, Smart Industry and smart Health.

UNIT - II

Internet Principles and communication technology: Internet Communications: An Overview –IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS.

UNIT - III

Prototyping and Programming: Cost Vs Ease of Production, Prototypes and Production, Open-Source Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling

Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/Time Operations., Classes, Python packages for IoT, IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT - IV

Cloud computing and Data analytics: Introduction to Cloud storage models -SAAS, PAAS, IAAS. Communication APIs, Amazon web services for IoT, Skynet IoT Messaging Platform. Introduction to Data Analytics for IoT - Apache Hadoop- Map reduce job execution workflow

UNIT - V

IoT Case Studies: Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation, Business model for IoT product manufacturing, IoT Startups, Mass manufacturing, Ethical issues in IoT.

TEXTBOOKS:

1. Internet of Things - Converging Technologies for smart environments and integrated ecosystems, River Publishers.
2. Adrian McEwen (Author), Hakim Cassimally, “Designing the Internet of Things”, Wiley India Publishers

REFERENCES/SUGGESTEDREADING:

1. Fundamentals of Python, Kenneth A Lambert and B.L. Juneja, Cenage Learning.
2. Internet of Things (A Hands-on-Approach), Vijay Madisetti, Arshdeep Bahga, VPT Publisher, 1st Ed., 2014.

Course Code	Course Title	Core/Elective					
6OE602ME	3D PRINTING	Elective					
	TECHNOLOGIES	L	T	P/D	Credits	CIE	SEE
	(OPEN ELECTIVE –II)	3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student

1. To understand the fundamental concepts of 3D Printing, its advantages & limitations.
2. To know the various types of STL file errors and other data formats used in additive manufacturing Technology.
3. To know the working principle, advantages, disadvantages & applications of liquid, solid and powder based 3D Printing technologies.
4. To know the diversified applications of 3D Printing technologies and explore them in different industrial sectors.

COURSE OUTCOMES :

At the end of the course students will be able to

1. Describe the fundamentals of 3D printing, classify and explain advantages and disadvantages of 3D Printing technologies.
2. Select the suitable CAD data formats and software used in 3D Printing technology.
3. Describe the operating principles, capabilities and limitations of liquid, solid & powder based 3D Printing Technologies.
4. Compare different 3D printing technologies based on their process capabilities and applications.
5. Apply the capabilities and knowledge of 3D printing in different industrial sectors.

UNIT - I

Prototyping Fundamentals: Historical Development, Fundamentals of 3D Printing, Advantages and Limitations of 3D Printing, commonly used terms, 3D Printing Process Chain, 3D Modeling, Data conversion and transmission, Checking & Preparing, Building, Post processing, Classification of 3D Printing processes,

Fundamental Automated Processes, Distinction between 3D Printing and Conventional Machining Processes.

Data Formats & Software: Data formats; conversion and transmission, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs, Newly Proposed Formats. Software's Features: Magics, Mimics, Solid View, Cura, ITK Snap.

UNIT - II

Liquid based Systems: Stereo Lithography Apparatus (SLA) Models and Specifications, Process, working principle, photopolymers, photo polymerization, Layering Technology laser and laser scanning, Applications, Advantages and Disadvantages Poly jet: Models and Specifications, Process, working principle, Applications, Advantages and Disadvantages Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT - III

Solid-based Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Multi Jet Modeling (MJM): Models and specifications, Process, Working principle, Applications, Advantages and Disadvantages.

UNIT - IV

Powder Based Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Three Dimensional Printing (3DP): Models and Specifications, Process, working principle, Applications, Advantages and Disadvantages. Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT - V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Construction field, Arts and Architecture, Pattern for investment and vacuum casting, Medical Models

and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production. Medical Devices, Forensic Science and Anthropology and Web Based Rapid Prototyping Systems.

TEXTBOOKS:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth edition, World scientific
2. 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" Springer, Second Edition.

REFERENCES/SUGGESTEDREADING:

1. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies:
2. Frank W. Liou, "Rapid Prototyping & Engineering Applications"- CRC Press, Taylor & Francis Group.
3. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley & Sons.

Course Code	Course Title	Core/Elective					
4PC656EE	ELECTRICAL MACHINES - II LAB	core					
		L	T	P/D	Credits	CIE	SEE
		0	0	3	1.5	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To learn operation and performance characteristics of induction machines by conducting variousexperiments and tests practically.
2. To understand the operation and performance characteristics of synchronous machines by conducting various experiments and tests.

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Understand Performance characteristics of single-phase induction motor.
2. Analyze the performance of Three-phase induction motor by conducting No load, blocked rotor and Brake test.
3. Understand the speed control methods of 3-Phase Induction Motor and BLDC motor.
4. Understand the importance of Voltage regulation of an alternator.
5. Explain different methods used to measure the voltage regulation of an alternator.

LIST OF EXPERIMENTS

1. Brake test on a 3 phase Induction Motor
2. No load & blocked rotor tests on a 3 phase Induction Motor.
3. Equivalent circuit of a single phase Induction Motor.
4. Regulation of a three phase alternator by Synchronous Impedance & MMF methods.
5. Regulation of 3 phase alternator by ZPF method.
6. V & inverted V curves of a three phase synchronous motor.
7. Determination of Xd&Xq of a salient pole synchronous machine.
8. Speed control of 3-phase induction motor by rotor resistance control method.
9. Power factor improvement of 3-phase induction motor using capacitors.
10. Power angle characteristics of synchronous machine.
11. Speed control of BLDC motor.

Note: At least 10 experiments should be conducted.

SUGGESTEDREADING:

1. P. S. Bimbhra, Electrical Machinery, 7th Edition, Khanna Publishers, 2011.
2. J.B. Gupta. Theory & Performance of Electrical Machines Published by S.K. Kataria& Sons, 2015 Edition.
3. I. J. Nagrath and D. P. Kothari, Electric Machines, 5th Edition, McGrawHill Education, 2017.

Course Code	Course Title	Core/Elective					
4PC657EE	POWER ELECTRONICS AND DRIVES LAB	Core					
		L	T	P/D	Credits	CIE	SEE
		0	0	3	1.5	40	60

COURSE OBJECTIVES :

The objectives of this course is to make student

1. Study various power electronic devices and its characteristics.
2. Study firing and commutation circuits of SCR.
3. Study various power electronic circuits and its applications.

COURSE OUTCOMES:

After completion of this course student should be able to:

1. Analyze the characteristics of SCR.
2. Analyze firing and commutation circuits of SCR.
3. Analyze various power electronic circuits.
4. Analyze the operation of various motors fed by power electronic circuits.
5. Simulate various power electronic circuits fed motors using MATLAB/ SIMULINK software.

LIST OF EXPERIMENTS

1. Static Characteristics of SCR.
2. R, RC, UJT Firing circuits for SCR.
3. Commutation circuits of SCR.
4. Single-phase half-controlled and fully-controlled rectifiers with R and RL loads.
5. Single-phase AC voltage regulators with R and RL loads.
6. Single-phase cyclo-converters with R and RL loads.
7. MOSFET based Chopper.
8. V/f control of induction motor.
9. Simulation of AC Chopper.
10. Simulation of DC motor control using rectifiers.
11. Simulation of DC motors control using choppers.
12. Simulation of three-phase inverter for 120 and 180 degree mode of operation

Note : At least 10 experiments should be conducted.

SUGGESTEDREADING :

1. Fundamentals of Electrical Drives , G.K Dubey, Narosa Publications.
2. Power Electronics: Circuits, Devices, and Applications' by M. H. Rashid, Pearson Education India, 2014.
3. Power Electronics byDr. P.S Bimbhra, Khanna Publishers, 2013.

Course Code	Course Title	Core/Elective					
4PC657EE	SOFT SKILLS LAB	Core					
		L	T	P/D	Credits	CIE	SEE
		0	0	2	1	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. To enable the students to listen to different speakers in different contexts for various purposes and learn target language expressions.
2. To enable the students to develop confidence and interactive skills to speak professionally in different situations.
3. To enable students to learn and develop various reading skills and strategies.
4. To enable the students to develop written expression of thought and provide opportunities to explore ideas by utilizing various techniques.
5. To equip the students to develop needed confidence and interactive skills to speak professionally and acquire skills to face any Interview.

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Listen to a variety of speakers and texts and will be able to comprehend and perform the required tasks.
2. Interact in a group professionally and communicate confidently in terms of both the spoken and written communication.
3. Develop the skills and strategies of reading and writing.
4. Face any Interview confidently by managing time, making decisions by speaking appropriately according to the context.
5. Demonstrate right attitude and right skills to cope with team and communicate professionally.

LIST OF EXPERIMENTS

I. Listening Skills

- Listening to different situations by Native Speakers.
- Listening to Conversations.
- Listening to Motivational Speeches.

II. Speaking Skills

- Describing a person or a place or a thing using relevant adjectives.
- Picture Perception.
- Oral Presentations.
- Etiquette in different situations.

III. Reading Skills

- Reading different Texts.
- Reading Comprehension Passages.
- Skimming and Scanning.
- Paraphrasing.

IV. Writing Skills

- Writing Slogans related to the image.
- Communicating on Social Media.

V. Interview Skills

- Skills required to attend an Interview.
- Soft Skills to be demonstrated in a Job Interview.
- Debates and Group discussions.

SUGGESTEDREADING:

1. Andrea J. Rutherford. Basic Communication Skills for Technology. Pearson Education. Inc. New Delhi.
2. Antony Jay and Ros Jay. Effective Presentation. How to be a Top Class Presenter. Universities Press.(India) Limited.1999.
3. Robert M Sherfield and etal. "Developing Soft Skills" 4th edition, New Delhi: Pearson Education, 2009.
4. M.Ashraf Rizvi Effective Technical Communication, Tata McGraw-Hill Publishing Company Limited. New Delhi.

Course Code	Course Title	Core/Elective					
4PW651EE	MINI PROJECT SEMINAR	Core					
		L	T	P/D	Credits	CIE	SEE
		0	0	2	1	40	60

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. The student(s) shall explore the technological needs of society.
2. The student(s) shall understand the technological problems of society.

COURSE OUTCOMES :

After completion of this course student should be able to:

1. The student(s) is able to provide a solutions the technological problems of society.
2. The student(s) is able suggest technological changes which suits current needs of society.
3. The student(s) is able to explain new technologies available for problems of the society.

Preamble :

There is lot of scientific and technological changes in the nation during last few decades in almost all the sectors. The state and central governments are introducing many schemes to all classes of people of the nation to increase the productivity in various sectors. India is a rural centric nation and the fruits of the scientific inventions and new technology shall be shared among all remote corners of the nation. With this aim, a socially relevant project is newly introduced in the curriculum with an objective of taking up the projects relevant to the societal needs.

