B.Tech. Degree

in

ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM STRUCTURE & SYLLABUS

(With effect from 2019-2020 onwards)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY

PUDUCHERRY

KARAIKAL - 609 609

CURRICULUM STRUCTURE - B.Tech.(EEE)

Semester	Sl. No.	Course Code	Name of the Course	L	T	P	C
I	1	HM131	Communication Skills in English	2	0	3	4
	2	MA131	Algebra and Calculus	3	1	0	4
	3	ME131	Engineering Mechanics	3	0	0	3
	4	PH131	Engineering Physics	3	0	0	3
	5	HM134	Environment, Energy and Agricultural Engineering	3	0	0	3
	6	ME133	Engineering Graphics	1	0	3	3
	7	PH133	Engineering Physics Lab	0	0	3	2
	Total credits						**22**
II	1	HM132	Life Sciences	2	0	0	2
	2	MA132	Differential Equations and Laplace Transforms	3	0	0	3
	3	EE102	Electric Circuits and Networks	3	1	0	4
	4	CH132	Engineering Chemistry	3	0	0	3
	5	CS132	Basics of Programming / Advanced Programming	2	0	3	4
	6	ME132	Basic Mechanical and Civil Engineering	3	0	0	3
	7	CH134	Engineering Chemistry Lab	0	0	3	2
	8	ME134	Workshop Practice	0	0	3	2
	Total credits						**23**
III	1	MA231	Fourier Transforms and Probability Statistics	3	0	0	3
	2	EE201	Analog Electronics	3	0	0	3
	3	EE203	Signals and Systems	3	0	0	3
	4	EE205	Electrical Machines I	3	1	0	4
	5	EE207	Electrical Power Generation Systems	3	0	0	3
	6	EE209	Digital Logic Circuits and Systems	3	0	0	3
	7	EE211	Analog Electronics Lab	0	0	3	2
	8	EE213	Circuits and Digital Electronics Lab.	0	0	3	2
	Total credits						**23**
IV	1	MA232	Numerical Methods for Electrical Engineers	3	0	0	3
	2	EE202	Electrical machines II	3	1	0	4
	3	EE204	Transmission and Distribution of Electrical Energy	3	0	0	3
	4	EE206	Control Systems	3	1	0	4
	5	EE208	Computer Organisation and Microcontrollers	3	0	3	5
	6	EE210	Electrical Machines Lab	0	0	3	2
	Total credits						**21**

V	1	EE301	Power System Analysis	3	1	0	4
	2	EE303	Measurement and Instrumentation	3	0	0	3
	3	EE305	Electromagnetic Theory	3	0	0	3
	4	CS331	Data structures and algorithms	2	0	3	4
	5	EE5**	Professional Elective I	3	0	0	3
	6	EE10**	Open Elective I	3	0	0	3
	7	EE307	Control and Instrumentation Lab	0	0	3	2
	Total credits						**22**
VI	1	HM331	Engineering Ethics and Precepts of Constitution of India	2	0	0	0
	2	EE302	Power Electronics	3	1	0	4
	3	EE304	Power System operation and control	3	1	0	4
	4	EE5**	Professional Elective II	3	0	0	3
	5	EE10**	Open Elective II	3	0	0	3
	6	EE10**	Open Elective III	3	0	0	3
	7	EE306	Power System Simulation Lab	0	0	3	2
	8	EE308	Power Electronics & Drives Lab	0	0	3	2
	9	EE310	Soft Skills	0	0	3	0
	10		Summer Internship				0
	Total credits						**21**
VII	1	HM401	Principles of Economics / Principles of Management	3	0	0	3
	2	EE401	Power System Protection and Switchgear	3	0	0	3
	3	EE5**	Professional Elective III	3	0	0	3
	4	EE5**	Professional Elective IV	3	0	0	3
	5	EE10**	Open Elective IV	3	0	0	3
	6	EE403	Project Work Phase 1	0	0	6	3
	Total credits						**18**
VIII	1	EE5**	Professional Elective V	3	0	0	3
	2	EE10**	Open Elective V	3	0	0	3
	3	EE402	Project Work Phase II	0	0	12	6
	Total credits						**12**
OVERALL CREDITS: **162**							

Professional Electives

Sl. No.	Course Code	Name of the Course	L	T	P	C
1	EE501	Electrical Machine Design	3	0	0	3
2	EE502	Digital logic Design using VHDL	3	0	0	3
3	EE503	High Voltage Engineering	3	0	0	3
4	EE504	Modern Control Theory	3	0	0	3
5	EE505	Design with PIC Microcontrollers	3	0	0	3
6	EE506	Special Electrical Machines	3	0	0	3
7	EE507	Digital Control Systems	3	0	0	3
8	EE508	Solid state drives	3	0	0	3
9	EE509	Biomedical Instrumentation	3	0	0	3
10	EE510	Intelligent Techniques	3	0	0	3
11	EE511	Power System Restructuring	3	0	0	3
12	EE512	Automotive Electronics	3	0	0	3
13	EE513	Utilization of Electrical Energy	3	0	0	3
14	EE514	Flexible AC Transmission Systems	3	0	0	3
15	EE515	Power Quality	3	0	0	3
16	EE516	Electrical Energy Conservation and Management	3	0	0	3
17	EE517	Virtual Instrument Design	3	0	0	3
18	EE518	Static Relays	3	0	0	3

Open Electives

Sl. No.	Course Code	Name of the Course	L	T	P	C
1	EE1001	Electrical Safety	3	0	0	3
2	EE1002	Power Electronic Systems	3	0	0	3
3	EE1003	Power System Engineering	3	0	0	3
4	EE1004	Maintenance and troubleshooting of Electrical Appliances	3	0	0	3
5	EE1005	Renewable Energy Systems	3	0	0	3
6	EE1006	Industrial Electronics	3	0	0	3
7	EE1007	Soft Computing Techniques	3	0	0	3
8	EE1008	Medical Instrumentation	3	0	0	3
9	EE1009	Applied Electrical and Electronics Engineering	3	0	0	3
10	EE1020	Conservation of Electrical Energy	3	0	0	3
11	EE1011	Internet of Things	3	0	0	3
12	EE1012	Digital Control Engineering	3	0	0	3

SEMESTER I

HM 131 COMMUNICATION SKILLS IN ENGLISH

L	T	P	C
2	0	3	4

COURSE OBJECTIVES

- To equip students in understanding and putting into practice the basic sub-skills of English language, along with the effective demonstration of Soft skills.

Essentials of Communication: Definition, Importance, Process of Communication, Factors of Communication - Sender, Receiver, Channel, Code etc., Filters and Barriers, Verbal and Non-verbal Communication, Channels.

Technical Writing Skills: Mechanics of Technical Writing, Paragraph Writing - Coherence, Cohesion, Linkers, Unity; Report Writing- Oral and Written Reports, Summary writing, Paraphrasing.

Writing for Special Purposes: Business Proposals, Business Correspondence: Enquiry, complaint, sales letters; Textual Schematization, Linguistic interpretation of diagrammatic representation of data – Graphs, Tables, Charts etc.

Functional Skills: Presentation Skills, Group Discussions, Pamphlet and brochure designing, Seminar Skills.

Soft Skills: Relationship between Soft skills and Communication Skills, Leadership Skills, Team management Skills, Interview Skills, Telephone etiquettes

Activities for Practice:

Activities designed on the basis of theory syllabus such as pair work activities, role plays, Jam sessions, mock interviews, group discussions, data interpretation and linguistic analysis practice, writing and soft skills practice etc.,

TEXT BOOKS

1. Meenakshi Raman and Sangeeta Sharma, *Technical Communication: Principles and Practice*, OUP Publication, 2014.
2. John Sealy. *The Oxford Guide to effective writing and Speaking*, OUP publication, 2007.
3. K. Alex, *Soft Skills*, S Chand Publications, 2010.

REFERENCE BOOKS

1. David Lindsay, *A Guide to Scientific Writing*, Macmillan, 1995.
2. C. Bovee& C.A. Paul. *Business Communication Today*, Pearson, 2018.
3. Raymond V Lesikar and Marie E. Flatley. *Basic Business Communication*, Tata Mc-Graw Hill, 2005.
4. Comfort, Jeremy, et al. *Speaking Effectively: Developing Speaking Skills for Business English*. Cambridge University Press, Cambridge: Reprint 2011.

COURSE OUTCOMES

At the end of the course, the students will be able to

- Recognize the basics of communication with an emphasis on its functional and technical aspects.
- Integrate language with content specific subject knowledge through task based activities
- Showcase the knowledge of the various uses of English in their professional and everyday environment

MA131	ALGEBRA AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To apply the concepts of linear algebra in the fields of electrical and communication systems.
- To explain the method of finding Eigen values and Eigenvectors.
- To apply iterative methods to solve linear and nonlinear equations

Unit-I: Matrix Theory**:** Elementary row and column operations on a matrix, Rank of matrix, Normal form, Inverse of a matrix using elementary operations, Consistency and solutions of systems of linear equations using elementary operations, Linear dependence and independence of vectors, Characteristic roots and vectors of a matrix, Caley - Hamillton theorem (statement only) and its applications, Canonical form by linear and orthogonal transformations.

Unit-II: Sequences: Sequences of real numbers, Limit of a sequence, Convergent and divergent sequences, sub sequence, Cauchy's sequence, Monotone convergence theorem (without proof), Sequence with recurrence relations.

Unit-III: Infinite series: Convergence Tests for positive term series,Comparison, Root, Ratio and Raabe's tests, Alternating series, Leibnitz's rule, Absolute and Conditional Convergence.

Unit-IV: Differential Calculus: Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's theorems (without proof) with remainders, Functions of several variables, Partial Differentiation, Total Differentiation, Euler's theorem and generalization, Maxima and minima of functions of several variables (two and three variables),Lagrange's method of Multipliers, Change of variables, Jacobians.

Unit-V: Beta and Gamma functions, Multiple Integrals: Double and triple integrals, surface areas by double integrals, Volumes by double and triple integrals change of variables in double and triple integrals.

TEXT BOOKS

1. ErwynKreyszig, *Advanced Engineering Mathematics*, John Wiley and Sons, 8th Edition.
2. M.D. Greenberg, *Advanced Engineering Mathematics*, 2nd Edition, Pearson Education Inc., 2002.

REFERENCE BOOKS

1. B.S.Grewal, *Higher Engineering Mathematics*, Khanna Publications, 2002.
2. C.Y. Hsiung and G. Y. Mao, *Linear Algebra*, World Scientific Publishing Co. Inc., 1999.
3. T.M. Apostol, *Calculus*, Volume I & II, 2nd Edition, John Wiley & Sons (Asia), 2005

ME131	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the basics of engineering mechanics which includes statics, dynamics and properties of surfaces and solids

Unit-I: Fundamentals: Mechanics and its relevance, concepts of forces, laws of mechanics parallelogram law, Lami's theorem, Law of polygon, concept of free-body diagram, centroids, center of gravity, area moment of inertia, mass moment of inertia – simple and composite planes, simple truss analysis, Numerical problems.

Unit-II: Friction: Laws of friction, static friction, rolling friction, application of laws of friction, ladder friction, wedge friction, body on inclined planes, simple screw jack – velocity ratio, mechanical advantage, efficiency, Numerical problems.

Unit-III: Statics: Principles of statics, types of forces, concurrent and non-concurrent forces, composition of forces, forces in a plane and space, simple stresses and strains, elastic coefficients, Numerical problems.

Unit-IV: Kinematics: Fundamentals of rectilinear and curvilinear motion, application of general equations, concept of relative velocity, analytical and graphical techniques, Numerical problems.