General guidelines :

- A socially relevant project (Mini Project) shall be a community service based project and it shall be innovative.
- A student has to pursue the socially relevant project to solve real life and pressing problems of society.
- The pursued socially relevant projects shall contribute to national development goals and priorities.

- Socially relevant project can be carried out by an individual student or by a team of maximum five (05) of the department.
- The student(s) shall visit the society (Villages/Hospitals/Social Service Organizations etc.) to identify the problem, conduct literature survey, and provide a feasible solution through fabricated models.
- The socially relevant project selected shall be in the broad area of concerned discipline of course. Preference shall be given to rural societal problems.
- Each team shall work under the supervision of a faculty member of the concerned department.
- The duration of the project is about 15 to 20 hrs in total and students may split total duration into 2hrs per week based on convenience. The attendance shall be maintained by the respective supervisor.
- The developed solutions will be assessed by the Department and shall be evaluated for 40 Marks.

Sample Projects (but not limited to):

- A solar-powered cell phone charger, while learning about batteries, solar cells, power, and efficiency.
- A programmable "useless box", which is a silly toy to play with on your desk. While building this project, you will use switches, motors, transistors, digital logic, and learn to control physical things with software.
- An LED display, which uses the idea of multiplexing to control more lights than your microcontroller has outputs.
- An electrocardiogram (ECG) to measure your heartbeat. You will learn how to build an amplifier capable of magnifying the tiny electrical signal from your heart into something your microcontroller can measure.

Course Code	Course Title	Core/Elective					
4PW701EE	SUMMER INTERNSHIP	Core					
		L	T	P/D	Credits	CIE	SEE
		4-6 weeks duration					

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. Produce an accurate record of work performed during the Internship/Co-op.
2. Apply engineering knowledge to a problem in industry.
3. Produce a technical report.
4. Discuss work in a team environment, if relevant to the project.
5. Conduct herself/himself responsibly, safely, and ethically in a professional environment.

COURSE OUTCOMES :

After completion of this course student should be able to:

1. Get Practical experience of software design and development, and coding practices within Industrial / R & D Environments.
2. Gain working practices within Industrial /R & D Environments.
3. Prepare reports and other relevant documentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organizations/Computer Industry/Software Companies/R&D Organization for a period of 4-6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry coordinate (person from industry).

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship :

- Overview of company/project.
- Safety training.
- Discussions with project teams.

- Background research, review of documents, white papers, and scientific papers.
- Planning, designing, and reviewing the planned work.
- Executing the plans.
- Documenting progress, experiments, and other technical documentation.
- Further team discussions to discuss results.
- Final report writing and presentation.

After the completion of the project, each student will be required to:

1. `Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department).

Award of sessional marks are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will co-ordinate the overall activity of Industry Attachment Program.

Note : Students have to undergo summer internship of 4-6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

Department of Electrical and Electronics Engineering

Scheme of Instruction and Examination

B. E. IV Year

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			Hours per week				Maximum Marks		
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	4PC715EE	Power System Operation and Control	3	0	0	3	40	60	3
2	4PC716EE	Utilization of Electrical Energy	3	0	0	3	40	60	3
3	4PC717EE	Power Electronics Applications to Power Systems	3	0	0	3	40	60	3
4	4PE7-EE	Professional Elective-III	3	0	0	3	40	60	3
5	4PE7-EE	Professional Elective-IV	3	0	0	3	40	60	3
6	4OE7-	Open Elective-III	3	0	0	3	40	60	3
7	4PC758EE	Microprocessors & Microcontrollers Lab	0	0	2	2	40	60	1
8	4PC759EE	Power Systems Lab	0	0	2	2	40	60	1
9	4PW752EE	Comprehensive Viva Voce	0	0	2	2	20	30	1
10	4PW753EE	Summer Internship Seminar	0	0	2	2	50	-	1
		Total	**18**	**0**	**8**	**26**	**390**	**510**	**22**

Professional Elective – III		
1	4PE710EE	Programmable Logic Controllers
2	4PE711EE	Digital Signal Processing
3	4PE712EE	Power Quality Engineering

Open Elective – III			
1	1OE703AD	Machine Learning	Not for CSE & AI&DS
2	3OE703CS	Human Computer Interaction	Not for CSE & AI&DS
3	5OE703EC	Medical Electronics	Not for ECE
4	6OE703ME	Introduction to Robotics	Not for ME
5	4OE703EE	Programmable Logic Controllers	Not for EEE
6	2OE703CE	Essential of Road Safety Engineering	Not for CE

Professional Elective – IV		
1	4PE713EE	Energy Management Systems and SCADA
2	4PE714EE	AI Techniques in Electrical Engineering
3	4PE715EE	Electrical Distribution Systems

Course Code	Course Title	Core/Elective					
4PC715EE	POWER SYSTEM	Core					
	OPERATION AND	L	T	P/D	Credits	CIE	SEE
	CONTROL	3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Understand the concepts and Importance of Load flow studies,
2. Understand Economic Operation of thermal power units, frequency control of interconnected Power System Networks.
3. Understand about reactive Power Control and Stability of Power System Networks.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Solve load flow by appropriate modeling of the given power system and formulation of Y-bus.
2. Evaluate generation mix for economic operation with and without transmission losses.
3. Explain load frequency control and estimate the frequency deviation through modeling.
4. Analyze and describe different types of power system stability and establish SSSL.
5. Identify various methods of voltage control and study the reactive power compensation.

UNIT-I

Load Flow Studies: Formulation of Y bus by inspection method, modeling of tap changing and phase shifting transformer, Formulation of load flow problem, Solution of load flow by Gauss-Seidel, Newton-Raphson, Decoupled and Fast Decoupled methods, comparison of different load flow methods.

UNIT-II

Economic Operation of Power System: Input-Output curves, Heat rates and incremental cost curves, Equal Incremental cost criterion neglecting transmission losses with and without generator limits, Bmn coefficients, Economic operation including transmission losses.

UNIT - III

Modelling of governor, turbine and excitation systems: Modelling of governor: Mathematical modelling of speed governing system, derivation of small signal transfer function; Modelling of turbine: First order turbine model, block diagram representation of steam turbines and approximate linear models; Modelling of excitation system: Fundamental characteristics of an excitation system, transfer function, block diagram representation of IEEE type-1 model.

UNIT-IV

Load Frequency Control: Load frequency control of single area system: Necessity of keeping frequency constant, definitions of control area, single area control, block diagram representation of an isolated power system, steady state analysis, dynamic response, uncontrolled case. Load frequency control of two area system: Uncontrolled case and controlled case, tie line bias control; Load frequency controllers: Proportional plus integral control of single area and its block diagram representation, steady state response, load frequency control and economic dispatch, case study on LFC of Micro grid with Renewable sources and study of parameter uncertainties in single area and two area system.

UNIT-V

Power System Stability: Definitions of Steady state stability and Transient stability, Steady state stability of asynchronous machine connected to infinite bus, calculation of steady state stability limit, synchronous machine models with and without saliency, Equal area criterion, Application of equal area criterion, Swing equation, Step by step solution of Swing equation, factors effecting transient stability, Auto Reclosures, Mathematical formulation of voltage stability problem.

TEXT BOOKS :

1. D.P.Kothari and, I.J.Nagrath, Modern Power System Analysis, Tata Mc Graw Hill.
2. C.L.Wadhwa ,Electric Power Systems, New Age International (p) Ltd.
3. Haadi Sadat, Power System Analysis, Tata McGraw Hill.

REFERENCE BOOKS :

1. John. J. Grangier, William D. Stevenson Jr., Power System Analysis, Tata McGraw Hill.
2. Elgerd, Electrical EnergySystems Theory, Tata Mc Graw Hill.

Course Code	Course Title	Core/Elective					
4PC716EE	UTILIZATION OF ELECTRICAL ENERGY	Core					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Understand Utilization of electrical energy for various applications like industrial heating, welding etc.,
2. Understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
3. Understand the concept of electrification of traction system.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand electrical heating and welding for industrial applications.
2. Explain the control methods of induction and synchronous motors.
3. Design illumination for different application.
4. Understand the traction mechanics.
5. Understand the characteristics of traction motors.

UNIT – I

Industrial Heating and Welding : Advantages and methods of electric heating. Description, operation and performance of resistance ovens. Design of elements. Core type furnace, Coreless type furnace, High frequency eddy current heating, Dielectric heating, Arc furnace. Electric Welding: Resistance welding, Welding transformer and its rating. Various types of Electric arc welding and Electric resistance welding. comparison between A.C. and D.C. Welding.

UNIT – II

Illumination Fundamentals and Illumination Methods : Introduction, terms used in illumination, Units of light laws of illumination, polar curves, photometry, integrating nature and production of light, Sensitivity of the eye,. The inverse square law and cosine law, Solid angle, lighting calculations, determination of M.S.C.P, Rousseau's construction, Discharge lamps, Sodium vapour lamps, Mercury vapour lamps,

Fluorescent lamps, Starting and power factor corrections, Stroboscopic effects, Neon signs, Application to factory lighting, Street lighting and Flood lighting.

UNIT - III

Schematic Utilization and Connection Diagram for Motor Control: Two supply sources for 3-phase Induction motors. Direct reversing, remote control operation, Jogging operation of induction motor. Contactor control circuit. Pushbutton control stations. Over load relays, limit switches, Float switches. Interlocking methods for reversing control. Starting of Synchronous motor and motor protection.

UNIT – IV

Electric Traction – I: System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, types of motors: DC series motors, AC series motors, 3-phase induction motors, DC motor series & parallel control, Shunt bridge transition, methods of electric braking-plugging rheostatic braking and regenerative braking.

UNIT – V

Electric Traction-II: Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

TEXT BOOKS :

1. Partab G,"Artand Science of Utilization of Electric Power", publisher Dhanpatrai & Sons, 1990.
2. RainaK.B & Bhattacharya S.K., "Electrical Design, Estimating and Costing", publisher, Wiley Eastern Ltd., 1991.

REFERENCE BOOOKS:

1. Dubey G.K., "Fundamentals of Electric Drives", publisher, Narosa Public House, Delhi, 2001.
2. Open Shaw Taylor, "Utilization of Electrical Energy".
3. Wadhwa C.L., "Generation, Distribution & Utilization of Electrical Energy", publisher, Wiley, 1989

Course Code	Course Title	Core/Elective					
4PC717EE	POWER ELECTRONIC APPLICATIONS TO POWER SYSTEMS	Core					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Understand the issues involved in existing Power Transmission system.
2. Familiar with the Techniques to overcome the problems associated with AC Power Transmission system.
3. Understand the control of active and reactive power control using Power electronic converters.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand the reactive power compensation.
2. Understand the series and shunt compensation in Power Transmission system.
3. Understand the application of FACTS devices in Power Transmission system.
4. Understand Study and apply the power transmission schemes – HVDC Transmission.
5. Study MTDC Transmission.