Unit-V: Dynamics: Principles of dynamics, D'Alembert's principle, conservation of momentum and energy, vibrations of simple systems, Numerical problems

TEXT BOOKS

1. S. Timoshenko and D. H.Young, Engineering Mechanics, McGraw Hill, 2006.
2. K. L. Kumar and V. Kumar, Engineering Mechanics, Tata McGraw Hill, 2011.
3. M. S. Palanichamy and S. Nagan, Engineering Mechanics – Statics & Dynamics, Tata McGraw Hill, 2002.
4. E. P. Popov, Engineering Mechanics of Solids, Prentice Hall, 1998.

REFERENCE BOOKS

1. I. H. Shames and G. K. M. Rao, Engineering Mechanics – Static and Dynamics, Pearson Education, 2009.
2. F. P. Beer and E. R. Johnson Jr, Vector Mechanics for Engineers, McGraw Hill, 2009.
3. J. S. Rao and K. Gupta, Introductory Course on Theory and Practice of Mechanical Vibrations, New Age International, 1999.

COURSE OUTCOMES

- Apply the laws of mechanics
- Illustratethefreebodydiagramofasystem;determinetheforcesandvariousmoments and couples
- Compute the centroid and first moment of area of various sections
- Applytheparallelandperpendicularaxistheoremtofindoutthemomentofinertiaof various sections
- Analyse the relative motion and types of friction

PH131	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To enable the students to refresh their basics of Physics and orient themselves in implementation of concepts in engineering.
- To give an exposure on basics of quantum mechanics and statistical physics.
- To provide fundamentals of Solid state physics, which give foundation for engineering Physics and Materials Science
- To enable the students to get exposure on different types advanced materials in engineering, properties and application in the field of engineering

Waves and Oscillations: Wave motion- Wave equation examples-Superposition of waves and standing waves-Simple harmonic motion -energy of SHM damped oscillations-forced oscillations and resonance conditions; theory of Lissajous figure.

Quantum mechanics: Inadequacy of classical mechanics-Wave and particle duality of radiation-de Broglie concept of matter waves-Heisenberg's uncertainty principle-Schrödinger wave equation-Interpretation of wave function- Eigen values and Eigen functions-Superposition principle-Particle confined in one dimensional infinite square well potential.

Solid state Physics: Drude theory of electrical conductivity, Free electron theory (classical and quantum), band theory of solids, semiconductors and semiconductor devices, superconductivity-types, Meissner effect, applications; Magnetism-types and properties-Hard and soft magnetic materials, applications; Dielectrics-types of polarization, Claussius Mosotti equation.

Advanced materials: Nanomaterial (one, two and three dimensional)-synthesis techniques-physical properties and applications. Composites-Shape memory allows, piezoelectric materials, thermo electric materials, Ferro-electric materials, Thin film synthesis and characterization, Materials for battery applications.

Electrodynamics: Coulomb's law for distribution of charges-polarization and Gauss's law-electric current and equation of continuity-magnetic induction and Lorentz force-steady current and Biot Savart law-Ampere's law-magnetization and magnetic intensity-Faraday's law of induction-generalization of Ampere's law-Maxwell's equation.

TEXT BOOKS

1. M.N. Avadhanulu and P.G. Kshirsagar, *A text book of Engineering Physics*, S. Chand and Company, New Delhi (2014).
2. R.K. Gaur and S.L. Gupta ,*Engineering Physics*, DhanpatRai Publications (P) Ltd., 8thedn., New Delhi (2001)
3. V. Rajendran, *Materials Science*, Tata McGraw-Hill-2011
4. R. A.Serway and J.W.Jewett, *Physics for Scientists and Engineers*, 9th edition, Cengage Learning.2014
5. Anthony R. West, *Solid State Chemistry and its Applications*, John Wiley and sons 2nd Edition. 2014
6. Arthur Beiser, *Concepts of Modern Physics*., Tata McGraw-Hill, NewDelhi (2010).

REFERENCE BOOKS

1. Halliday, Resnic and Walker, *Fundamentals of Physics*, 9thEd., John Wiley& sons (2011)
2. Walter Greiner, Ludwig Neise, Horst StöckerandD. Rischke, Thermodynamics *and Statistical Mechanics*, Springer (1997)
3. Richard P. Feynman ,*The Feynman Lectures on Physics* - Vol. I,II and III: The New Millennium Edition (2012)
4. Rolf. E. Hummel, *Electronic Properties of Materials*, Springer (2001)

COURSE OUTCOMES

- Fundamental knowledge of students obtained in school will get refreshed while handling topics with mathematical approach.
- Exposure on physics of materials science for the advancements in the materials science.

HM134	ENVIRONMENT, ENERGY AND AGRICULTURAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students on various sources, effects and control measures of air pollution, water pollution and pollution due to industries and transport
- To understand the various sources of energy and their effect on environment
- To know the various types of crops and irrigation methods

Unit-1: Air pollution - Sources, effects, control, air quality standards -Air pollution act, air pollution measurement. Water pollution-Sources, impacts, control and measure, water contamination, sewage treatment plants–Quality of water for various purposes-Noise pollution - Sources, impacts, control, measure.

Unit-2: Pollution aspects of various industries- Impacts of fossil fuels and transport emissions – impacts - Municipal solid waste generation and management - Swachh Bharat Mission – Challenges and activities - Environment and forest conservation – Greenhouse gases and global warming- climate change

Unit-3: Present energy resources in India and its sustainability - Different types of conventional power plants-Energy demand scenario in India - Advantage and disadvantage of conventional Power Plants – Conventional vs. non-conventional power generation - Environmental impacts and safety.

Unit-4: Basics of Solar Energy, Solar thermal and Solar photovoltaic systems -Power and energy from wind turbines-Types of wind turbines-Biomass resources Biomass conversion technologies- Feedstock pre-processing and treatment methods Introduction to geothermal energy and tidal energy- Environmental benefits and impacts.

Unit-5: Introduction to agriculture engineering -Major crops of India–Types and categories of crops-Types of farming and cultivation procedures-Different monsoon seasons-Types of irrigation systems-Major draughts-Agricultural machinery-Dairy farming and its economic importance

TEXT BOOKS

1. B. H. Khan, Non-Conventional Energy Resources-The McGraw –Hill Second edition, 2009.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Prentice Hall, 2nd Edition, 2003.
3. G.L. Asawa, Elementary Irrigation Engineering, New Age International, First Edition, 2014
4. Sukhpal Singh, Agricultural Machinery Industry in India, Allied Publishers, New Delhi, 2010
5. Dilip R. Shah, Co-Operativization Liberalization And Dairy Industry In India, A.B.D. Publishers, 2000

REFERENCE BOOKS

1. Unleashing the Potential of Renewable Energy in India –World Bank report.
2. G. Boyle, Renewable energy: Power for a sustainable future, Oxford University press, 2004.

ME133 **ENGINEERING GRAPHICS** **L T P C**
1 0 3 3

COURSE OBJECTIVES

The student is expected to possess the efficient drafting skill depending on the operational function in order to perform day to day activity.

- To provide neat structure of industrial drawing.
- Enables the knowledge about position of the component and its forms
- Interpretation of technical graphics assemblies
- Preparation of machine components and related parts

UNIT-I

Fundamentals Drawing standard - BIS, dimensioning, lettering, type of lines, scaling conventions. Geometrical constructions: Dividing a given straight line into any number of equal parts, bisecting a given angle, drawing a regular polygon given one side, special methods of constructing a pentagon and hexagon – conic sections – ellipse – parabola – hyperbola - cycloid – trochoid.

UNIT-II

Orthographic projection: Introduction to orthographic projection, drawing orthographic views of objects from their isometric views - Orthographic projections of points lying in four quadrants, Orthographic projection of lines parallel and inclined to one or both planes Orthographic projection of planes inclined to one or both planes. Projections of simple solids - axis perpendicular to HP, axis perpendicular to VP and axis inclined to one or both planes.

UNIT-III

Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to other plane. Intersection of surfaces: Intersection of cylinder & cylinder, intersection of cylinder & cone, and intersection of prisms.

UNIT-IV

Development of surfaces: Development of prisms, pyramids and cylindrical & conical surfaces. Isometric and perspective projection: Isometric projection and isometric views of different planes and simple solids, introduction to perspective projection, perspective projection of simple solids prisms, pyramids and cylinders by visual ray method and vanishing point method.

UNIT-V

Computer aided drafting: Introduction to computer aided drafting package to make 2-D drawings. 2D drafting commands (Auto CAD) for simple shapes – Dimensioning (Based on the assignment, student will be evaluated for this unit)

TEXT BOOKS

1. Natarajan, K. V., A text book of Engineering Graphics, Publication: Dhanalakshmi Publishers, Chennai, 2006.
2. Venugopal, K. and Prabhu Raja, V., Engineering Drawing and Graphics + AutoCAD, Pub.: New Age International, 2009

REFERENCE BOOKS

1. Jolhe, D. A., Engineering drawing, Publication: Tata McGraw Hill, 2008
2. Shah, M. B. and Rana, B. C., Engineering Drawing, Pub.: Pearson Education, 2009.
3. Basant Agarwal and Agarwal C.M., ―Engineering Drawing‖, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
4. Luzzader, Warren.J. and Duffjohn M., ―Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. Bhatt,N. D and Panchal,V.M., Engineering Drawing, Publication: Charotar Publishing House, 2010.

COURSE OUTCOMES

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

- Perform free hand sketching of basic geometrical constructions and multiple views of objects.
- Do orthographic projection of lines and plane surfaces.
- Draw projections and solids and development of surfaces.
- Prepare isometric and perspective sections of simple solids.
- Demonstrate computer aided drafting.

PH133	ENGINEERING PHYSICS LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES

- To enable the students to understand fundamentals of measurement, error analysis and its impact on results.
- Exposure and to understand basic experiments in different areas of Physics.
- Experiments emphasising the topics covered in the course PH101.
- Fundamentals of measurements, error detection, error analysis and usage of scientific calculator in engineering.

LIST OF EXPERIMENTS

1. Simple harmonic motion.
2. Sonometer- frequency of tuning fork/AC (Melde's technique).
3. Determination of Young's modulus- Searle's dynamical method.
4. Modulus of rigidity using torsion pendulum.
5. Measurement of temperature using thermocouple.
6. Specific heat of liquids by Newton's law of cooling.
7. B-H curve of ferromagnetic materials.
8. Determination of magnetic field along the axis of a circular coil.
9. (i) Conversion of Galvanometer into ammeter and voltmeter.
   (ii) Calibration of voltmeter-Potentiometer.
10. Series LCR circuit-resonance phenomenon.
11. Newton's rings- determination of radius of curvature of a lens.
12. Determination of wavelength, spot size and divergence of laser.
13. I-V Characteristics of a PN junction diode and Zener diode.
14. Determination of resistivity and band gap of a semiconductor.
15. Charge-discharge characteristics of RC circuit.
16. Introduction to CRO- Lissajous figures.
17. Determination of Planck's constant
18. Verification of Photo-electric effect.

TEXT BOOKS

1. C.L Arora, B.Sc. *Practical Physics*. Chand &Co. (2012).
2. Singh Harnam and Hemne P.S., *B.Sc. Practical Physics*, S. Chand & Company (2002)
3. J.D. Wilson and Cecilia A. Hernández-Hall, *Physics laboratory experiments*, 7th edition, Cengage Learning (2009).
4. R.A. Dunlap, *Experimental Physics: Modern Methods*, Oxford University Press (1997)

COURSE OUTCOMES

- Learning Appropriate methods for specific characterization;
- Explaining the data obtained, analysis and interpretation of the phenomena exhibited

SEMESTER II

HM132	LIFE SCIENCES	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To inculcate in the students the overview of theories of human life, laws on genetics, energy flow in cell and the physiology of various systems of human body

Course Overview- Evolution & Origin of Life, Theories for origin of life –Darwinian selection, Diversity of Life

Cell structure- Prokaryotic and Eukaryotic Cell Structures, Functions of Organelles, Mitosis and Meiosis

Classical Genetics – Mendel's laws and Patterns of Inheritance. Structures of Bio-molecules – DNA, RNA, Protein, Carbohydrates and Lipids; Molecular Genetics – Overview of Information Flow in Biological Systems; Techniques in Cell & Molecular biology Structure and Regulation of Cellular Metabolism;

Energy Flow – Photosynthesis, Cell Respiration, Cellular Oxidation of Glucose;

Membrane biology – Cellular Transport and Signal Processing. Overview of Developmental Biology, Human physiology, Behavioural biology.