UNIT - I

Facts concepts :

Introduction to Power system's issues, Reactive power control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, basic types of FACTS controllers, brief description of FACTS controllers.

UNIT - II

Static shunt and series compensators:

Shunt compensation - objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators - SVC, STATCOM, SVC and STATCOM comparison. Series compensation - objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes.

UNIT - III

Combined compensators:

Unified power flow controller (UPFC) - Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters.

UNIT - IV

HVDC Transmission:

HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DC links, Layout of HVDC Converter station and various equipments. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations.

UNIT - V

Control of HVDC system :

Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics-introduction, generation, ac filters and dc filters. Introduction to multi terminal DC systems and applications, comparison of series and parallel MTDC systems.

TEXT BOOKS :

1. Song, Y.H. and Allan T. Johns, Flexible AC Transmission Systems (FACTS), Institution of Electrical Engineers Press, London.
2. Hingorani ,L.Gyugyi, Concepts and Technology of Flexible AC Transmission System, IEEE Press New York, 2000.
3. Padiyar, K.R.,HVDC Transmission Systems, Wiley Eastern Ltd., 2010.

REFERENCE BOOKS :

1. Padiyar K.R., FACTS controllers for Transmission and Distribution systems, New Age International Publishers, 1st Edition, 2007.
2. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar AngelesCamacho FACTS – Modeling and simulation in Power Networks John Wiley & Sons, 2002
3. Namburi Nireekshana Power Electronics Applications to Power systems AP LAMBERT Academic Publishing (23 Aug. 2022).

Course Code	Course Title	Core/Elective					
4PE710EE	PROGRAMMA	Elective					
	BLE LOGIC	L	T	P/D	Credits	CIE	SEE
	CONTROLLERS	3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Understand of PLC programming, ladder logic.
2. Analyze and classification of the process control.
3. Understand PLC hardware units and utilizing them.

COURSE OUTCOMES:

After completion of the course, the student will be able to

1. Describe typical components of a Programmable Logic Controller.
2. State basic PLC terminology and their meanings.
3. Use latch, timer, counter, and other intermediate programming functions.
4. Explain and apply the concept of electrical ladder logic, its history, and its relationship to programmed PLC instruction.
5. Design and program a small, automated industrial production line.

UNIT–I

Introduction to PLC

What is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks, and limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc

UNIT– II

Working of PLC

Basic operation and principles of PLC, Scan Cycle, Memory structures, I/O structure, Programming terminal, power supply

UNIT-III

Instruction Set

Basic instructions like latch, master control self-holding relays, Timer instruction like retentive timers, resetting of timers, Counter instructions like up counter, down counter, resetting of counters, Arithmetic Instructions (ADD, SUB, DIV, MUL etc.),

MOV instruction, RTC (Real Time Clock Function), Watch Dug Timer, Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal.

UNIT – IV

Ladder Diagram Programming

Programming based on basic instructions, timer, counter, and comparison instructions using ladder program.

UNIT–V

Applications of PLCs

Object counter, On-off control, Car parking, Sequential starting of motors, Traffic light control, Motor in forward and reverse direction, Star-Delta, DOL Starters, Filling of Bottles, Room Automation.

TEXTBOOKS :

1. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA.
2. Introduction to PLCs by Gary Dunning. McGraw Hill.
3. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh.

REFERENCE BOOKS:

1. Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar.
2. Module on "Allen BradlagPlC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
3. Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh
4. CHUNGPA, "User's Manual :Universal PLC Training System CPS-3580U", English ver1, 2020.
5. Handbook, P. L. C. "Practical Guide to Programmable Logic Controllers." Automation Direct. com.

Course Code	Course Title	Core/Elective					
4PE711EE	DIGITAL SIGNAL PROCESSING	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES:

The objective of this course is to make student

1. Describe signals mathematically.
2. Understand how to perform mathematical operations on signals.
3. Understand the concept of digital filters.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Explain the concepts of digital signals, digital systems and digital signal processing.
2. Compute linear convolution, circular convolution and linear convolution using DFT, and solve linear constant difference equation.
3. Compute DFT and IDFT using formula and FFT algorithms.
4. Design IIR and FIR filters using various methods.
5. Analyze IIR and FIR filters using z-transforms.

UNIT – I

Introduction to Digital Signal Processing:

Discrete Time Signals & Sequences, conversion of continuous to discrete signal, Normalized Frequency, Classification of discrete time signals, Discrete time systems-classification, Linear Shift Invariant Systems, Stability, and Causality, Linear Convolution, Solution to Linear Constant Coefficient Difference Equations.

UNIT – II

Discrete Fourier series:

Discrete Fourier Series, Properties of Discrete Fourier Series, Discrete Fourier Transforms, Properties of DFT, Circular Convolution, Linear Convolution of Sequences using DFT, Over-Lap Add Method, Over-Lap Save Method. Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT.

UNIT-III

IIR Digital Filters:

Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital Filters from Analog Filters, Step and Impulse Invariant Techniques, Bilinear Transformation Method, Spectral Transformations.

UNIT –IV

FIR Digital Filters:

Characteristics of FIR Digital Filters, Frequency Response. Design of FIR Filters: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique, Comparison of IIR & FIR filters.

UNIT – V

Realization of Digital Filters:

Solution of Difference Equations of Digital Filters, System Function, Stability Criterion, Realization of Digital Filters – Direct, Canonic, Cascade and Parallel Forms.

TEXT BOOKS :

1. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008.
2. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris, Thomson, 2007.
3. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.

REFERENCE BOOKS:

1. Digital Signal Processing – S. Salivahanan, A. Vallavaraj and C. Gnanapriya, TMH, 2009.
2. Digital Signal Processing - A Practical approach, Emmanuel C. Ifeachor and Barrie W. Jervis, 2nd Edition, Pearson Education, 2009.
3. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.

Course Code	Course Title	Core/Elective					
4PE712EE	POWER QUALITY ENGINEERING	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Understand the importance of power quality.
2. Understand the different power quality issues. and their effects in power system network
3. Evaluate the effects of Harmonics in power system network

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Describe the different PQ disturbances and state remedies to improve PQ.
2. Determine voltage sag for different network configurations.
3. Demonstrate the effect of ASD systems on power quality and the effect of voltage sags on operation Of various electrical machines.
4. Evaluate harmonic levels for distribution systems.
5. Describe power quality monitoring and measuring techniques.

UNIT – I

Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring. Power Quality Data: Data collection, Data analysis, Database structure, Creating PQ databases, and Processing PQ data.

UNIT – II

Voltage Sag Characterization: Voltage sag – definition, causes of voltage sag, voltage sag magnitude, monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, Meshed systems, voltage sag duration Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-III

PQ Considerations in Industrial Power Systems: Adjustable speed drives (ASD) systems and applications, mitigation of harmonics. Characterization of voltage sags experienced by three-phase ASD systems: Types of sags and phase - angle jumps. Effects of momentary voltage dip on the operation of induction and synchronous motors. Voltage sag coordination for reliable plant operation.

UNIT –IV

Effects of Harmonics on Power Quality: Harmonic analysis of industrial customers, technical barriers in ASDs. Methods of evaluation of harmonic levels in industrial distribution systems. Harmonic effects on transformers. Impact of distribution system capacitor banks on PQ. Guidelines for limiting voltage harmonics.

UNIT – V

Power Quality Monitoring: Introduction, site surveys, Transducers, IEC measurement techniques for Harmonics, Flicker, IEC Flicker meter.

TEXT BOOKS :

1. Math H.J. Bollen, Understanding Power Quality Problems, IEEE Press, 1999.
2. Roger C. Dugan, MarkF. McGranaghan, Surya Santoso, H. Wayne Beaty, Electrical Power Systems Quality, Second Edition, Tata McGraw-Hill Edition.
3. C. Sankaran, Power Quality, CRC Press, 1st Edition 2001.

REFERENCE BOOKS :

1. Bipin Singh, Simmi P.Burman, Power Quality, 2nd Edition 2016,S.K.Kataria & Sons publisher.
2. Roger C. Dugan, MarkF. McGranaghan, Surya Santoso, H. Wayne Beaty, Electrical Power Systems Quality, 3rd Edition.
3. Alexander kusko, Marc T.Thompson,Power Qulality in Electrical systems,1st Edition, Tata McGraw-Hill 2007.

Course Code	Course Title	Core/Elective					
4PE713EE	Energy Management Systems and SCADA	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Outline energy management systems and unit commitment and its solution techniques.
2. Discuss power generation scheduling with limited energy.
3. Describe the architecture, functions and applications of supervisory control and data acquisition (SCADA) and apply SCADA in power system automation and communications.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand energy management centers.
2. Know the principles of power generation scheduling.
3. Understand the regional operations of power systems.
4. Understand about Supervisory control and data acquisition.
5. Understand the SCADA Communications protocol.

UNIT -I

Energy Management Centers: Introduction, Energy management centers and their functions, architectures, recent developments, characteristics of power generating units and economic dispatch, unit commitment (spinning reserve, thermal, hydro and fuel constraints), solution techniques of unit commitment.

UNIT-II

Generation Scheduling: Generation scheduling with limited energy, energy production cost models, budgeting and planning, practical considerations, interchange evaluation for regional operations, types of interchanges, exchange costing techniques.

UNIT-III

Supervisory Control And Data Acquisition: Introduction to supervisory control and data acquisition, SCADA functional requirements and components. SCADA

Application: General features, functions and applications, benefits of SCADA, architectures of SCADA, applications of SCADA.

UNIT-IV

SCADA and Power Systems: Configurations of SCADA, RTU (remote terminal units) connections, power systems SCADA and SCADA in power system automation.

UNIT-V

SCADA and Communication: SCADA communication requirements, SCADA communication protocols: past present and future, structure of a SCADA communications protocol.

TEXTBOOKS:

1. Handschin E, Energy Management Systems, Springer Verlag, 1st Edition, 1990.
2. Handschin E, Real Time Control of Electric Power Systems, Elsevier, 1st Edition, 1972.
3. John D Mc Donald, Electric Power Substation Engineering, CRC press, 1st Edition, 2001.

REFERENCES BOOKS :

1. Wood, A J and Wollenberg, B F, Power Generation Operation and Control, John Wiley and Sons, 2nd Edition 2003.
2. Green, J N Wilson, R, Control and Automation of Electric Power Distribution Systems, Taylor

   and Francis, 1st Edition, 2007.
3. Turner, W C, Energy Management Handbook, Fairmont Press, 5th Edition, 2004.

Course Code	Course Title	Core/Elective					
4PE714EE	AI TECHNIQUES IN ELECTRICAL ENGINEERING	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Understand concepts of ANNs, Fuzzy logic and Generic Algorithm.
2. Understand operation of fuzzy controller and generic Algorithm.
3. Apply soft computing techniques for real- world problems

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Understand the concepts of artificial intelligence techniques Control DC motors with Dual converters.
2. Apply ANN, fuzzy logic control and GA to electrical engineering problems.
3. Analyze and appreciate the concepts of fuzzy set over classical set theory.
4. Evaluate the computational and mathematical theory, and application of fundamental AI algorithms for electrical engineering problems and submit the report.
5. Create feed forward and feedback neural networks.

UNIT-I

Introduction: Definition of AI, difference between soft computing techniques and hard computing systems, expert systems brief history of ANN, Fuzzy and GA.

UNIT – II

Artificial Neural Networks: Introduction, Models of Neuron Network-Architectures – Knowledge representation, Artificial Intelligence and Neural networks – Learning process - Error correction learning, Hebbian learning – Competitive learning- Boltzman learning, supervised learning-Unsupervised learning–Reinforcement learning-Learning tasks. Multi-layer perceptron using Back propagation Algorithm (BPA). Applications of ANN for load forecasting, voltage control.

UNIT-III

Fuzzy Logic: Introduction –Fuzzy versus crisp, Fuzzy sets-Membership function – Basic Fuzzy set operations, Properties of Fuzzy sets–Fuzzy cartesion Product, Operations on Fuzzy relations–Fuzzy logic–Fuzzy Quantifiers; Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods.

UNIT –IV

Genetic Algorithms : Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modelling –Genetic operators - Crossover - Single site crossover, Two point crossover –Multipoint crossover-Uniform crossover, Matrix crossover-Crossover Rate-Inversion & Deletion, Mutation operator–Mutation–Mutation Rate-Bit-wise operators, Generational cycle-convergence of Genetic Algorithm.

UNIT – V

Applications of AI: Fuzzy logic for Automatic Generation control, voltage stability and Genetic Algorithm for Automatic Generation Control, Best Capacitor location for reactive power control-Algorithm.

TEXT BOOKS :

1. Rajasekharan and Pai, Neural Networks, Fuzzy logic, Genetic Algorithm - Synthesis and Applications, PHI second edition, 2017
2. S. N. Sivanandam, S. Sumathi, S. N. Deepa, “Soft computing techniques”, Wiley Publications third edition 2018.

REFERENCES BOOKS:

1. Jacek M Zurada, Introduction to Artificial Neural Systems Jaico Publishing House, First edition, 1994.
2. K. Deb, Optimization for Engineering Design – Algorithms and Examples, Prentice Hall of India, New Delhi, second edition, 2012.
3. F. Karray and C. De Silva, “Soft Computing and Intelligent Systems Design, Theory, Tools and Applications”, Prentice Hall, first edition 2009.

Course Code	Course Title	Core/Elective					
4PE715EE	ELECTRICAL	Elective					
	DISTRIBUTION	L	T	P/D	Credits	CIE	SEE
	SYSTEMS	3	0	0	3	40	60

COURSE OBJECTIVES:

The objective of this course is to make the student:

1. Understand the concepts and Importance of different loads characteristics.
2. Understand the Design of Sub- Transmission Lines, Sub-Stations and Feeders.
3. Understand about importance of Power Quality and Applications of capacitors in distribution systems.

COURSE OUTCOMES :

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

1. Understand the concept of different factors used in design of distribution systems.
2. Analyze load characteristics, rate structure & types of Distribution Transformers.
3. Analyze & Solve Sub-Transmission lines and various substation Bus schemes with multiple feeders and analyze the design considerations and protection of Distribution systems.
4. Solve voltage drop, power loss calculations & justify placement of capacitor in distribution system.
5. Design the optimal locations and ratings of shunt capacitors and Formulate Distribution automation like SCADA.

UNIT–I

Load Characteristics:

Introduction, Diversified demand, non-coincidence demand, Coincidence factor, contribution factor, Load factor, Loss factor, Relationship between the Load factor and Loss factor and Numerical Problems. Rate structure, customer billing, types of distribution transformers.

UNIT– II

Design of Sub-transmission Lines and Distribution Sub-Stations:

Introduction, Substation bus schemes, rating of distribution substation, service area with multiple feeders, percentage voltage drop Calculations.

Design Considerations of Primary& Secondary Systems: Introduction, Radial type and Loop type Primary feeder, Primary feeder loading, uniformly distributed load application to a long line, Secondary banking, Secondary networks. Network transformers.

UNIT-III

Protection: Objectives of distribution system protection, types of common faults and procedure for fault calculations,

Over Current Protective Devices: Principle of operation of Fuses, Auto-Circuit Recloser -and Auto-line sectionalizes, and circuit breakers.

Coordination: Coordination of Protective Devices: Objectives of protection co-ordination, general coordination procedure, Types of protection coordination: Fuse to Fuse, Auto-Recloser to Fuse, Circuit breaker to Fuse, Circuit breaker to Auto-Recloser.

UNIT–IV

Voltage Drop and Power Loss Calculations of a 3-Phase Systems:

Introduction, Voltage Drop and Power Loss Calculations, Voltage fluctuations, measures to reduce flickering, Methods of load flow of Distribution Systems - forward sweep and backward sweep methods.

UNIT–V:

Application of Capacitors to Distribution Systems:

Introduction, Effect of series and shunt capacitors, power factor correction, economic justification for capacitors, Procedure to determine the best capacitor location.

Distribution Automation: Definitions, Components of distribution SCADA, Advanced Metering Infra and Automatic Metering Reading.

TEXTBOOKS:

1. Electric Power Distribution Engineering, Turan Gonen, CRC Press, Special Indian 3rd Edition, 2017.
2. Electric Power Distribution, A.S. Pabla, Tata McGraw Hill Publishing Company Ltd., 7th Edition, 2019.
3. Electric Distribution Systems, Dale R Patrick, Stephen W Fardo, Prentice Hall PTR, 1998.

REFERENCES/SUGGESTEDREADING:

1. Electric Power Distribution Systems, V. Kamaraju, McGraw Hill Education, 2017.
2. Electrical Power Distribution System, M Narendra Kumar, Yes Dee Publishing Pvt. Ltd, 2022.
3. Electric Distribution Systems, Abdelhay A. Sallam, Om P. Malik, Wiley–Blackwell, IEEE Press, 2011.

Course Code	Course Title	Core/Elective					
1OE703AD	MACHINE LEARNING	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES:

The objective of this course is to make the student:

1. Learn the concepts of machine learning and types of learning
2. Study various supervised learning algorithms.
3. Learn ensemble techniques and various unsupervised learning algorithms.
4. Understand assessment methods and evaluation parameters of machine learning algorithms

COURSE OUTCOMES :

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

1. Describes types of data and their preprocessing methods.
2. Describes supervised, unsupervised learning methods and their appropriate evaluation procedures and metrics.
3. Applies different supervised and unsupervised machine learning algorithms to different datasets.
4. Evaluates different machine learning approaches and infers the best learning model for a given scenario.

UNIT - I

Introduction: Types of Machine Learning Algorithms: Parametric and Non-parametric Machine Learning Algorithms, Supervised, Unsupervised, Semi-Supervised and Reinforced Learning.

Data Objects and Attribute Types: Nominal Attributes, Binary Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes.

Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode. Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation.

UNIT - II

Representation and Learning: Feature Vectors, Feature Spaces

Supervised Algorithms: Regression: Linear Regression, Logistic Regression. Evaluation Measures: SSE, RMSE, R2.

UNIT - III

Classification: Decision Tree, Naïve Bayes, K-Nearest Neighbors, Support Vector Machines.

Evaluation of classification: cross validation, hold out The Confusion Matrix, Accuracy, precision, recall, F- Score, Receiver Operator Characteristic (ROC) Curve

UNIT - IV

Unsupervised Learning: Cluster Analysis: Similarity Measures.

Categories of clustering algorithms, k-means, Hierarchical Clustering.

UNIT - V

Ensemble Algorithms: Bagging, Random Forest, Boosting

TEXTBOOKS :

1. Machine Learning, Tom Mitchell, McGraw-Hill Science/Engineering/Math; (1997).
2. Data Mining -Concepts and Techniques, Jiawei Han, MichelineKamber, Jian Pei, III Edition, Morgan Kauffmann Publisher, 2012.

REFERENCE BOOKS :

1. MachineLearning: An Algorithmic Perspective, Stephen Marsland, IIEdition , Chapman & Hall/Crc
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer. (2006).
3. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson, 2014.

Course Code	Course Title	Core/Elective					
3OE703CS	HUMAN COMPUTER INTERACTION	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student:

1. Gain an overview of Human-Computer Interaction (HCI),
2. Understand user interface design and alternatives to traditional "keyboard and mouse" computing
3. Familiar with the vocabulary associated with sensory and cognitive systems as relevant to task performance by humans
4. Apply models from cognitive psychology to predicting user performance in various human-computer interaction tasks
5. Analyze the importance of a design and evaluation methodology that begins with and maintains a focus on the user

COURSE OUTCOMES :

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

1. Explain the capabilities of both humans and computers from the viewpoint of human information processing.
2. Describe typical human–computer interaction (HCI) models, styles, and various historic HCI paradigms.
3. Apply an interactive design process and universal design principles to designing HCI systems.
4. Describe and use HCI design principles, standards and guidelines.
5. Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.

UNIT - I

Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.

The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

UNIT - II

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.

Screen Designing: Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

UNIT - III

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colours, uses problems, choosing colours

UNIT - IV

HCI in the software process, The software life cycle Usability Engineering Iterative design and prototyping Design Focus: Prototyping in practice Design rationale Design rules Principles to support us ability Standards Golden rules and heuristics HCI patterns Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi-modal interaction

UNIT - V

Cognitive models Goal and task hierarchies

Design Focus: GOMS saves money Linguistic models The challenge of display-based systems Physical and device models Cognitive architectures Ubiquitous computing and augmented realities Ubiquitous computing applications research

Design Focus: Ambient Wood – augmenting the physical Virtual and augmented reality Design Focus: Shared experience

Design Focus: Applications of augmented reality Information and data visualization

Design Focus: Getting the size right.

TEXT BOOKS :

1. The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech.
2. Human – Computer Interaction. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg,Pearson Education.

REFERENCE BOOKS :

1. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen , Pearson Education.
4. Human –Computer Interaction, D. R. Olsen, Cengage Learning.
5. Human –Computer Interaction, Smith - Atakan, Cengage Learning.