REFERENCE BOOKS

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Molecular Biology of the Cell, 5th Edition, 2007, Garland Science
2. David S. Goodsell, The Machinery of Life, 2nd Edition, 2009, Springer
3. Paul Davidovits, Physics in Biology and Medicine, 3rd Edition, 2007, Academic Press
4. Colin Ratledge, Bjorn Kristiansen, Basic Biotechnology, 3rd Edition, 2006, Cambridge University Press

COURSE OUTCOMES

- To explain the theories of human life and the laws of genetics
- To realize the structure of a cell, the chemical process and energy flow in cell
- To comprehend the anatomy of various systems of human body

MA132	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Solve linear differential equations with constant and variable coefficients.
- Construct partial differential equations and find the solutions of non-linear partial differential equations of first order.
- TogiveanabilitytoapplyLaplacetransformtechniqueforsolvingengineeringproblems

Unit-I: Ordinary differential equations of first order: Linear first order equations, Bernoulli's equation, Orthogonal trajectories, Newton's law of cooling, Law of Natural growth and Decay.

Unit-II: Higher order Ordinary differential equations: Higher order linear equations with constant coefficients, Euler and Cauchy's equations, Method of variation of parameters, System of linear differential equations with constant coefficients.

Unit-III: Laplace Transformations: Laplace transform, Inverse Laplace transform, properties of Laplace transforms, Laplace transforms of unit step function, Impulse function and periodic function, Convolution theorem.

Unit-IV: Solution of ordinary differential equations with constant coefficients and system of linear differential equations with constant coefficients using Laplace transform.

Unit-V: Partial Differential Equations: Solutions of Wave equation, Heat equation and Laplace's equation by the method of separation of variables and their use in problems of vibrating string, One dimensional unsteady heat flow and two dimensional steady state heat flow.

TEXT BOOKS

1. ErwynKreyszig, *Advanced Engineering Mathematics*, John Wiley and Sons, 10th Edition, 2010.
2. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publications, 42nd Edition, 2012.

REFERENCE BOOKS

1. M.D. Greenberg, *Advanced Engineering Mathematics*, 2nd Edition, Pearson Education Inc., 2002.

EE102	ELECTRIC CIRCUITS AND NETWORKS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The objectives of this course are to

- Expose the students with the knowledge on electric circuit elements, techniques and methods to find the response.
- familiarize the concepts and terminologies of series & parallel resonance circuits and tuned circuits among the students
- Motivate the students for analysing three phase 3 wire, three phase 4 wire circuits and the concept of power measurement.
- Impart knowledge on finding the transient response of series and parallel AC and DC circuits.

Unit I: DC CIRCUITS

Independent and dependent voltage and current sources – R, L, C components –- Series and Parallel connection –Circuit laws– source transformation- star-delta transformation - nodal and loop analysis -network theorems.

Unit II: AC CIRCUITS

Introduction to AC circuits – active and reactive power- phasor analysis –Network Theorems– Resonance in series and parallel circuits - self and mutual inductances - coefficient of coupling - dot convention- analysis of coupled circuits.

Unit III: THREE PHASE SYSTEMS

Balanced and unbalanced systems - symmetrical components - star and delta circuits with balanced and unbalanced loads- Three phase power measurements-power factor calculations

Unit IV: TRANSIENTS

Time response of RL, RC and RLC circuits with step and sinusoidal inputs

Unit V: TWO PORT NETWORKS

Characterization of two port networks in terms of Z, Y, H and T parameters – networks equivalents – relations between network parameters –transfer function of terminated two port networks.

TEXT BOOKS

1. Hayt.W.H and Kemmerly.J.E, “Engineering Circuit Analysis”, Tata McGraw Hill, New York, 7th Edition, 2007.
2. Joseph. A. Edminister, “Electric Circuits - Schaum's outline series”, Tata McGraw Hill International, 5th Edition, 2003.
3. Arumugam.M and Premkumar.N, “Electric Circuit Theory”, Khanna Publishers, 9th Reprint, 1997

REFERENCE BOOKS

1. Charles K. Alexander and Matthew N. O. Sadiku, “Fundamentals of Electric Circuits”, Tata McGraw Hill Companies, 5th Edition, 2013.

COURSE OUTCOMES

1. Apply network reduction techniques, circuit laws and network theorems to find the response of an electric circuit.
2. Analyse the AC circuits under resonance conditions and AC circuits with magnetic coupling.
3. Analyse the balanced and unbalanced three phase systems with star and delta connected loads and measure the power and power factor.
4. Carryout the transient analysis on RL, RC and RLC circuits using Laplace transforms with both DC & AC inputs.
5. Characterize the linear two port networks in terms of different network parameters and form the corresponding equivalent circuit.

CH132	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To help the learners to analyze the hardness of water and its removal.
- To familiarize the learners with the basics of electrochemistry, its applications, corrosion and its control.
- To endow with an overview of nano materials and fuel cells.

UNIT I - Electrochemistry and Corrosion: Introduction to Electrochemistry, Electrolytic and galvanic cells - EMF, Reference Electrode - Weston standard cell, hydrogen electrode, calomel electrode, glass electrode, reversible and irreversible cells, concentration cell – Hydrogen-Oxygen fuel cells. Corrosion: Dry and wet corrosion - General mechanism, Types of corrosion, Factors affecting corrosion - Corrosion protection – Electro and Electroless Plating.

UNIT II - Organic Chemistry: Carbon-carbon bond properties, homolytic and heterolytic cleavage of carbon-carbon bonds, S_N1 and S_N2, $E^1$and E^2reactions, aromatic nucleophilic substitution, aromatic electrophilic substitution, Baeyer-Villigeroxidation, MPV reduction.

UNIT – III Coordination Chemistry: Formation and types of metal complexes, EAN rule, 16 and 18 electron rule, crystal field theory, CFSE, color and magnetism of transition metal ions, metal carbonyls (Ni & Fe) -bonding and structure, Organometallic compounds in catalysis -hydrogenation, hydroformylation and polymerization of olefin, Chemistry of hemoglobin, Bohr effect..

UNIT – III Water Treatment: Sources, hard and soft water, estimation of hardness by EDTA method, softening of water - zeolite process, demineralization by ion exchangers, boiler feed water, internal treatment methods, specificationsfor drinking water, BIS and WHO standards, treatment of water for domestic use, desalination,reverse osmosis, electro dialysis.

UNIT – V Fuel and Nanomaterials: Fuels -classification, examples and relative merits, types of coal, determination of calorific value of solid fuels -Bomb calorimeter - Theoretical oxygen demand, proximate and ultimate analysis of coal, manufacture of metallurgical coke. Nanomaterials Introduction - Properties at nanoscale (optical, mechanical, electronic,and magnetic), Classification based on dimensionality - Carbon - based nanomaterials (buckyballs, nanotubes, graphene) – Metal based nanomaterials (nanogold, nanosilver and metal oxides)

TEXT BOOKS

1. P.C. Jain and M. Jain, Engineering Chemistry, DhanpatRai Publishing Company (P) Ltd., New Delhi, 2015.
2. J. March, Advanced Organic Chemistry, Wiley Eastern, New Delhi, 2012.
3. Alain Nouailhat, An Introduction to Nanoscience and Nanotechnology, John Wiley, 2008.

REFERENCE BOOKS

1. R. Gopalan, D. Venkappayya and N. Sulochana, Engineering Chemistry, Vikas Publishing House, New Delhi, 2017.
2. J.C. Kuriacose, J. Rajaram, Chemistry in Engineering and Technology, Vol I & II, Tata McGraw Hill publishing Company Ltd, New Delhi, 1984.
3. P.W. Atkins, Physical Chemistry, Oxford University Press, 2006.
4. J.E. Huheey, E.A. Keiter and R.L. Keiter, Inorganic Chemistry - Principles of Structure and Reactivity, Harper Collins College Publishers, New York, 2011

CS132	BASICS OF PROGRAMMING	L	T	P	C
		2	0	3	4

COURSE OBJECTIVES

- To learn the fundamentals of computers.
- To learn the problem solving techniques in writing algorithms and procedures.
- To learn the syntax and semantics for C programming language.
- To understand the constructs of structured programming such as conditions, iterations, arrays, functions and pointers.
- To analyse complex engineering problems to develop suitable solutions.

Unit- I Fundamentals of Computers, Algorithms and Structured Programming

Introduction to computers – Computer Organization – Characteristics – Hardware and Software –Modes of operation – Types of programming languages – Developing a program, Algorithms – Characteristics – Flowcharts - Principles of Structured programming – Sequential, Selective structures - Repetitive structures –Bounded, Unbounded and Infinite iterations.

Unit-II Overview of C and Branching

Introduction to C – C character set – Identifiers and Keywords – Data types – Constants – Variables – Declarations – Expressions – Statements – Symbolic constants – Operators– Library functions . Data input and output: Single character input and output – Entering input data – Writing output data – gets and puts functions. Control statements: Conditional-Branching- Looping- unconditional: Break- continue-go to.

Unit-III Functions and Arrays& Strings

Functions: Overview- Defining a Function- Accessing a Function- Function Prototypes-Passing Argument to a Function- Recursion- Storage Classes: Automatic Variables-External (Global) Variables-Static Variables- Register variables. Arrays: Defining an Array- Processing an Array- Passing Array to function- Multidimensional Arrays.

Unit IV Strings and Pointers

Strings: Defining a String- NULL Character- Initialization of Strings- Reading and Writing a String- Processing Strings- Character Arithmetic- Library Functions for Strings. Pointers: Pointer Declaration-Passing Pointers to a Function-Pointers and One-dimensional Array-Dynamic Memory Allocation- Operations on Pointers- Pointers and Multidimensional Arrays- Array of Pointers, Command line arguments.

Unit-V Structures, File Management and Preprocessors

Basic of Structures, structures and functions, array of structures, structure data types, type definition, defining, opening and closing of files, input and output operations. Introduction to preprocessors, compiler control directives.

TEXT BOOKS

1. Brian W Kerningan and Dennis M. Ritchie, “The C Programming Langauge”, Second Edition, PHI, 2012.
2. Byron Gottfried, “Programming with C”, Third Edition, Tata McGraw Hill Education, 2010.
3. R.G. Dromey, “How to Solve it By Computers?”, First edition, Prentice Hall, 2001

REFERENCE BOOKS

1. J.R. Hanly and E.B. Koffman, "Problem Solving and Program Design in C", Sixth Edition, Pearson Education, 2009.
2. Paul Deital and Harvey Deital, "C How to Program", Seventh Edition, Prentice Hall, 2012.
3. YashavantKanetkar, "Let Us C", Twelfth Edition, BPB Publications, 2012.

COURSE OUTCOMES

- Understand the organization of a computer.
- Knowledge of the syntax and semantics of C programming language.
- Ability to code a given logic in C language.
- Knowledge in using C language for coding a given algorithm.