Course Code	Course Title	Core/Elective					
5OE703EC	MEDICAL ELECTRONICS	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student:

1. To familiarize with the fundamental principles of medical electronics and the nature of bioelectric signals.
2. To provide with the knowledge and skills necessary for the acquisition, processing, and interpretation of bio signals such as ECG, EEG, EOG, and EMG
3. Understand the common artifacts and sources of noise in bio signals and develop techniques for artifact removal.
4. To introduce to the clinical applications of bio signal analysis in the diagnosis and monitoring of various medical conditions.
5. To foster an understanding of emerging trends and technologies in medical electronics and their potential impact on healthcare.

COURSE OUTCOMES :

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

1. Demonstrate an understanding of the principles underlying bioelectric signals and their relevance in medical diagnostics.
2. Apply appropriate techniques for the acquisition and preprocessing of bio signals using specialized instrumentation.
3. Analyze and interpret bio signals such as ECG, EEG, EOG, and EMG to identify normal and abnormal patterns.
4. Implement signal processing algorithms to remove artifacts and enhance the quality of bio signals for accurate diagnosis.
5. Evaluate the clinical significance of bio signal analysis in the context of specific medical conditions and treatment strategies.

UNIT-I

Medical Electronics Overview: Definition, scope, and importance in healthcare. **Bioelectric Signals Basics:** Nature, characteristics, and acquisition techniques. Signal Processing Fundamentals: Basics and artifact removal techniques.

UNIT – II

Physiology of the Heart: Understanding the cardiac cycle and ECG signal generation. **ECG Signal Acquisition:** Electrodes, instruments, and techniques. ECG Interpretation: Normal/abnormal waveforms analysis. ECG Artifacts and Noise: Sources and minimization methods.

UNIT – III

Fundamentals of Brain Signals: EEG signal generation and EEG signal acquisition techniques.

EEG Signal Analysis: Preprocessing, feature extraction, and classification. EEG Artifacts: Identification and mitigation strategies.

UNIT – IV

Muscle Physiology: EMG signal generation and EMG signal acquisition techniques. EMG Signal Interpretation: Normal/abnormal waveforms analysis, Noise Sources and minimization methods.

UNIT – V

Other Biosignals Introduction: EOG and EDA overview. Wearable Medical Electronics: Continuous monitoring and diagnosis applications. Medical Electronics Trends: Recent advancements and future directions. Case Studies and Practical **Applications:** Real-world examples.

TEXT BOOKS :

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Engineering", 4th Edition, Academic Press, 2012.
2. C. Raja Rao and Sujoy K. Guha, "Principles of Medical Electronics and Biomedical Instrumentation", 5th Edition, McGraw Hill Education, 2018.

REFERENCE BOOKS:

1. Malcolm S. Milner, Iain Hunter, and David G. Sixto Jr., "Biomedical Signal Analysis: A Practical Guide", 3rd Edition, Artech House, 2012.
2. IEEE Transactions on Biomedical Engineering.

Course Code	Course Title	Core/Elective					
6OE703ME	INTRODUCTION TO ROBOTICS	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student:

1. Familiarize with basic terminologies of the robotic science and essential knowledge required to get started in field of Robotics.
2. Learn different types of grippers and sensors used in robotics.
3. Understand sensor selection criteria.
4. Learn programming languages for robot programming.
5. Understand the socio economic aspects and interdisciplinary applications of robotics

COURSE OUTCOMES :

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

1. Understand the principles and functions of robotic components.
2. Analyze the role of sensors, actuators, and controllers in robotic systems.
3. Apply kinematic principles to model and control robot movement.
4. Develop basic programming skills for robot control and simulation.
5. Understand socio economic aspects of robotics.

UNIT-I

Introduction to Robotics:

Brief History, Basic Concepts of Robotics such as Definition, Three laws, Types of robots, Elements of Robotic Systems , DOF, Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.

UNIT-II

Grippers and sensors for robotics:

Grippers for robotics - types of grippers, guidelines for design for robotic gripper, force analysis for various basic gripper system.

Sensors for robots - types of sensors used in robotics, classification and applications of sensors, selections of sensors. Need for sensors and vision system in the working and control of a robot.

UNIT-III

Drives and control for robotics: drive - types of drives, types of transmission systems & actuators.

Control systems: types of controllers, introduction to closed loop control.

UNIT - IV

Programming and languages for robotics: robot programming: methods of robot programming, wait, signal and delay commands, subroutines, programming languages, generations of robotic languages, introduction to val,rail, aml, python, ros etc., development of languages since wave till ros.

UNIT - V

Socio-economic aspect of robotisation: socio-economical aspects for robot design, safety for robot and standards, introduction to artificial intelligence, ai techniques, need and application of ai, new trends & recent updates in robotics.

TEXT BOOKS :

1. "Robotics: Modeling, Planning and Control" by Bruno Siciliano, Springer.
2. "Introduction to Robotics: Mechanics and Control" by John J. Craig, Pearson.

REFERENCE BOOKS:

1. "Robotics: Control, Sensing, Vision, and Intelligence" by C.S.G. Lee and K. S. Fu.
2. "Robot Modeling and Control" by Mark W. Spong.
3. "Robotics: Control, Sensing, Vision, and Intelligence" by C.S.G. Lee and K. S. Fu, McGraw-Hill Education.
4. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, Pearson.

Course Code	Course Title	Core/Elective					
2OE703CE	ESSENTIALS OF	Elective					
	ROAD SAFETY	L	T	P/D	Credits	CIE	SEE
	ENGINEERING	3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to impart knowledge & skills to students so that they can:

1. Comprehend global and Indian road accident trends to grasp fundamental road safety principles.
2. Apply statistical and engineering tools to analyze traffic safety data effectively.
3. Design road infrastructure with safety features considering vehicle and human factors.
4. Manage traffic effectively to enhance road safety outcomes.
5. Conduct thorough road safety audits and propose evidence-based improvement strategies.5.Understand the socio economic aspects and interdisciplinary applications of robotics

COURSE OUTCOMES :

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

1. Understand fundamental principles of road safety.
2. Analyze traffic safety data using statistical methods and engineering techniques.
3. Apply geometric design principles and integrate safety features into road infrastructure.
4. Master traffic management systems to enhance road safety.
5. Conduct road safety audits and develop comprehensive safety management systems.

UNIT - I

Global and Indian Road Safety Landscape: Current state of road safety, leading causes of accidents, comparison with global trends.

Accident Characteristics: Analyzing real-world accident data, understanding the "who, what, when, where, and why" of crashes.

UNIT - II

Traffic Engineering Fundamentals : Traffic flow, capacity analysis, role of traffic control devices like signs and signals.

Statistical Methods for Action: Applying regression analysis and other statistical tools to identify correlations between factors and accidents, predicting high-risk areas.

UNIT - III

Accident Investigations and Risk Management: Conducting thorough accident investigations, understanding root causes, and preventing future incidents.

Human Factors and Vehicle Characteristics: The impact of human behavior, perception limitations, and vehicle design features on road safety.

Road Design for Safety: Geometric design elements influencing safety (lane width, curves, sight distance) and road equipment (guardrails, delineators).

Road Lifecycle Approach: Strategies for safe and efficient road maintenance, reconstruction, and rehabilitation.

UNIT-IV

Traffic Signals & Street Lighting: Principles of traffic signal design considering traffic flow and pedestrian needs. Importance of proper street lighting for nighttime safety.

Provisions for Vulnerable Users: Dedicated infrastructure and design considerations for the safety of pedestrians, cyclists, and other vulnerable road users.

The Power of Signs and Markings: Different types of road signs and pavement markings, design standards, and their role in guiding drivers and improving safety.

UNIT-V

Traffic Management Systems (TMS) & Intelligent Transportation Systems (ITS): Implementing technology to improve traffic flow and mitigate accidents.

Road Safety Audits: Conducting comprehensive road safety audits to identify potential safety issues in existing or planned road infrastructure.

Safety from Start to Finish: Best practices for construction site safety, including worker protection measures and proper signage.

TEXT BOOKS :

1. Sarkar, Pradip Kumar, Maitri, Vinay, Joshi, G.J., Transportation Planning: Principles, Practices And Policies, Third Edition, 2021.
2. L.R. Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers, 9th Edition, 2019.

REFERENCE BOOKS:

1. Geetam Tiwari (Editor), Dinesh Mohan (Editor), Transport Planning and Traffic Safety, CRC Press, 1st edition, 2016.
2. HSS Committee, Manual on Road Safety Audit (IRC:SP-088), Indian Road Congress, First Revision, 2019.

Course Code	Course Title	Core/Elective					
4OE703EE	PROGRAMMABLE LOGIC CONTROLLERS	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Understand of PLC programming, ladder logic.
2. Analyze and classification of the process control.
3. Understand PLC hardware units and utilizing them.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Describe typical components of a Programmable Logic Controller.
2. State basic PLC terminology and their meanings.
3. Use latch, timer, counter, and other intermediate programming functions.
4. Explain and apply the concept of electrical ladder logic, its history, and its relationship to programmed PLC instruction.
5. Design and program a small, automated industrial production line.

UNIT – I

Introduction to PLC

What is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks, and limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc

UNIT – II

Working of PLC

Basic operation and principles of PLC, Scan Cycle, Memory structures, I/O structure, Programming terminal, power supply.

UNIT - III

Instruction Set

Basic instructions like latch, master control self-holding relays, Timer instruction like retentive timers, resetting of timers, Counter instructions like up counter, down counter, resetting of counters, Arithmetic Instructions (ADD, SUB, DIV, MUL etc.),

MOV instruction, RTC(Real Time Clock Function), Watch Dug Timer, Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal.

UNIT–IV

Ladder Diagram Programming

Programming based on basic instructions, timer, counter, and comparison instructions using ladder program.

UNIT–V

Applications of PLCs

Object counter, On-off control, Car parking, Sequential starting of motors, Traffic light control, Motor in forward and reverse direction, Star-Delta, DOL Starters, Filling of Bottles, Room Automation.

TEXTBOOKS :

1. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA.
2. Introduction to PLCs by Gary Dunning. McGraw Hill.
3. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh.

REFERENCES/SUGGESTEDREADING :

1. Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar.
2. Module on "Allen Bradlag PlC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh.
3. Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh.
4. CHUNGPA, "User's Manual: Universal PLC Training System CPS-3580U", English ver1, 2020.

Course Code	Course Title	Core/Elective					
4PC758EE	MICROPROCESSORS &	Core					
	MICROCONTROLLERS	L	T	P/D	Credits	CIE	SEE
	LAB	0	0	2	1	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student:

1. Apply assembly language programs on 8086 trainer kit in standalone/serial mode.
2. Classify interface modules into input /output and memory interfaces with 8086.
3. Develop and execute the assembly language programming concepts of 8051 Microcontroller and for various interface modules.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Apply different addressing modes and model programs using 8086 Instruction set.
2. Explain the usage of string instructions of 8086 for string manipulation, and comparison.
3. Develop interfacing applications using 8086 processor.
4. Develop different programs using C cross compilers for 8051 microcontroller.
5. Develop interfacing applications using 8051 microcontroller.

LIST OF EXPERIMENTS

PART-A

1. Use of 8086 trainer kit and execution of programs. (Instruction set for simple Programs using 4 to 5 lines of instruction code under different addressing modes for data transfer, manipulation, and arithmetic operations).
2. Branching operations and logical operations in a given data.
   - i) Transfer byte and word data from source to destination memory.
   - ii) Count even and odd numbers from given array of ten bytes.
   - iii) Find Largest and Smallest number from given array of words.
   - iv) Sort the given array in ascending order, descending order.

3. Multiplication and Division
   i) Use MUL and IMUL for Unsigned and signed multiplication on 8 bit and 16 bit sets.
   ii) Use DIV and IDIV for Unsigned and signed division on 8 bit and 16 bit data sets.
   iii) Find Factorial of a given number using multiplication instructions.
4. Single byte, multi byte Binary and BCD addition and subtraction.
5. Code conversions.
   i) BCD Unpacked to Packed BCD code.
   ii) ASCII code to BCD code.
   iii) BCD to ASCII code.
6. String Searching and Sorting. (Using string instructions)
   i) Find number of repetitions of a character in a string.
   ii) Find and replace a character in the given string

PART - B

[Experiments for 8051 using any C- Cross Compiler & appropriate hardware]

1. Familiarity and use of 8051/8031 microcontroller trainer, and execution of programs.
2. Instruction set for simple programs (using 4 to 5 lines of instruction code).
3. Timer and counter operations & programming using 8051.
4. Programming using interrupts.
5. Interfacing traffic signal control using 8051.
6. Program to control stepper motor using 8051.

Note :

1. At least 10 experiments to be conducted in the semester.
2. Minimum of 5 from Part A and 5 from Part B is compulsory.
3. In Part-B, perform the experiments using assembler simulators like edsim51/Keil software.

Course Code	Course Title	Core/Elective					
4PC759EE	POWER SYSTEMS LAB	Core					
		L	T	P/D	Credits	CIE	SEE
		0	0	2	1	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Determine different parameters of long transmission lines and transformer.
2. Understand the importance of protective relays and their characteristics in power system.
3. Develop Simulink models for various electrical systems.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Determine regulation, efficiency of transmission line and measure capacitance of Three-Core Cable.
2. Acquire knowledge in relay setting for safe operating of power system.
3. Determine capacitance measurement of a three core cable, sequence parameters of transformer, dielectric strength of oil and the efficiency of string insulators.
4. Validate simulated results from programs/Simulink models with theoretical calculations.
5. Develop Simulink models for various electrical systems.

LIST OF EXPERIMENTS

Part - A

1. Determination of regulation & efficiency of transmission lines and verification of Ferranti Effect.
2. IDMT characteristics of Over-current relay.
3. Differential protection of transformer.
4. Determination of positive, negative and zero-sequence Impedance of a Three-Phase transformer.
5. Determination of positive, negative and zero-sequence Impedance of a Alternator.
6. Characteristics of Static relays.

7. Determination of dielectric strength of oils
8. Determination of Voltage distribution and String efficiency of a given model of suspension insulators.

Part - B

1. Simulation of Y-Bus formation.
2. Simulation of Power flow analysis using Gauss-Seidal method.
3. Simulation of Power flow analysis using Newton-Raphson method.
4. Simulation of Fault analysis.
5. Simulation of Economic power Scheduling.
6. Simulation of Transient stability analysis of SMIB System.
7. Simulation of Load Frequency control with and without PI Controller.

Note : At least Five experiments should be conducted from each Part.

Course Code	Course Title	Core/Elective					
4PW752EE	COMPREHENSIVE VIVAVOCE	Core					
		L	T	P/D	Credits	CIE	SEE
		0	0	2	1	20	30

COURSE OBJECTIVES:

The objective of this course is to

1. Assess the overall knowledge of the student in Electrical and Electronics Engineering acquired over 4 years of study in the undergraduate program.
2. Prepare student to face interview both in academic and industrial sector.

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Comprehend the concepts in the core courses
2. Assess technical knowledge to face interviews.
3. Exhibit lifelong learning skills to pursue higher studies or professional practice
4. Demonstrate good oral communication skills.
5. Develop work habits and attitudes necessary for job success.

- The comprehensive viva voce shall normally cover the subjects taught in all the semesters of B.E. Program.
- Viva Voce will be conducted, which will be covering the complete syllabus till VII Semester.
- This will test the student's learning and understanding of concepts during the course of their B.E. Program.
- Every student will be required to undergo comprehensive viva-voce in VII semester of B.E. Program.
- The duration of the viva will be for 20 minutes.
- The department committee will be constituted by the HOD and consist of at least three faculty.
- Continuous Internal Evaluation for Comprehensive Viva Voce will be taken for 20 marks by department committee.
- Semester End Examination is conducted for 30 marks by External Examiner.
- A Candidate shall be considered as pass in the course only if he/she secures not less than the 50% of aggregate of CIE & SEE together i.e., not less than 25 marks out of 50 Marks.

Course Code	Course Title	Core					
4PW753EE	SUMMER INTERNSHIP SEMINAR	Core					
		L	T	P/D	Credits	CIE	SEE
		4-6 weeks duration			2	50	-

COURSE OBJECTIVES :

The objectives of this course is to impart knowledge of

1. Produce an accurate record of work performed during the Internship/Co-op
2. Apply engineering knowledge to a problem in industry
3. Produce a technical report
4. Discuss work in a team environment, if relevant to the project
5. Conduct herself/himself responsibly, safely, and ethically in a professional environment

COURSE OUTCOMES :

After completion of this course student should be able to:

1 Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.

2 Gain working practices within Industrial/R&D Environments.

3. Identify, write down, and carry out performance objectives (mutually agreed upon by the employer, the MCC experiential learning supervisor, and the student) related to their job assignment.
4. Prepare reports and other relevant documentation.
5. Develop work habits and attitudes necessary for job success.

Summer Internship is introduced as part of the curriculam of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organizations/Computer Industry/Software Companies/R&D Organization for a period of 4-6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry coordinate (person from industry).

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship :

- Overview of company/project.
- Safety training.
- Discussions with project teams.
- Background research, review of documents, white papers, and scientific papers.
- Planning, designing, and reviewing the planned work.
- Executing the plans.
- Documenting progress, experiments, and other technical documentation.
- Further team discussions to discuss results.
- Final report writing and presentation.

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department).

Award of session marks are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will co-ordinate the overall activity of Industry Attachment Program.

Note: Students have to undergo summer internship of 4-6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

Department of Electrical and Electronics Engineering

SCHEME OF INSTRUCTION AND EXAMINATION

B. E. IV YEAR

Semester - VIII

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			Hours per week				Maximum Marks		
			L	T	P/D	Duration in Hrs	CIE	SEE	
Theory Courses									
1	4PE8--EE	Professional Elective-V	3	0	0	3	40	60	3
2	4OE8--EE	Open Elective-IV	3	0	0	3	40	60	3
3	4PW854EE	Project	0	0	16	16	50	100	8
Total			**9**	**0**	**16**	**27**	**170**	**280**	**14**

Open Elective – IV			
1	1OE804AD	Big Data Analytics	Not for CSE & AIDS
2	3OE804CS	Data Science	Not for CSE & AIDS
3	5OE804EC	Industrial Electronics	Not for ECE
4	6OE804ME	Industrial Management & Engineering	Not for ME
5	4OE804EE	Sensors and Transducers	Not for EEE
6	2OE804CE	GIS and Remote Sensing	Not for CE

Professional Elective – V		
1	4PE818EE	Smart Grid Technology.
2	4PE821EE	Sensors and Transducers.
3	4PE822EE	Grid Integration of Renewable Energy Systems.

Course Code	Course Title	Core/Elective					
4PE818EE	SMART GRID TECHNOLOGY	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make the student:

1. Understand various aspects of smart grid.
2. Study various smart transmission and distribution technologies.
3. Appreciate distribution generation and smart consumption.
4. Understand the regulations and market models for smart grid.

COURSE OUTCOMES:

After completion of this course student should be able to:

1. Understand technologies for smart grid.
2. Appreciate the DC distribution and smart grid systems.
3. Realize the Smart Grid Communications and Measurement Technology.
4. Summarize the renewable energy and storage.
5. Outline the smart grid control.

UNIT - I

Introduction to Smart Grid: Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions-comparison of Power Grid and Smart Grid-New Technologies for Smart Grid – Advantages – Present development and International policies in Smart Grid, Indian Smart Grid, and Key Challenges for Smart Grid, Components and Architecture of Smart Grid-Description.

UNIT-II

DC Distribution and Smart Grid: AC Vs DC Sources-Benefits of and drives of DC power delivery systems –Powering equipment and appliances with DC-Data centres and information technology loads–Future neighbourhood –Potential future work and research, Introduction to Building Energy Management Systems.

UNIT-III

Smart Grid Communications and Measurement Technology: Communication and Measurement –Monitoring, Smart Meters, Automated Meter Reading, Phasor Measurement Unit (PMU), Wide area measurement System (WAMS).

UNIT-IV

Renewable Energy and Storage: Introduction to Renewable Energy Technologies-Microgrids- Storage Technologies – Electric Vehicles and plug-in hybrids-Environmental impact and Climate Change-Economic Issues. Grid integration issues of renewable energy sources.

UNIT-V

Smart Power Grid System Control: Load Frequency Control (LFC) in Micro Grid System–Voltage Control in Micro Grid System, Reactive Power Control in Smart Grid.

TEXTBOOKS:

1. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRCPress, 2013.
2. A.G. Phadke and J.S.Thorp, "Synchronized Phasor Measurements and their Application", Springer Edition, 2010.
3. IqbalHussein,"Electric and Hybrid Vehicle: Design fundamentals", CRC Press, 2003.

REFERENCE BOOKS :

1. Gil Masters, Renewable and Efficient Electric Power System,Wiley-IEEE Press, 2004.
2. Fereidoon P.Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012.
3. Jean Claude Sabonnadiere, Nouredine Hadjsaid,"SmartGrids". Wiley-ISTE, IEEEPress, May 2012.
4. Smart Grid Handbook for regulators and Policy Makers Nov. 2017.

Course Code	Course Title	Core/Elective					
4PE821EE	SENSORS AND TANSDUCERS	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to make student

1. Expose to various sensors and transducers for measuring mechanical quantities.
2. Understand the specifications of sensors and transducers.
3. Learn the basic conditioning circuits for various sensors and transducers.
4. Introduce advances in sensor technology.