LLIST OF EXPERIMETS IN BASICS OF PROGRAMMING

COURSE OBJECTIVES

- Design algorithms for simple problems.
- Sharpen programming skill in C Language

LIST OF EXPERIMENTS

1. Programs using sequence construct
2. Programs using selection construct
3. Programs using Iterative construct
4. Programs using nested for loops
5. Programs using functions with Pass by value
6. Programs using functions with Pass by reference
7. Programs using recursive functions
8. Programs using one dimensional Array
9. Programs using two dimensional Arrays
10. Programs using Pointers and functions
11. Programs using Pointers and Arrays
12. Programs using Pointers and structures
13. Programs using structures and arrays
14. Programs to perform I/O operations on files.
15. Programs to perform error handling during I/O operations on files.
16. Programs to perform random access to files.

COURSE OUTCOMES

- Ability to write program in C language
- Ability to test and debug the programs for critical errors
- Ability to analyze and optimize programs

ME132	BASIC MECHANICAL AND CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the concepts, significance and importance of Power Plant Engineering, Internal Combustion Engines, Refrigeration and Air Conditioning
- To introduce the concepts of Surveying, Civil Materials, and Building Components

Unit-I Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydroelectric and Nuclear Power plants – Merits and Demerits – Pumps and Turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

Unit-II Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boilers, Classification of Boilers - Fire tube and Water Tube Boilers.

Unit-III Terminology of Refrigeration and Air Conditioning, Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

Unit-IV Surveying: Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples. Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections.

Unit-V Foundations: Types, Bearing capacity – Requirement of good foundations. Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring –plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

TEXT BOOKS

1. Seetharaman S , “Basic Civil Engineering”, Anuradha Agencies, (2005).
2. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering” ,Anuradha Publishers, Kumbakonam, (2000).

REFERENCE BOOKS

1. Rajput, R K, Engineering Materials, S Chand & Co. Ltd., New Delhi, 2002.
2. El.Wakil, M.M., Power Plant Technology, Mc Graw Hill Book Co.,1985.
3. Hajra Choudhry, et. al., “Workshop Technology”, Vol I and II, Media Promoters Publishers Pvt. Ltd., Bombay, 2004.
4. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, (1996).
5. Ramamrutham S, “Basic Civil Engineering”, Dhanpat Rai Publishing Co. (P) Ltd. (1999). Nagpal, Power Plant Engineering, Khanna Publishers, Delhi, 1998.
6. Shantha Kumar S R J., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, (2000).

COURSE OUTCOMES

Upon completion of this course, the students can able to understand the power plant engineering, IC Engines, R&AC, Surveying, Civil Materials and Building Components.

CH134	ENGINEERING CHEMISTRY LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES

Enabling the Students to understand the basics concept of Instrumentation technique, corrosion studies, coal analysis and estimation of water samples.

1. Percentage purity of bleaching powder
2. pH metric titration
3. Conductometric titration
4. Potentiometric titration
5. Determination of corrosion rate of mild steel in acid medium by weight loss method
6. Estimation of total alkalinity in the given water sample
7. Estimation of carbonate, noncarbonated and total hardness in the given water sample
8. Estimation of dissolved oxygen in waste water
9. Estimation of Fe2+ by external indicator
10. Estimation of proximate analysis of Coal.

REFERENCE BOOKS

1. Laboratory Manual, Department of Chemistry, NITT

ME134	WORKSHOP PRACTICE	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES

Introduction to the use of tools and machinery in Carpentry, Welding, Foundry, Fitting and Sheet Metal Working.

1. Department of Mechanical Engineering; (Any Three Experiments)

1. Carpentry: Wood sizing exercise in planning, marking, sawing, chiselling, and grooving to make Half –Lap Joint
2. Welding: Exercise in arc welding for making Lap Joint
3. Fitting: Preparation of joints, markings, cutting, and filling for making Square Fitting
4. Sheet Metal: Making of small parts: Tray/Dust Pan

II. Department of Electrical and Electronics Engineering; (Any Three Experiments)

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.

III. Department of Electronics and Communication Engineering

1. Identification and checking of basic electronic equipment and components
2. Introduction to function generator, cathode ray oscilloscope and regulated power supply.
3. Construction of simple electronic circuit using bread board and printed circuit board (PCB).

IV. Department of Civil Engineering

1. Making Series PVC pipe connection for checking the flow rate
2. Making Parallel PVC pipe connection for checking the flow rate

COURSE OUTCOMES

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

- Fabricate carpentry components
- Use welding equipment to join the structures
- Make the mould using patterns and different fittings
- Fabricate sheet metal, components
- Fabricate electrical and electronics circuits
- Reform the shape of the metals

III SEMESTER

MA231	FOURIER TRANSFORMS AND PROBABILITY STATISTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students with the concept of Fourier series and its applications to solve steady state heat and wave equations
- To familiarize the fundamentals of Fourier Transforms and its applications to Electrical Engineering
- To acquaint the concept of probability and find the physical significance of various distribution phenomena
- To realize the importance of testing of Hypothesis in Electrical Engineering.

Unit-I: Fourier series: Expansion of a function in Fourier series for a given range, Half range sine and cosine expansions.

Unit-II: Fourier Transforms: Complex form of Fourier series, Fourier sine and cosine transformations, simple illustrations, Finite Fourier sine and Cosine transforms.

Unit-III: Two-dimensional steady state heat flow equation, Heat equation, Wave equation-Fourier series solution.

Unit-IV: Probability: Definitions of Probability, sample space, Events, Basics of Combinatorial Analysis, Conditional Probability, Baye's Rule, Random variable, Probability mass function, Density function, Distribution Function, Bernoulli Trials, Binomial Distribution, Poisson Approximation, Poisson Distribution, Normal Distribution, Moment Generating Functions.

Unit-V: Testing of Hypothesis: Z-test for single mean and difference of means, t-test for single mean and difference of means, F-test for comparison of variances, Chi-square test for goodness of fit.

TEXT BOOKS

1. Erwyn Kreyszig, *Advanced Engineering Mathematics*, John Wiley and Sons, 10th Edition, 2015.
2. S.C. Gupta, V.K. Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand, 2000.

REFERENCE BOOKS

1. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publications, 42nd Edition, 2013.
2. W. Feller, *An Introduction to Probability Theory and its Applications*, Vol. 2, 3rd edition, Wiley Eastern, New Delhi, 2008.

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Apply Fourier series to sine and cosine expansions
2. Illustrate the applications of Fourier Sine and Cosine transforms in Electrical engineering
3. Find the solution of Fourier series in steady state heat and wave equations
4. Apply the probability and distribution phenomena to Electrical Engineering applications
5. Make statistical decisions on experimental or survey data by using hypothesis testing.

EE201	ANALOG ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the working and characteristics of semiconductor diodes and apply them in real time applications
- To familiarize the students with small signal and large signal transistorised amplifiers
- To familiarize the students with operational amplifiers and its applications

Unit I: Review of Diodes, transistor, FET, UJT- characteristics. Biasing of BJT-AC analysis of BJT and FET.

Unit II: Small signal amplifiers-Large signal amplifiers - class A and class B power amplifiers, class C and class D amplifiers, Tuned amplifiers.

Unit III: Operational Amplifiers-Block diagram - characteristics of ideal and practical op amp - parameters of op-amp -Inverting and Non-inverting amplifier configurations - Frequency response.

Unit IV: summing amplifier - difference amplifier - Differentiator - Integrator - clamper - clipper - Precision Rectifier, Log and anti-log amplifiers, filters, comparators, Schmitt trigger. Sinusoidal and non-sinusoidal waveform generators using op-amps.

Unit V: IC555 Timer- monostable and astable modes of operation, voltage regulators - fixed voltage regulators, adjustable voltage regulators - switching regulators.

TEXT BOOKS

1. David, A.Bell, 'Electronic Devices and Circuits', PHI, 5th Edition, 2008.
2. Millman and Halkias, 'Electronic Devices and Circuits', McGraw-Hill International student Edition, 5th Reprint 1993.
3. Floyd, "Electron Devices", Pearson Asia 5th Edition, 2001

REFERENCE BOOKS

1. Allen Mottershead, 'Electronic Devices and Circuits-An Introduction', PHI, 18th Reprint, 2006.
2. Albert Malvino and David J Bates, 'Electronic Principles', McGraw Hill, 7th Edition, 2007.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Recognize the characteristics of diodes, BJT, UJT and FET, and realize its biasing circuits.
2. Design simple small signal and large signal amplifier circuits using BJT
3. Describe the various ideal and practical characteristics of an OPAMP.
4. Develop OP-AMP based analog signal conditioning circuits.
5. Analyze and construct various application circuits using 555 timers.

EE203	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the concepts and techniques associated with signals and systems
- To familiarize techniques suitable for analyzing and synthesizing both continuous-time and discrete time signals which provide foundation for more advanced subjects like signal processing, system theory, control and robotics.

Unit I: Introduction to signals, classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable.

Unit II: Introduction to systems, properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions – Laplace transform – system transfer function.

Unit III: Impulse response of a physical system, introduction to convolution, system impulse response and convolution integral, numerical convolution. Sampling theorem, Z-transform, convergence of Z-transform, properties of Z-transform, inversion of Z-transform.

Unit IV: Representation of signals in terms of elementary signals, representation of signals by elementary sinusoids, Fourier series representation, power spectrum.

UNIT V: Fourier Transform, system function, energy spectrum. Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform.

TEXT BOOKS

1. Oppenheim, Wilsky and Nawab, "Signals and Systems", 2nd Edition, Prentice Hall, New Delhi, 1997.
2. Gabel.R.A and Robert.R.A, "Signals and Linear Systems", 3rd Edition, John Wiley and Sons, New York, 2009.
3. Chen.C.T, "Systems and Signal Analysis", Oxford University Press, India, 3rd Edition, 2004, ISBN 100195156617.

REFERENCE BOOKS

1. Chesmond, Wilson and Lepla, "Advanced Control System Technology", ISBN-8176490326, Viva Books, India, 1998.
2. Ziemer R.E, Tranter W.H and Fannin D.R, "Signals and Systems", 4th Edition, Pearson Education Asia, Singapore, 1998.

COURSE OUTCOMES

On completion of this course the student will be able to

1. Classify and analyse the different types of signals and systems
2. Determine the response of system for different input signals using convolution.
3. Apply Z-transforms for the analysis of discrete time systems.
4. Analyze the properties of signals by representing it in different forms.
5. Apply Fourier Transform to represent complex signals interms of impulses for analysis.

EE205	ELECTRICAL MACHINES I	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The objective of this course is

- To introduce the principles of electromechanical energy conversion in singly and multiply excited systems.
- To study the working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.
- To study the working principles of DC machines as Generator and Motor, types, characteristics, starting and methods of speed control of motors, braking and testing.
- To familiarize the constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.

Unit I: Basic magnetic circuit analysis - BH curve – BH loop - hysteresis and eddy current loss. Faradays law of Electromagnetic induction – Principle of Energy conversion- singly and doubly Excited magnetic field systems.

Unit II: DC Generator – construction- principle of operation - armature windings, types – EMF equation – Characteristics - commutation - Armature reaction, Parallel operation of Generators – computer based analysis

Unit III: DC motor – principle of operation, types – Torque equation –characteristics – Losses in DC machines, Efficiency- starting – speed control – Braking, Various testing, Parallel operation of motors.– introduction to Permanent magnet motors- Computer based analysis

Unit IV: Transformers – Construction, working principle, EMF equation, performance of transformer on no load and loaded condition- Equivalent circuit – efficiency, Losses, Voltage regulation -Tests on Transformer- parallel operation of transformer- Computer based analysis

Unit V: Auto-transformer-Three phase transformer – types of connections – Open Delta Connection-Scott connections. Three-phase to single phase conversion. all day efficiency, Instrument Transformers – Current Transformer, Potential Transformer. Tap-changing and voltage control.

TEXT BOOKS

1. Nagrath.I.J and Kothari.D.P, “Electrical Machines”, Tata McGraw Hill Education Private Limited, New Delhi, 4th Edition, 2010.
2. Theraja B.L., Theraja A.K., “ A Textbook of Electrical Technology: Volume 2 AC and DC Machines: AC and DC Machines - Vol. 2”, S. Chand, 23rd Edition, 2006.

REFERENCE BOOKS

1. Cotton.H, “Electrical Technology”, CBS Publishers, 7th Edition, 2005.
2. Sawhney.A.K, “ A course in Electrical machines Design”, Dhanpat Rai and Sons , New Delhi, 5th Edition, 2013.

COURSE OUTCOMES

Students will acquire the ability to:

1. Compute the force, torque and EMF developed in electromechanical energy conversion systems
2. Investigate the types of DC generators with its performance characteristics for various applications
3. Explicate the operation, control and testing of DC motor with its performance characteristics and find their suitable applications
4. Elucidate the working and testing of various types of single-phase transformers
5. Analyse the performance of different types of three phase transformer connections and Instrument transformers

EE207	ELECTRICAL POWER GENERATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To familiarize the students with major components, operation and types of various renewable and non-renewable power plants.
- To understand the economic operation of steam-hydro power plants

Unit I: Thermal Stations- layout- main components- boiler- economizer- air preheater- super heater- reheater- condenser- feed heater- cooling powers- FD and ID fans- Coal handling plant- water treatment plant- Ash handling plant- Types of boilers and their characteristics- Steam turbines- and their characteristics- governing system for thermal stations.

Unit II: Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a hydro-plant- governing system for hydro plant- types of turbines-pumped storage plants.

Unit III: Economic operation of steam-hydro plants- inter connected operations- division of load in inter-connected system, economic loading of steam and hydro power plants.

Unit IV: Nuclear power plants - principle of power generation, location, advantages and disadvantages of nuclear power plants; Reactor control- reactor safety waste disposal.

Unit V: Non-conventional power plants - basic concepts, principles of working of solar, wind, fuel cells, OTEC, tidal, biomass and geothermal power generation.

TEXT BOOKS

1. Soni Gupta, Bhatnagar and Chakrabarti, "A text book on Power Systems Engineering", Dhanpat Rai and Sons, New Delhi, 1997.
2. Wadhwa.C.L, "Generation, Distribution and Utilization of Electrical Energy", Wiley Eastern Limited, 3rd Edition, 2011.

REFERENCE BOOKS

1. Deshpande.M.V, "Elements of Electrical Power station Design", Pitman, New Delhi, Tata McGraw Hill, 2008.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Draw the layout of the thermal power plants by analysing the characteristics of components involved.
2. Identify the major components of different types of hydro power plants and draw their layouts
3. Analyze the economic operation of thermal-hydro power plants
4. Explain the major components of nuclear power plants with controlled operation and waste disposal
5. Characterize the various renewable energy sources and draw the schematic diagram of renewable energy power plants

EE209	DIGITAL LOGIC CIRCUITS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To Impart Knowledge on the Following Topics

- Various number systems and to simplify the mathematical Expressions using Boolean
- Functions – simple problems.
- Implementation of combinational circuits
- Design of various synchronous and asynchronous circuits.
- Digital simulation techniques for development of application oriented logic circuit

Unit I: Review of Number systems - Complements - Subtraction using complements - Binary codes - Theorems of boolean algebra - Canonical forms - Logic gates, Simplification of Boolean functions-K maps. Digital logic families: TTL, ECL, MOS-Comparison between the families.

Unit II: Combinational Logic circuits-adders, subtractors - Multiplexers and de-multiplexers – encoder, decoder, Code converters, comparators-computer based analysis

Unit III: Sequential Logic-Flip flops - SR, JK, D and T flip flops - Level triggering and edge triggering - Excitation tables - Counters - Asynchronous and synchronous counters - Shift registers - Ring counters - computer based analysis

Unit IV: Design of Synchronous sequential circuits: Model Selection – State transition diagram –State synthesis table – Design equations and circuit diagram – State reduction technique - computer based analysis

Unit V: Asynchronous sequential circuits – Analysis – Problems with asynchronous sequential circuits – Design of Asynchronous sequential circuits-State transition diagram, Primitive table, State reduction, state assignment and design equations- computer based analysis - PLA, PAL, Introduction to FPGA

TEXT BOOKS

1. Morris Mano.M, 'Digital logic and computer design', Prentice Hall of India, 1st Edition, 2008.
2. Donald D. Givone, “Digital Principles and Design”, Tata McGraw Hill, 2002.
3. Tocci R.J.,Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 9th Edition, 2013.

REFERENCE BOOKS

1. Floyd and Jain, “Digital Fundamentals”, Pearson Education, 10th Edition 2013, 2007.
2. Donald P. Leach, Albert Paul Malvino, Goutam Sha, “Digital Principles and Applications”, Tata McGraw Hill, 6th Edition, 2007
3. Mandal, “Digital Electronics Principles & Application, McGraw Hill Edu, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

1. Represent various number systems and simplify the logical expressions using Boolean functions
2. Design combinational logic Circuits and simulate the same using software package
3. Characterize various Flip-Flops and Design various counters and simulate the same using software package
4. Design synchronous sequential logic Circuits and simulate the same using software package
5. Design asynchronous sequential logic Circuits and simulate the same using software package

EE211	ANALOG ELECTRONICS LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES

- To equip the students with an understanding of designing a practical electronic circuit.
- To develop skill for constructing various electronic circuits in the breadboard.

LIST OF EXPERIMENTS

1. Characteristics of semiconductor devices
2. Rectifiers and regulators using Diodes
3. Amplifier circuits using transistors
4. Inverting and Non-Inverting operational Amplifier
5. Integrator and differentiator using op-amp
6. Filters using op-amp
7. Oscillators using op-amp
8. Precision Rectifiers
9. Clippers and Clampers using op-amp
10. Comparators using op-amp
11. Astable multivibrator using IC 555.
12. Monostable multivibrator using IC 555

COURSE OUTCOMES

Upon completion of the course, students will be able to

1. Make circuit connections to draw the characteristics of semiconductor devices and identify its applications
2. Design and experiment amplifier circuits using BJTs
3. Design and experiment the wave shaping circuits using Op-Amp
4. Identify the pins of IC555 and make connections to implement multivibrator circuits
5. Simulate the analog circuits using software packages

EE213	CIRCUITS AND DIGITAL ELECTRONICS LAB.	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES

- To prove the basic electric circuital laws and theorems
- To impart the applications of basic logic gates.
- To design and implement combinational and sequential logic circuits using basic gates and digital ICs to upgrade their skills.
- To design and apply the combinational logic circuits, flip-flops, shift registers, synchronous in real time applications.

LIST OF EXPERIMENTS:

1. Verification of Circuit theorems
2. Study of flip flops
3. Study of encoders and decoders
4. Binary counter
5. Decade counter with decoder/driver and seven segment LED display
6. Ring counter
7. Design of sequential logic circuit
8. Design of combinational logic circuits
9. Electronic gain using bi-directional shift registers
10. Mini project or presentation of innovative ideas on learning of the above experiments

COURSE OUTCOMES

Upon completion of the course, students will be able to

1. Apply basic circuital laws and theorems to analyze the electrical and electronic circuits.
2. Demonstrate the Boolean laws using basic logic gates and verify truth tables of flip-flops
3. Design and implement the sequential and combinational logic circuits.
4. Design and implement the synchronous, asynchronous and shift registers
5. Simulate the digital logic circuits using software packages

SEMESTER IV

MA232	NUMERICAL METHODS FOR ELECTRICAL ENGINEERS	L	T	P	C
		3`	0	0	3

COURSE OBJECTIVES

- To understand iterative methods to solve linear and nonlinear equations.
- To familiarize the construction of approximate polynomial and find the intermediate values when huge amounts of experimental data are involved using interpolation techniques.
- To know single and multistep methods to solve ordinary differential equations

Unit-I: Solution of linear system, Gaussian elimination and Gauss-Jordan methods, LU-decomposition methods, Crout's method, Jacobi and Gauss-Seidel iterative methods sufficient conditions for convergence.

Unit-II: Numerical solution of algebraic and transcendental equations by Bisection method, Regula-Falsi method, Newton - Raphson's method, Muller method- Order of convergence.

Unit-III: Lagrange interpolation, Forward, Backward and central difference operators, Newton's forward and backward interpolation formulae, Stirling and Bessel's interpolation formulae, Newton's divided difference formulae, Numerical differentiation at the tabulated points with forward backward and central differences.

Unit-IV: Numerical Integration with Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Numerical solution of ordinary differential equations by Taylor series method, Euler's method, Modified Euler's method, 4^{th} order Runge-Kutta method and Milne's Predictor- Corrector method.

Unit-V: Curve fitting by the method of least squares, Fitting of Straight line, Second and higher order linear, nonlinear and exponential fit. Weighted least squares approximation, linear Weighted least squares approximation, Non-linear weighted least squares approximation

TEXT BOOKS

1. Erwyn Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 10^{th} Edition, 2011.
2. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern, 2012.

REFERENCE BOOKS

1. C.F.Gerald, P.O. Wheatley, Applied Numerical Analysis, Pearson/Addison Wesley, Seventh Edition, 2004.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 42^{nd} Edition, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

1. To apply iterative methods to solve linear and nonlinear equations.
2. To construct approximate polynomial and find the intermediate values when huge amounts of experimental data are involved using interpolation techniques.
3. To apply single and multistep methods to solve ordinary differential equations
4. To apply different curve fitting methods

EE202	ELECTRICAL MACHINES II	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To expose the students to understand the concepts of induction motor
- To make the students to acquire the knowledge of alternator
- To make the students to acquire the knowledge of synchronous motor
- To expose the students to understand the concepts of special motor

Unit I: Induction motor- construction, types, principle of operation, Concept of rotating flux, slip, effect of slip on motor parameters – Torque equation- slip-torque characteristics-equivalent circuit - power flow diagram-testing of induction motor-Computer based analysis

Unit II: Circle diagram-Starting and speed control methods – Braking- induction generators - crawling and cogging, applications.

Unit III: Alternators - construction, working principle, types, winding factor, EMF equation, armature reaction, equivalent circuit, voltage regulation-methods, Salient pole synchronous machine-two reaction theory, determination of X_d and X_q, power angle characteristics, parallel operation of synchronous generator, short circuit transient in synchronous machine – computer based analysis

Unit IV: Synchronous motors - construction, principle - starting methods – performance study– Hunting. Applications – computer-based analysis

Unit V: Single phase induction motors – Rotating magnetic Vs alternating magnetic field - Double revolving field theory – Torque - speed characteristics – types – Reluctance motor– Two phase Servo motor– Stepper motors – Universal motor- linear induction motor - permanent magnet AC motor.

TEXT BOOKS

1. Nagrath.I.J and Kothari.D.P, "Electrical Machines", Tata McGraw Hill Education Private Limited, New Delhi, 4th Edition, 2010.
2. Irving L.Kosow, "Electric Machinery and Transformers", Prentice Hall of India Private Ltd., New Delhi, 2nd Edition, Reprint 2007.
3. Sawhney.A.K, " A course in Electrical machines Design", Dhanpat Rai and Sons , New Delhi, 5th Edition, 1990.

REFERENCE BOOKS

1. Say M.G, "Performance and Design of Alternating Machines", CBS Publishers and Distributors, New Delhi, Reprint 2005.
2. Stephen J.Chapman, "Electric Machinery Fundamentals", Tata McGraw Hill International Edition, New Delhi, 4th Edition, 2005.
3. Theraja B.L., Theraja A.K., " A Textbook of Electrical Technology: Volume 2 AC and DC Machines: AC and DC Machines - Vol. 2", S. Chand, 23rd Edition, 2006.