COURSE OUTCOMES :

After completing this course, the student will be able to

2. Understand the static characteristics of Measurement system and sensors.
3. Explain resistive transducers.
4. Explain capacitive and inductive transducers.
5. Understand the temperature measurement using transducers.
6. Understand the principle and working of various advanced sensors and transducers.

UNIT - I

Introduction to measurement system (MS) static characteristics of MS: linearity, Hysteresis, Threshold, Repeatability, Reliability and maintainability, Span, Calibration. Sensor Fundamentals: Basic sensor technology and sensor system Sensor characteristics, system characteristics, instrument selection, data acquisition and read out, and installation.

UNIT-II

Resistive Transducer : Classification of transducers, Basic requirements of transducers, Variable resistance transducers; Potentiometers, Strain gauge (SG), types of Strain Gauge.

UNIT - III

Variable capacitive transducers: Capacitance, Principles, Capacitance displacement transducers, Capacitive hygrometer, and capacitive proximity transducers.

Variable inductive transducers: Linear variable differential transformer, Rotary variable differential transformer.

UNIT - IV

Measurement of temperature: Standards for calibration of temperature. Temperature measuring devices, types of filled in system thermometers — liquid in glass, vapour pressure, bimetallic on solid rod thermometer Resistance temperature detectors, thermostat thermo couple.

UNIT - V

Advance Sensors: Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Digital displacement sensors, Fibre optic sensor, Semi conductor sensor and Smart sensors.

TEXT BOOKS:

1. 1 C.S.Rangan ,GR Sarma & VSN Mani, Instrumentation Devices and Systems-TMH, 2nd Edition 2004.
2. B.Nakra & Chowdhari, Instrumentation Measurement and Analysis, TMH, 2nd Edition 2003.
3. D.V.S.Murthy, Transducers and Instrumentation, PHI, 1995
4. John P.Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education, 2000.

REFERENCES:

1. Doebelin E.O,Measurement Systems-Application and Design, 4th Edition, McGraw-Hill, New
2. Patranabis D, Principles ofIndustrial Instrumentation, 2nd Edition, Tata Mc Graw Hill, New Delhi, 1997.
3. Jon Wilson Sensor Technology Handbook ,Newness Publication Elsevier.

Course Code	Course Title	Core/Elective					
4PE822EE	GRID INTEGRATION OF RENEWABLE ENERGY SYSTEMS	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to

1. Introduce the characteristics of various types of renewable energy sources and converters.
2. Explain the power system operation, power quality, renewable energy grid integration and types of grid.
3. Study the basic analysis and operation techniques on power electronic systems.
4. Understand power control and management systems for grid.
5. Understand the issues in grid integration of renewable energy sources.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Identify the characteristics of renewable energy sources and converters.
2. Understand the operation of power system
3. Analyze the importance of power electronic systems in renewable power applications.
4. Realize the management systems for grid integration.
5. Analyze the challenges faced by the grid by integrating renewable energy sources.

UNIT - I

Review of characteristics of power sources: Basic review of power generation from wind - Solar PV - Thermal - Small hydro - Biomass power strategies in each of these energy conversion systems - Review of maximum power point tracking techniques in solar PV and wind (perturb & observe, hill climbs, incremental conductance).

UNIT-II

Power system operation: Introduction on electric grid, supply guarantees, power quality and stability, introduction to renewable energy grid integration, concept of

mini/micro grids and smart grids; wind, solar, biomass power generation profiles, generation electric features, Load scheduling.

UNIT-III

Converter Topologies for grid integration: Need of power electronic equipment in grid integration, DC/DC converter (buck, boost, buck boost) - DC/AC inverters (sine, triangular, PWM techniques) - Phase locked loop for inverters.

UNIT-IV

Power control and management systems for grid integration: Island detection systems, synchronizing with the grid; Issues in integration of converter-based sources; Network voltage management; power quality management and frequency management; Influence of PV/WECS on system transient response.

UNIT-V

Issues in grid integration of renewable energy sources: Overview of challenges in integrating renewable sources to the grid - Impact of harmonics on power quality – need to maintain voltage within a band and fluctuations in voltage because of renewable integration - power inverter and converter technologies - mechanism to synchronize power from renewable sources to the grid - overview of challenges faced in designing power injection from offshore generation sources - challenges in modeling intermittent nature of renewable power in a power system.

TEXTBOOKS:

1. Kersting W. H. Distribution System Modeling and Analysis, Second Edition, CRC Press, 2004.
2. Vittal V. and Ayyanar R. Grid Integration and Dynamic Impact of Wind Energy, Springer, 2012.
3. Bollen M. H. and Hassan F. Integration of Distributed Generation in the Power System, Wiley-IEEE Press, 2011.
4. . Keyhani A. Design of Smart Power Grid Renewable Energy Systems, Wiley–IEEE Press, 2011

REFERENCE BOOKS :

1. Muhannad H. R. Power Electronics: Circuits, Devices and Applications, Pearson Prentice Hall. 2004.
2. Gellings C. W. The Smart Grid: Enabling Energy Efficiency and Demand Response, First Edition, CRC Press, 2009.
3. Teodorescu R. Liserre M. Rodriguez P. Grid Converters for Photovoltaic and Wind Power Systems, First Edition, Wiley-IEEE Press, 2011.

Course Code	Course Title	Core/Elective					
1OE804AD	BIG DATA ANALYTICS	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

1. Understand the Big Data Platform and overview of Apache Hadoop.
2. Provide HDFS Concepts and Interfacing with HDFS.
3. Understand Map Reduce Jobs.
4. ProvidehandsonHadoopEco System Pig, Hive.
5. Understand various Hadoop Eco Systems like Hbase, Zookeeper.

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Explain the foundations, definitions, and challenges of Big Data.
2. Use Hadoop file system interfaces.
3. Program using HADOOP and Map reduce.
4. Understand various Hadoop Eco Systems like Pig, Hive.
5. Outline Hadoop Eco System using HBase, Zookeeper.

UNIT - I

Introduction to Big Data and Hadoop Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with UNIX tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System.

UNIT - II

HDFS (Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT - III

Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

UNIT - IV

Hadoop Eco System-I Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

UNIT - V

Hive: Hive Shell, Hive Services, Hive Meta store, Comparison with Traditional Databases, Hive QL, Tables, Querying Data and User Defined Functions.

TEXTBOOKS

1. Hadoop: The Definitive Guide, Tom White, III Edition, O'reily Media, 2012.

REFERENCE BOOKS

1. Big Data Analytics, Seema Acharya, Subhasini Chellappan, Wiley 2015.
2. Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007.

Course Code	Course Title	Core/Elective					
3OE804CS	DATA SCIENCE	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

1. Learn fundamental knowledge on basics of data science
2. Understand various statistical concepts like linear and logistic regression
3. Learn fundamentals of how to obtain, store, explore, and model data efficiently.
4. Understand the concepts of classification and clustering

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Recognize the different levels of Data Science concepts for visualization of data.
2. Demonstrate the data visualization and statistical techniques, for describing data structure property.
3. Analyze the basics of probability and statistics models for data exploration
4. Make use of Hypothesis testing for statistical analytics for destroying target based on the mission requirements.
5. Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.

UNIT - I

Introduction : What is Data Science, Where Do We See Data Science, and How Does Data Science Relate to Other Fields, The Relationship between Data Science and Information Science, Computational Thinking, Skills for Data Science, Tools for Data Science, Issues of Ethics, Bias, and Privacy in Data Science.

UNIT - II

Data Collection and Data Pre-Processing: Data Types-Structured Data, Unstructured Data, Challenges with Unstructured Data, Data Collections- Open Data, Social Media Data, Multimedia Data, Data Storage and Presentation, Data Pre-processing -Data Cleaning, Data Transformation, Data Reduction, Data Discretization.

UNIT - III

Exploratory Data Analysis: data summarization, data distribution, Frequency Distribution, Measures of Centrality, Dispersion of a Distribution, Diagnostic Analytics-Co-relations Predictive Analytics, Perspective Analytics, Exploratory Analysis, hypothesis testing using confidence intervals, using p-values.

UNIT - IV

Predictive Modeling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression, Robust Regression. Evaluation Measures: SSE, RMSE, R2.

UNIT - V

Classification: Decision Tree Induction, Support Vector Machine, K-Nearest neighbours (KNN), performance measures: The Confusion Matrix, precision, recall, F-Score, Receiver Operator Characteristic (ROC) Curve. Clustering: K-means Clustering.

TEXT BOOKS :

1. A Hands on Introduction to Data Science, Chirag Shah, Cambridge University Press 2020
2. Practical Statistics for Data Scientists, Peter Bruce and Andrew Bruce,O"Reilly, 2017.
3. R for Data Science,Hadley Wickham and Garrett Grolemund, O"Reilly, 2017.

REFERENCE BOOKS :

1. R Programming for Data science, Roger D Peng, Lean Publishing, 2016.
2. Introduction to Data Science, Rafael A Irizarry, Lean Publishing, 2016.
3. R Data Analysis cookbook, VishwaVishwanathan and Shanthi Vishwanathan, 2015.

Course Code	Course Title	Core/Elective					
5OE804EC	INDUSTRIAL ELECTRONICS	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

This course aims at

1. Introducing electronic device characteristics suitable for industrial applications.
2. Designing AC to DC, DC to AC Converters, Amplifiers , inverters and SMPS.
3. Understanding various voltage control techniques in power converters.
4. Comprehending quadrant operation of various power converters.
5. Introducing various electronic techniques for industrial heating to minimize EM interference.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Understand Industrial Semiconductor devices SCR , DIAC, TRAIC, and MOSFET respectively.
2. Comprehend DC amplifiers, Operational amplifier and Instrumentation amplifier.
3. Design and analysis of DC to DC converters and DC to AC converters and different types of Choppers.
4. Develop skills to build and troubleshoot power electronic circuits.
5. Synthesis of PWM Inverters, UPS and Switched mode regulators

UNIT - I

Characteristics of Semiconductor Power Devices : Thyristor, power MOSFET and IGBT (Qualitative Treatment only), Protections and thermal considerations. Brief introduction to power devices: DIAC and TRIAC, MOS controlled thyristor, Power Integrated Circuit (Smart Power), Concept of fast recovery and Schottky diodes as free-wheeling and feedback diodes.

UNIT – II

DC Amplifiers: Need for DC amplifiers, DC amplifiers: Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Operational Amplifiers, and Instrumentation Amplifiers.

Choppers circuits: Principle, methods and Configurations operations of Type A, Type B, Type C, Type D and type E choppers, TRIACS: Triggering modes, Firing Circuits, Control techniques for choppers: TRC and CLC.

UNIT – III

Regulated Power Supplies : Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques: Short Circuit, over voltage and Thermal Protection. Switched Mode and IC Regulators: Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators.