COURSE OUTCOMES

Upon completion of the course, the Students will be able to

1. Explain the principle of operation, types, starting, speed control and performance of Induction Motors
2. Describe the principle of operation, types and performance of Synchronous generator and Predetermine the voltage regulation of different types of alternator from test data
3. Demonstrate the various parts of synchronous motor and explain its operating principle, performance and speed control.
4. Explain the construction, operation and identify the applications of single-phase induction motor and special electrical machines.

EE204	TRANSMISSION AND DISTRIBUTION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To know the principle of operation of transmission and distribution equipment.
- To Understand the major components of Transmission and Distribution Systems (TDS) and its practical significance.
- To Have good Knowledge on the calculation of parameters of Transmission line and to evaluate the performance of the line.
- To Have awareness of various equipment specifications and design aspects of TDS.

Unit I: Transmission line parameters – resistance, inductance and capacitance calculations - single phase and three phase lines – double circuit line - effect of earth on transmission line capacitance.

Unit II: Performance of transmission lines – regulation and efficiency – tuned power lines power flow through a transmission line – power circle diagrams, formation of corona – critical voltages – effect on line performance.

Unit III: Mechanical design of overhead lines – line supports – insulators - voltage distribution in suspension insulators – string efficiency - testing of insulators stress and sag calculation – effects of wind and ice loading.

Unit IV: Underground cables – comparison with overhead line – types of cables – insulation resistance – potential gradient – capacitance of single core and three core cables.

Unit V: Distribution systems – general aspects – Kelvin's Law, A.C. distribution – single phase and three phase - techniques of voltage control and power factor improvement, recent trends in transmission and distribution systems.

TEXT BOOKS

1. Wadhwa.C.L, "Electrical Power systems", New Academic Science Limited Publishers, 2009.
2. Gupta.B.R, "Power System Analysis and Design", Chand Publishing, 2005.
3. Cotton.H, "Transmission and Distribution of Electrical Energy", ELBS, reprinted edition, 2006.

REFERENCE BOOKS

1. Singh.S.N, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Private Limited, New Delhi, 2nd edition, 2008.
2. Kothari.D.P and Nagarath.I.J, "Power System Engineering", Tata McGraw-Hill Publishing Company limited, New Delhi, 2nd edition, 2007.
3. Luces M.Fualkenberry and Walter Coffer, "Electrical Power Distribution and Transmission", Pearson Education, 1st edition, 2007.

COURSE OUTCOMES

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

1. Determine the transmission line parameters of different line configurations
2. Analyse the performance and corona effect in overhead transmission lines
3. Do the mechanical design of overhead lines
4. Classify various underground cables and determine the grading of cables
5. Analyse the operation and various voltage control techniques of AC distribution systems

EE206	CONTROL SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To introduce the concept of feedback control system.
- To impart knowledge in mathematical modeling of physical systems.
- To impart knowledge in characteristics and performance of feedback control system.
- To teach a variety of classical methods and techniques for analysis and design of control systems.

UNIT 1 Open and closed loop control system – Basic components - Mathematical model of physical systems – Electrical analogy of physical systems – Transfer functions - Block diagram algebra – Signal flow graph – Computer based analysis.

UNIT 2 Time domain analysis: various test signals and its importance - Time-domain specifications - Generalized error series –Routh-Hurwitz stability criterion- Computer based analysis.

UNIT 3 Root Locus Technique: Definitions - Root locus diagram - Rules to construct root loci - Effect of pole zero additions on the root loci- Computer based analysis.

UNIT 4 Frequency domain analysis: Bode plot - Polar plot - Nyquist plot - phase-margin - gain margin - Nyquist stability criterion - Computer based analysis.

UNIT 5 Controller design: Design of P, PI, PID, lag, lead, lead-lag compensator design - Computer based analysis.

TEXT BOOKS

1. Nagrath I.J. and Gopal M, 'Control Systems Engineering', New Age International Publications, 5 th Edition, 2010.
2. Benjamin C.Kuo and Farid Golnaraghi, 'Automatic Control Systems', John Wiley & Sons Publications, 8 th Edition, 2002.
3. Katsuhiko Ogata, 'Modern Control Engineering', Pearson Education Publishers, 5th Edition, 2010.

REFERENCE BOOKS

1. Richard C. Dorf and Robert H. Bishop. 'Modern Control Systems', Pearson Prentice Hall Publications, 12th Edition, 2010.
2. Gene F. Franklin, J. David Powell and Abbas Emami-Naeini, 'Feedback Control of Dynamic Systems', Pearson Education India Publications, 6th Edition, 2008.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Develop mathematical models of dynamic control system by applying differential equations.
2. Analyze and characterize the behavior of a control system in terms of different system and performance parameters.
3. Compute and assess system stability.
4. Evaluate and analyses system performance using frequency and transient response analysis.
5. Design linear feedback control systems, PID controller to achieve required stability, performance and robustness.

EE208	COMPUTER ORGANISATION AND MICROCONTROLLERS	L	T	P	C
		3	0	3	5

COURSE OBJECTIVES

- To provide the concept of computer architecture and mechanisms related to the design of processors, memories and networks.
- To equip the students with a basic understanding of architecture, addressing modes, instruction set, interrupt structure of 8051 microcontroller.
- To familiarize commonly used interfacing ICs.
- To develop skill for writing simple assembly language program using 8051 microcontroller.

UNIT I FUNDAMENTAL PROCESSORS: Instruction set architecture; single-cycle, FSM and pipelined processor microarchitecture; resolving structural, data, control, and name hazards; and analyzing processor performance

UNIT II FUNDAMENTAL MEMORIES: Memory technology; direct-mapped vs. associative caches; write-through and write-back caches; memory protection, translation, and virtualization; FSM and pipelined cache microarchitecture; analyzing memory performance; and integrating processors and memories

UNIT III FUNDAMENTAL NETWORKS: Network topology and routing; buffer, channel, and router microarchitecture; analyzing network performance; and integrating processors, memories, and networks

UNIT IV 8051 MICRO CONTROLLER: Functional block diagram - Instruction format and addressing modes – Instruction Set –Simple programs interrupt structure, Timer –I/O ports – Serial communication, Memory interfacing.

UNIT V APPLICATIONS OF 8051 MICROCONTROLLER: Seven segment LED Display systems - Interfacing LCD Display - Stepper motor control - Interfacing A/D Converter –D/A Converter – Waveform generators - Generation of Gate signals.

TEXT BOOKS

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface," Elsevier, 4th Edition, 2009.
2. D. M. Harris and S. L. Harris, "Digital Design and Computer Architecture," Elsevier, 2nd Edition, 2012.
3. M. Morris Mano, "Computer system Architecture," PHI, New Delhi, 3rd Edition 1993.
4. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, "The 8051 Microcontroller and Embedded systems Using Assembly and C," Pearson Education, 2nd Edition, 2011.

REFERENCE BOOKS

1. William Stallings, 'Computer Organization and Architecture – Designing for Performance," 8th Edition, Pearson Education, 2010.
2. S. Yeralan and A. Ahluwalia, "Programming and Interfacing the 8051 Microcontroller," Addison Wesley, Pap/Dskt Edition, 1995.
3. K. J. Ayala, "The 8051 Micro controller," Cengage Learning, 3rd Edition, 2007.

COURSE OUTCOMES

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

1. Describe the general architecture of computers.
2. Apply the understanding to new computer architecture design problems.
3. Develop simple programs in 8051 microcontroller.
4. Build microcontroller based applications.

EE210	ELECTRICAL MACHINES LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES

- To determine or predetermine the internal and external characteristics of the given DC generators from the test data.
- To determine or predetermine the performance characteristics of the given DC motors from the test data.
- To determine or predetermine the regulation and efficiency of the given transformers from the test data
- To determine the voltage regulation of alternator from test data and analyze the effect of various factors such as armature resistance, armature reactance, leakage reactance and power factor on regulation.
- To determine the performance of single phase and three phase induction motor from test data and analyze the effect of speed, power factor line current and efficiency under different loading conditions.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator
2. Load characteristics of DC compound generator
3. Speed control of DC shunt motors
4. Swinburne's test
5. Open circuit and short circuit test on single phase transformer
6. Sumpner's test
7. Polarity test on transformer
8. Parallel operation of transformer
9. Load test on three phase induction motor
10. Speed control of three phase inductor Motor
11. No load and blocked rotor test on three phase induction motor
12. Regulation of three phase alternator by EMF and MMF methods
13. Synchronization of three phase alternator with infinite bus bar
14. V and inverted V-curves of synchronous motor
15. Load test on single phase alternator

SEMESTER V

EE301	POWER SYSTEM ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The objective of this course is

- To model the power system under steady state operating condition.
- To apply efficient numerical methods to solve the power flow problem.
- To model and analyze the power systems under abnormal (or) fault conditions.
- To model and analyze the transient behavior of power system when it is subjected to a fault.

UNIT I POWER SYSTEM

Power system components – Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram - Network graph, Bus incidence matrix, Primitive parameters, Bus admittance matrix from primitive parameters.

UNIT II POWER FLOW ANALYSIS

Bus classification - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method-Fast decoupled method.

UNIT III SYMMETRICAL FAULT ANALYSIS

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm – Symmetrical fault analysis through bus impedance matrix.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system.

UNIT V STABILITY ANALYSIS

Classification of power system stability - Swing equation – Swing curve - Power-Angle equation - Equal area criterion – modified Euler method.

TEXT BOOKS

1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd.,NewDelhi, 21st reprint, 2010.

REFERENCE BOOKS

1. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
2. J. Duncan Glover, Munukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
3. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, 2001.
4. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Model the various power system components under steady state operating condition in order to carry out power flow, short circuit and stability studies.
2. Formulate the power flow equations and apply iterative techniques to solve power flow equations
3. Model and carry out short circuit studies due to symmetrical faults on power system
4. Model and analyse the various types of unsymmetrical faults in power system
5. Model and analyze the stability issues in power system

EE303 MEASUREMENT AND INSTRUMENTATION L T P C

3 0 0 3

COURSE OBJECTIVES

- To expose the students to measure the electrical quantities using analog and digital instruments.
- To expose the students to the design of bridges for the measurement of resistance, capacitance and inductance.
- To familiarize the students with the instrumentation system for measurement of non-electrical quantities.

Unit I: SI units – Analog indicating instruments – PMMC – moving iron – ammeters and voltmeters - Electrodynamic wattmeters – Induction type energy meter, CT and PT.

Unit II: Null balance method of measurements: wheatstone bridge, kelvin bridge, meg ohm bridge, megger – measurement of L and C – Maxwell bridge – Max – Wien bridge – Anderson bridge – Schering bridge – Wien bridge.

Unit III: CRO – Function generator – Signal generators - Waveform analyzers - Spectrum analyzers.

Unit IV: Digital methods of measurement – timer –counter – frequency, time period, phase measurements – digital voltmeter – digital multimeter – data acquisition systems – digital storage oscilloscope.

Unit V: Instrumentation: Block diagram – sensors – signal conditioning and control – Transducers and their characteristics - classification & selection of transducers, strain gauges, inductive & capacitive transducers, piezoelectric and Hall-effect transducers, thermistors, thermocouples.

TEXT BOOKS

1. Sawhney.A.K, "Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai, 2003.
2. Cooper.W.D and Helfric.A.P, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 1st Edition, 1992.
3. Bentley.J.P, "Principles of Measurement Systems", Longman Group Limited (Pearson Education), 3rd Edition, 2008.

REFERENCE BOOKS

1. Doeblin, "Measurement Systems", Tata McGraw Hill Publication, 2nd Edition, 1990.
2. Gupta.J.B, "A Course in Electrical and Electronic Measurements and Instrumentation", S.K Kataria & Sons, Reprint, 2013.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Explain the working of analog measuring instruments used to measure the electrical quantities.
2. Explain the working of digital measuring instruments used to measure the electrical quantities
3. Explicate the working of measuring systems to generate and analyse the signals
4. Design suitable DC and AC bridges for the measurement of R, L, C and Frequency measurement.
5. Identify the transducers and form the instrumentation system for measurement of non-electrical quantities.