UNIT – IV

Single-Phase Inverters : Principle of operation of full bridge square wave, quasi square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters voltage and harmonic control at output of inverter, Filters at the output of inverters, Single phase current source inverter. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings.

UNIT – V

Industrial Applications-I: Industrial timers, Classification, types, Electronic Timers –Classification, RC and Digital timers. Electronic DC Motor Control.

Industrial Applications-II: High Frequency heating, principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating: principle, material properties, Electrodes and their Coupling to RF generator.

TEXT BOOKS:

1. Theodore. H. Bogart, “Electronic Devices and circuits”, Pearson Education, 6th Edition, 2003.
2. P.C. Sen., “Modern Power Electronics", 2nd Edition, Chand & Co., 2004.
3. V.R. Moorthi, “Power Electronics”, Oxford University Press, 2005.

REFERENCE BOOKS:

1. G. K. Mithal and Maneesha Gupta, “Industrial and Power Electronics”, Khanna Publishers, 19th Edition, 2003.
2. Ned Mohan, Robbins, “Power electronics”, 3rd Edition, John Wiley and sons, 2002.
3. Biswanth Paul,” Industrial Electronics and Control”, PHI Learning, 3rd edition 2014.

Course Code	Course Title	Core/Elective					
6OE804ME	INDUSTRIAL ENGINEERING AND MANAGEMENT	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

It is intended to make the students to :

1. Learn the concept of Management.
2. Understand role of PERT and CPM techniques in project management.
3. Learn various material procurement policies.
4. Understand the costing and cost control in engineering industries.
5. Learn job evaluation methods.

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Understand the concept of scientific management.
2. Apply different types of inventory models in material management.
3. Apply the concepts of PERT and CPM techniques in project management.
4. Analyse the elements of costing and determine the selling price.
5. Apply job evaluation and merit rating techniques to evaluate the performance of employees.

UNIT - I

Management: Introduction to Management, Scientific Management, Systems approach to Management, MBO, and Decision Making Process. Personnel Management, Functions of personnel management, types of training, Collective bargaining and labour participation in management.

UNIT - II

Cost Accounting and Control: Introduction, Elements of cost, types of cost- prime cost, overhead cost, factory cost, total cost. Selling price, nature of cost, control and accounting of materials, labor, and over head cost, depreciation, break even analysis, break even chart.

UNIT - III

Job Evaluation and Merit Rating: Job evaluation: Introduction, definition and concept, objectives, procedure and methods-ranking method, classification or

grading method, factor comparison method and point method, Merit rating: Introduction, definition, objectives, and methods- rating scale, check list and employee comparison method.

UNIT-IV

Material Management: Importance of inventory control, types of inventory models Inventory costs, deterministic inventory models, Basics of EOQ models, production model without shortages, Purchase model with instantaneous replenishment, production model with shortages, Inventory model with price breaks, Inventory model with probabilistic demand.

UNIT-V

Project Management: Project Management during construction phase, project organization, project planning and control using CPM & PERT techniques. Human aspects of project management, Assessment of tax burden.

TEXT BOOKS:

1. OP Khanna, Industrial engineering and management, Dhanpat Rai Publications.
2. SK Sharma &Savita Sharma," A course in Industrial Engineering & Operations Management", S K Kataria& Sons.

REFERENCE BOOKS :

1. M.Mahajan, "Industrial Engineering and Production Management", Dhanpatrai & sons, New Delhi.
2. S Kalavathi, "Operations Research", Vikas Publishing House Pvt. Ltd.
3. V. K. Kapoor , "Operations Research", S. Chand, New Delhi.

Course Code	Course Title	Core/Elective					
4OE804EE	SENSORS AND TANSDUCERS	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES:

The objective of this course is to make student

1. Expose to various sensors and transducers for measuring mechanical quantities.
2. Understand the specifications of sensors and transducers.
3. Learn the basic conditioning circuits for various sensors and transducers.
4. Introduce advances in sensor technology.

COURSE OUTCOMES :

After completing this course, the student will be able to

1. Understand the static characteristics of Measurement system and sensors.
2. Explain resistive transducers.
3. Explain capacitive and inductive transducers.
4. Understand the temperature measurement using transducers.
5. Understand the principle and working of various advanced sensors and transducers.

UNIT-I

Introduction to measurement system (MS) static characteristics of MS: linearity, Hysteresis, Threshold, Repeatability, Reliability and maintainability, Span, Calibration. Sensor Fundamentals: Basic sensor technology and sensor system Sensor characteristics, system characteristics, instrument selection, data acquisition and read out, and installation.

UNIT-II

Resistive Transducer: Classification of transducers, Basic requirements of transducers, Variable resistance transducers; Potentiometers, Strain gauge (SG), types of Strain Gauge.

UNIT-III

Variable capacitive transducers : Capacitance, Principles, Capacitance displacement transducers, Capacitive hygrometer, and capacitive proximity transducers.

Variable inductive transducers : Linear variable differential transformer, Rotary variable differential transformer.

UNIT - IV

Measurement of temperature: Standards for calibration of temperature. Temperature measuring devices, types of filled in system thermometers — liquid in glass, vapour pressure, bimetallic on solid rod thermometer Resistance temperature detectors, thermostat thermo couple.

UNIT - V

Advance Sensors: Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Digital displacement sensors, Fibre optic sensor, Semi conductor sensor and Smart sensors.

TEXT BOOKS :

1. C.S.Rangan ,GR Sarma & VSN Mani, Instrumentation Devices and Systems-TMH, 2nd Edition 2004.
2. B.Nakra & Chowdhari, Instrumentation Measurement and Analysis, TMH, 2nd Edition 2003.
3. D.V.S.Murthy, Transducers and Instrumentation, PHI, 1995
4. John P.Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education, 2000.

REFERENCE BOOKS :

1. Doebelin E.O,Measurement Systems-Application and Design, 4th Edition, McGraw-Hill, New
2. Patranabis D, Principles of Industrial Instrumentation, 2nd Edition, Tata Mc Graw Hill, New Delhi, 1997.
3. Jon Wilson Sensor Technology Handbook, Newness Publication Elsevier.

Course Code	Course Title	Core/Elective					
2OE804CE	GIS AND REMOTE SENSING	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES :

The objective of this course is to impart knowledge of :

1. Basics of remote sensing and Sensor Characteristics
2. Energy interactions with atmosphere and Earth surface features
3. Map projections and Data models in GIS
4. Spatial Data creation
5. Spatial data and Terrain modeling analysis

COURSE OUTCOMES:

After completing this course, the student will be able to :

1. Explain the basics of Remote Sensing, different types of satellite and sensors.
2. Define the principles of satellite remote sensing, able to comprehend the energy interactions with earth surface features, spectral properties of water bodies.
3. Demonstrate the basic concept of GIS and its applications, know different types of data representation in GIS.
4. Create the spatial data using various techniques.
5. Develop models using spatial & Terrain Analysis.

UNIT - I

Basics of Remote Sensing: Definition, History, Advantages, Aerial Photography and Satellite Remote Sensing, Components of Remote Sensing System: Energy Source, Energy-Atmosphere Interaction, Energy Interaction with Atmosphere and Surface Materials, Spectral Signatures.

UNIT - II

Remote Sensing Platforms: Aircrafts and Satellites, Orbital Characteristics of Sun-synchronous and Geostationary satellites - Special Purpose Satellites; Remote Sensing Sensors: Types of Sensors, Active and Passive; Framing Systems (Cameras) - Scanning System; Sensor Characteristics: Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution.

UNIT - III

Introduction to GIS : History of development of GIS- Geo Spatial Data - GIS operations- Standard GIS packages, Applications of GIS;

Datum and Map Projections : Concept of Datum, Coordinate Systems and Map Projections , Transformations.

UNIT - IV

Data Models: Spatial and Non-Spatial Data models; Spatial Digital formats

Spatial Data Creation: Scanners, digitizers; Digital Elevation Models; Sources of Errors & Corrections- Rotation and Resampling methods, Morphometric analysis- Triangular Irregular Network (TIN).

UNIT - V

Spatial Data Analysis : Raster data analysis; Vector data analysis - Buffering, Overlay, Union, Intersect, Merging, splitting operations.

Terrain Modelling & Analysis: Contouring, Vertical profiling, Hill shading, 3D perspectives; Slope & Aspect analysis, Viewshed & watershed analysis.

Software: Introduction to QGIS or ARCGIS software and its interface to perform spatial analysis.

TEXT BOOKS :

1. M.Anji Reddy – "Textbook of Remote Sensing and Geographic Information Systems", 3rd Edition, BS Publications, 2008.
2. K.T.Chang –"Introduction to Geographic Information Systems", 4th Edition, McGraw Hill International Edition, 2016.

REFERENCE BOOKS:

1. Lillesand, T., Kiefer, R. W., & Chipman, J. – "Remote Sensing and Image Interpretation", 7th Edition, John Wiley & Sons, 2015
2. Punmia, B.C. & Jain A.K.—"Higher Surveying", 15th Edition, Laxmi Publications, 2005.

Course Code	Course Title	Core/Elective					
4PW854EE	PROJECT	Core					
		L	T	P/D	Credits	CIE	SEE
		0	0	16	8	50	100

COURSE OBJECTIVES :

The objective of this course is to make student

1. Enhance practical and professional skills.
2. Familiarize tools and techniques of systematic literature survey and documentation.
3. Expose the students to industry practices and team work.
4. Encourage students to work with innovative and entrepreneurial ideas.

COURSE OUTCOMES :

After completion of the course, the student will be able to

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management.
4. Demonstrate effective written and oral communication skills.
5. Develop the hardware.

The department can initiate the project allotment procedure at the end of VII semester and finalize it in the first week of VIII semester.

The department will appoint a project coordinator who will coordinate the following:

1. Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries).
2. Grouping of students (max 3 in a group) and Allotment of project guides will be continued as framed during Mini Project.

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems.

Each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

Seminar schedule will be prepared by the coordinator for all the students. Two Project Reviews will be conducted, Review-I before CIE-I and Review-II before CIE-II Examinations.

Each group will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 20 minutes' presentation followed by 10 minutes' discussion.

Project coordinator, Head of the department and Project guide will be associated with the Project Seminar to evaluate students for the award of internal marks.

The seminar presentation should include the following components of the project:

1. Problem definition and specification.
2. Literature survey.
3. Broad knowledge of available techniques to solve a particular problem.
4. Planning of the work.
5. Oral Presentation.

Students have to submit duly signed copies of Project Report Book (1- Guide, 1-Department,1-Library,1-Student) before External Examination.

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SYLLABI of III – VIII Semesters

for

B.E. Four Year Degree Programme

in

Electrical and Electronics Engineering

(With Effect from the Academic Year 2024-25)

(As approved in Academic Council Meeting)

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