EE305	ELECTROMAGNETIC THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to

- Understand the basic concepts of electric and magnetic fields.
- Understand the concept of conductors, dielectrics, inductance and capacitance
- Gain knowledge on the nature of magnetic materials.
- Understand the concept of static and time varying fields.

Unit I: Sources and effects of electromagnetic fields – Vector fields – Different co-ordinate systems – Vector calculus – Gradient, Divergence and Curl – Divergence theorem – Stoke's theorem.

Unit II: Coulomb's Law – electric field intensity – Field due to point and continuous charges – Gauss's law and its applications – electrical potential – Electric field and equipotential plots – electric field in free space, conductors, dielectric – dielectric polarization. Electric field in multiple dielectrics – boundary conditions, Poisson's and Laplace's equations –Capacitance – Energy density – Dielectric strength – Applications.

Unit III: Lorentz Law of force, magnetic field intensity – Biot – Savart Law – Ampere's Law – Magnetic field due to straight conductors, circular loop, infinite sheet of current – Magnetic flux density (B) – B in free space, conductor, magnetic materials. Magnetization - Magnetic field in multiple media – Boundary conditions – Scalar and vector potential – Magnetic force – Torque – Inductance – Energy density.

Unit IV: Maxwell's equations (differential and integral forms)- Displacement current – Applications - Generation – electromagnetic wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors – skin depth, Poynting Theorem-Reflection and Refraction.

Unit V: Guided Waves Transmission line theory from the circuit concept, properties; constants; transmission line equations; infinite line; reflections in transmission lines; voltage, current and impedance relations-open and short circuit lines

TEXT BOOKS

1. Matthew. N.O. Sadiku, "Elements of Electromagnetics", Fourth Edition, Oxford University Press, Fifth Edition 2010.
2. Ashutosh Pramanik, "Electromagnetism – theory and application," Prentice Hall of India Private Ltd., New Delhi, 2nd edition, 2008.
3. K.A.Gangadhar, "Field theory", Khanna publishers, New Delhi,15th edition,2004.

REFERENCE BOOKS

1. William H.Hayt and John A Buck "Engineering Electromagnetics", 7th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. Edminister.J.A, Schaum's Outlines "Theory and problems of Electromagnetics", Tata Mc Graw Hill, 2nd Edition, Special Indian Edition 2006.
3. Guru and Hiziroghu "Electromagnetic field theory fundamentals", Thomson Asia Pvt. Limited, 2010.
4. John D Kraus, Daniel A Fleisch "Electromagenetics with Applications", Tata McGraw Hill 5th Edition, 2010.

COURSE OUTCOMES

1. Compute the spatial variations of physical quantities by using various coordinate Systems.
2. Apply Coulomb’s law to calculate the electric force and field intensity for various charge distributions.
3. Apply the concepts of magnetostatics to calculate the magnetic flux density and magnetic field intensity.
4. Analyze the electromagnetic fields generated by dynamic charge distributions using Maxwell's equations and Estimate the electromagnetic wave propagation in different media.
5. Assess the nature of electromagnetic wave propagation in guided medium which are used in transmission of wave

CS331	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		2	0	3	4

COURSE OBJECTIVES

- To teach students how to handle structured data and perform more complex tasks using programming languages
- To acquire skills in using generic principles for data representation & manipulation with a view for efficiency, maintainability, and code-reuse.

Unit–I Introduction

Introduction to Data Structures, Pointers- Basic Operations- Applications- Dynamic storage management – Linked Lists- Circular Linked Lists-Doubly Linked List.

Unit-II Stacks and Queues STACKS: Basic Stack Operations- Stack Applications, QUEUES: Operations Queue Applications

Unit-III Trees Binary Trees - Binary search trees –Applications, Tree traversals- preorder-inorder- postorder-Height balanced trees – Red black trees.

Unit-IV Graphs Graphs –Representation- Graph traversals-BFS-DFS- Topological sort-spanning trees.

Unit-V Searching, Sorting and Hashing Searching Techniques: Linear search - Binary search- Sorting Techniques: Selection sortBubble sort- Insertion sort- Hash table methods.

TEXT BOOKS

1. J.P.Tremblay and P.G.Sorenson, "An Introduction to Data Structures with applications", Second Edition, Tata McGraw Hill, 1981.
2. Richard Gileberg, Behrouz A. Forouzan, "Data Structures: A Pseudo code Approach with C", Second Edition, 2007

REFERENCE BOOKS

1. G.A.V. Pai, "Data Structures and Algorithms", Second Edition, Tata McGraw Hill, 2009.
2. Debasis Samanta, "Classic Data Structures", Second Edition, PHI Learning, 2009

COURSE OUTCOMES

1. Express the concept of Linear and nonlinear data structures, applications and its implementations
2. Appraise the knowledge of Tress with its operations
3. Recognize the concept of Sorting ,Searching and its types
4. Review various implementations and operations of Priority Queue and Hashing Techniques
5. Apply Shortest Path and Minimum Spanning Tree algorithms and Biconnectivity
6. Demonstrate the skills in related implementation tasks in the programming language, including extensive use of templates to allow for modularity and re-usability of code.

EE307	CONTROL AND INSTRUMENTATION LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES

- To familiarize the students to the basic principles of various transducers.
- To impart knowledge in static and dynamic characteristics of sensors.
- To impart knowledge in the design of signal conditioning circuits for transducers.
- To impart knowledge on analysis and design of control system in time and frequency domain.
- To impart knowledge in classical control and state space based control system design.

LIST OF EXPERIMENTS

1. Characteristics of temperature sensor
2. Measurement of strain using strain gauge
3. Differential Pressure transmitter
4. Measurement of displacement using LVDT
5. Design of V-F converter and F-V converter
6. Instrumentation amplifier
7. AC and DC Bridges
8. Speed control of DC servo motor
9. PID controller
10. Design of compensators
11. Design of state feedback controller for the given system
12. ADC and DACs

COURSE OUTCOMES

On completion of this lab, the students will be able to,

1. Measure the non-electrical quantities by establishing measurement setup using sensors
2. Measure resistance, capacitance, inductance and frequency using bridge circuits
3. Design signal conditioning circuits for transducers.
4. Design control systems in both classical and modern techniques.
5. Design and implement controllers to regulate and control various systems.

SEMESTER VI

HM331	ENGINEERING ETHICS AND PRECEPTS OF CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

The objective of this course is

- To create an awareness on engineering ethics and human values
- To Understand social responsibility of an engineer
- To appreciate ethical dilemma while discharging duties in professional life
- To know about the constitution of India and human rights

UNIT I: Engineering Ethics

Senses of 'Engineering Ethics' – Variety of Moral Issues – Types of Inquiry – Moral Dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional Roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories. Valuing Time – Cooperation – Commitment.

UNIT II: Engineering as Social Experimentation

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law – The Challenger Case Study.

UNIT III: Safety, Responsibilities and Rights

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – The Three Mile Island and Chernobyl Case Studies.

UNIT IV: Global Issues

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership.

UNIT V: Constitution of India

Preamble – Fundamental Rights and Duties- Role of Parliament and Legislatures in Federal Setup, Law and Justice – Human Rights and Protection of Human rights- Place of Official Languages and Education pertinent to Concurrent List – Perspectives of Indian issues on Trade and Commerce - Role parliament to impose restriction of Trade, Commerce and Intercourse.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, Ethics of Engineering, McGraw-Hill, New York, Fourth Edison, 2005
2. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi, 2008

REFERENCE BOOKS

1. M. Govindarajan, S. Natarajan and V. S. Senthil Kumar, Engineering Ethics, Prentice hall of India, New Delhi, 2004.
2. Magbook Indian Polity and Governance, Arihant Experts, 2020 Edition.
3. S.K.Kapoor, Human Rights Edition: Seventh, Year Of Publication: 2017

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Use ethical theories to analyse engineering ethics
2. Illustrate engineering as experimentation with real time examples
3. Realize the need of safety in testing and designing, risk benefit analysis and reducing risk in a plant.
4. Illustrate the ethics to be followed to avoid disaster having impact globally.
5. Explain the constitution of India and human rights

EE302	POWER ELECTRONICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The objective of this course is to

- Get an overview of different types of power semi-conductor devices and their switching characteristics.
- Understand the operation, characteristics and performance parameters of controlled rectifiers.
- Study the operation, switching techniques and basic topologies of DC-DC switching regulators.
- Learn the different modulation techniques of pulse width modulated inverters and to understand the harmonic reduction methods.
- Learn about few applications of power electronics.

Unit I: Power Semiconductor Devices –Power diodes -power transistors-SCRs – Triac – GTO – Understanding the parameters from data sheets - Power MOSFETs – IGBTs - Principles of operation and characteristics, ratings, protection and gate drive circuits.

Unit II: Controlled rectifiers - Introduction. Principle of phase controlled converter operation. Single- phase semi-converters. Full converters. Three-phase half-wave converters. Three-phase full-wave converters.

Unit III: DC choppers - Introduction. Principle of step-down and step-up chopper with R-L load. Performance parameters. Chopper classification. Introduction to forced commutated choppers.

Unit IV: Inverters - Introduction. Principle of operation. Performance parameters. Single-phase bridge inverters. Three-phase inverters. Voltage control of single-phase inverters – single pulse width, multiple pulse width, and sinusoidal pulse width modulation. Current source inverters. Variable DC link inverter.

Unit V: Voltage Controllers – Introduction - Principle of ON-OFF and phase control. Single-phase bidirectional controllers with resistive and inductive loads – Single phase Cyclo-converters.

Applications of power electronics, SMPS, UPS, Solid state motor speed control, - Static tap changer HVDC.

TEXT BOOKS

1. Rashid.M.H, “Power Electronics”, Prentice Hall of India, New Delhi, 2008.
2. Ned Mohan, Tore M. Undeland and William P. Robins, “Power Electronics – Converters, Applications and Design”, John Wiley and Sons, 3rd Edition, 2007.
3. Dubey.G.K, Doradla.S.R, Joshi.A and Sinha.R.M.K, “Thyristorised Power Controllers”, New Age International Publishers, 2nd Edition, 2010.

REFERENCE BOOKS

1. Singh.M.D and Khanchandani K.B, “Power Electronics”, Tata McGraw Hill, 2nd Edition, 2006.
2. Cyril Lander, “Power Electronics”, 3rd Edition, McGraw-Hill.
3. Jacob Thomson.J.M, “Power Electronics, Principles and Applications”, Vikas Publications.
4. Ananda Murthy.R.S and Nattarasu.V, “Power Electronics, A Simplified Approach”, Sanguine Technical Publishers.

COURSE OUTCOMES

At the end of the course the student will be able to

1. Select the appropriate power semiconductor devices along with protection and drive circuits and find its ratings to their applications
2. Recognize and analyze the performance factors of single phase and three phase AC-DC phase-controlled converters at different load conditions
3. Recognize and analyze the characteristics of various DC-DC converters.
4. Assess the performance characteristics of single and three phase inverters and develop modulation techniques to obtain the voltage control.
5. Describe the various types of AC voltage controllers and cyclo converter and identify the real time applications of power electronic circuits.

EE304 POWER SYSTEM OPERATION AND CONTROL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES

To impart knowledge on the following topics

- Significance of power system operation and control.
- Real power-frequency interaction and design of power-frequency controller.
- Reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- Economic operation of power system.
- SCADA and its application for real time operation and control of power systems

UNIT I PRELIMINARIES ON POWER SYSTEM OPERATION AND CONTROL

Necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - system load variation, load curves and basic concepts of load dispatching - load forecasting - Basics of speed governing mechanisms and modeling - speed load characteristics - regulation of two generators in parallel.

UNIT II REAL POWER - FREQUENCY CONTROL

Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases - LFC of two area system - tie line modeling - block diagram representation of two area system - static and dynamic analysis - tie line with frequency bias control – state variability model - integration of economic dispatch control with LFC.

UNIT III REACTIVE POWER – VOLTAGE CONTROL

Generation and absorption of reactive power - basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis – stability compensation – voltage drop in transmission line - methods of reactive power injection - tap changing transformer, SVC (TCR + TSC) and STATCOM for voltage control.

UNIT IV ECONOMIC OPERATION OF POWER SYSTEM

Statement of economic dispatch problem - input and output characteristics of thermal plant -incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - base point and participation factors method - statement of unit commitment (UC) problem - constraints on UC problem – solution of UC problem using priority list – special aspects of short term and long term hydrothermal problems.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS

Need of computer control of power systems-concept of energy control centres and functions– PMU - system monitoring, data acquisition and controls - System hardware configurations- SCADA and EMS functions - state estimation problem – measurements and errors -weighted least square estimation - various operating states - state transition diagram.

TEXT BOOKS

1. Olle.I.Elgerd, ‘Electric Energy Systems theory - An introduction’, McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollen berg, ‘Power Generation, Operation and Control’, John Wiley & Sons, Inc., 2016.
3. Abhijit Chakrabarti and Sunita Halder, ‘Power System Analysis Operation and Control’, PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

REFERENCE BOOKS

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Recognize the day-to-day operation of electric power system.
2. Analyse the control actions to be implemented on the system to meet the minute-to-minute variation of system demand.
3. Model power - frequency dynamics and to design power-frequency controllers
4. Model reactive power - voltage interaction and the control actions to be implemented for maintaining voltage profile against varying system load
5. Realize the SCADA and EMS for monitoring and controlling the power system

EE306	POWER SYSTEM SIMULATION LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVE

- To expose the students to solve the power system problem using software programs

LIST OF EXPERIMENTS

1. Real and reactive power computation
2. Transmission Line parameter calculation
3. Power Circle diagrams
4. Bus admittance matrix formulation
5. Load flow analysis
6. Z bus formulation
7. Short circuit analysis
8. Simulation of AC DC Converters
9. Power Electronic applications in Power Systems

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Calculate the transmission line parameters.
2. Develop the bus impedance and admittance matrix.
3. Analyze the load flow problem using different techniques.
4. Analyze the Symmetrical and Unsymmetrical faults.
5. Realize the applications of power electronics in power systems

EE308	POWER ELECTRONICS AND DRIVES LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES

- To Assemble and connect power electronics components to make converter, inverter and AC voltage controller and test its output voltage waveforms.
- To connect the triggering and commutation control circuit to power electronics devices and test its performance.
- To use power electronic circuits to speed control of electric motor

LIST OF EXPERIMENTS

1. Fully controlled single-phase thyristor bridge
2. Three-phase Thyristor Bridge
3. Buck Converter
4. Boost Converter
5. IGBT based 4-quadrant chopper
6. IGBT/MOSFET based single phase VSI with Sinusoidal PWM
7. IGBT/MOSFET based three phase square wave inverter
8. Extinction angle control of converter
9. Solid state speed control of motors
10. Calculation of efficiency of the system using data sheet

COURSE OUTCOMES

At the end of the course the students will be able to

1. Analyze the performance of phase-controlled converters.
2. Analyze the DC chopper circuit.
3. Analyze the performance of various topologies of single phase and three phase inverters.
4. Obtain the variable speed of DC motor using three phase fully controlled converter.

SEMESTER VII

HM401	PRINCIPLES OF ECONOMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To equip the students with a thorough understanding of the principles of micro and macroeconomics.
- To familiarize various tools / methods in the process of economic decision making.
- To provide the knowledge of banking system.
- To discuss various modern economic reforms.

UNIT I Definitions of Economics – Meaning of Industrial Economics– Economic Decision Making Process – Equations – Fundamental Concepts – Decision Environment – Profit Performance from Accounting point of view – Demand and Supply Analysis – Consumption Laws – Elasticity of Demand – Supply Elasticity – Measurements.

UNIT II Demand Forecasting Methods – Cost & Revenue Analysis. Competition – Perfect, Monopoly, Monopolistic and Oligopoly – Break Even Analysis – Capital Budgeting Technique – Decision Making under Certainty and Uncertainty –Utility as a Decision Criterion.

UNIT III Macro Static and Dynamics – Keynesian Theory of Income and Employment – Consumption Function – Saving and Investment Functions – Multiplier and Accelerator – Trade Cycles – National Income Accounting - Index Numbers – Price, Chain Base, Quantity and Value Index Numbers.

UNIT IV Functions of Money – International Trade – Balance of Trade – Balance of Payments – Functions of Central Bank (RBI), Functions of Commercial Banks – Credit Creation by Commercial Banks – Inflation – Exchange Rate Determination Technological Change, Location Theory and Taxation.

UNIT V Economic and Non – Economic Environment – Market, Economic Planning and Controls – Infrastructure and Business– Contemporary Economic Reforms.

TEXT BOOKS

1. Peterson. H. Craig, Lewis . W. Chris. Jain. K Sudhir. "Managerial Economics". Pearson Education.2008

REFERENCE BOOKS

1. Beri. G. C., "Business Statistics" - TMH.2010
2. Koutsoyiannis, "Modern Micro Economics", Macmillan.2008
3. Misra. S.K. Puri. V.K. "Economic Environment of Business". Himalaya Pubhshing Haase. 2008.
4. Vaish. MC., "Monetary Theory", Vikas Publishing House.2000

COURSE OUTCOMES

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

1. Analyse demand and supply of any commodity.
2. Apply tools / methods for Forecasting Demand, estimating various costs and revenue, calculating loss / profit, determining the viability to long-term investments and for making decision under certainty and uncertainty.
3. Investigate various national income accounting measures and index values.
4. Illustrate the operation of banking system.
5. Interpret Economic and Non – Economic Environment and modern economic reforms.

EE401	POWER SYSTEM PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objective of this course is

- To familiarize the working principle of different types of protective relays and circuit breakers.
- To impart knowledge about protection systems used for electric machines, transformers, bus bars, overhead and underground feeders.

Unit I: Review of Fault Analysis, Importance of protective schemes, Concept of Protective zones, Relays – General classification, Principle of operation, types, characteristics, Torque equation, Relaying Schemes, Relay Co- ordination.

Unit II: Apparatus and line protection – Line Protection – Distance, Differential protection and Carrier current protection. Generator protection – protection against abnormal condition, stator and Rotor protection - Transformer Protection – Incipient fault – Differential protection, Feeder and Bus bar protection.

Unit III: Protection against over voltages – Causes of over voltage Ground wires, Surge absorbers and diverters. Earthling types – Neutral Grounding, Insulation coordination.

Unit IV: Theory of arcing and arc quenching circuit breakers types – rating and comparison, RRRV, Resistor switching and capacitor switching, Current Chopping and Capacitive current Breaking.

Unit V: Static relays – Digital relays - Microprocessor based relays – Apparatus and line protection – Basics of Numerical relays.

TEXT BOOKS

1. Badri Ram and Vishwakarma.D.N, "Power System Protection and Switchgear", Tata McGraw Hill publishing company Limited, 2nd Edition, 2011.
2. Sunil S.Rao, "Protective Switch Gear", Khanna Publishers, New Delhi, 1999.
3. Paithangar.Y.G, "Fundamentals of Power System Protection", Prentice Hall of India

REFERENCE BOOKS

1. Soni.M.L, Gupta.P.V, Bhatnagar.U.S and Chakrabarti.A, "A Text Book on Power System Engineering", Dhanpat Rai and Co., 2008.
2. Wadhwa.C.L, "Electrical Power Systems", New Age International (P) Limited, 6th Edition, 2010.
3. Ravindra P.Singh, "Switchgear and Power System Protection", PHI Learning Private Limited, New Delhi 2009
4. Ravindranath.B and Chander.N, "Power Systems Protection and Switch Gear", Wiley Eastern Limited, 1977.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Classify and describe the working of various relaying schemes
2. Identify and implement an appropriate protection scheme for different power apparatus.
3. Illustrate the working principle and applications of Circuit Breakers

PROFESSIONAL ELECTIVES

EE501	ELECTRICAL MACHINE DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objective of this course is

- To familiarize techniques to design the main dimensions and other major parts DC and AC rotating machines.
- To introduce the procedures to design the parts of transformers and transformer tank.

Unit I: Introduction

Major considerations in Electrical Machine Design - Conductors, Insulators and magnetic Materials used in machines– Space factor – Choice of Specific Electrical and Magnetic loadings –-mmf calculation for the magnetic circuit of rotating machines-Leakage reactance calculation.

Unit II: DC Machines

Constructional details –Output Equations – Main Dimensions - Selection of number of poles – Design of Armature – design of field poles and field coil -Design of Commutator and brushes – losses and efficiency calculations –performance prediction using design values. (qualitative treatment only)

Unit III: **Transformers**

Constructional details of core and shell type transformers – output rating of single phase and three phase transformers – design of core, window dimension, yoke design and HV/LV winding design – Design of tank and cooling tubes-Predetermination of circuit parameters, magnetising current, losses, efficiency, temperature rise and regulation from design data (qualitative treatment only)

Unit IV: Induction Motors

Output equation – Main dimensions – Length of air gap-Design of stator- Design of squirrel cage and slip ring rotors - Design of end rings – Predetermination of circuit parameters, magnetising current, efficiency and temperature rise from design data (qualitative treatment only).

Unit V: Synchronous Machines

Constructional details of cylindrical pole and salient pole alternators – output equation – choice of specific loadings – main dimensions – short circuit ratio – Stator design-Design of salient pole field coil. - Estimation of air gap length – Design aspects of turbo alternators (qualitative treatment only)

TEXT BOOKS

1. Sawhney, A.K., “A Course in Electrical Machine Design”, Dhanpat Rai and Sons, New Delhi, 1984.
2. Sen.S.K, “Principles of Electrical Machine Designs with Computer Programmes”, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987
3. Say.M.G, “Performance and Design of AC machines”, CPS Publishers.

REFERENCE BOOKS

1. Shanmugasundaram.A, Gangadharan.G, Palani.P, "Electrical Machine Design Data Book", New Age International Private Limited, Reprint 2007.
2. Balbir Singh, "Electrical Machine Design", Brite Publications, Pune.
3. Agarwal.R.K, "Principles of Electrical Machine Design", S.K.Kataria & Sons, 2012
4. Mittle.V.N and Mittle.A, "Design of Electrical Machines", Standard Publications and Distributors, Delhi, 2009

COURSE OUTCOMES

Upon completion of this course, students will be able to

1. Estimate the Temperature Rise of Machines under different loading conditions.
2. Design the different parts of D.C. Machines, Transformers, Induction Machines and Synchronous Machines.
3. Predict the performance of machines using design values.

EE502	DIGITAL LOGIC DESIGN USING VHDL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To enable the students to design digital systems using VHDL and various programmable logic devices, CAD tools, simulation aspects and chip configuration.
- To familiarize the students with various VHDL concepts and programming and design steps for combinational circuits using VHDL.
- To enable the students to design both synchronous and asynchronous sequential circuits.

UNIT – I Implementation Technology Programmable logic devices- PLA, PAL, CPLD and FPGA– Custom chips–CAD Tools– design entry, synthesis, functional simulation, physical design, timing simulation, and chip configuration.

UNIT – II VHDL Concepts VHDL Terms – Behavioral Modeling– Sequential Processing – process statement- signal Variable assignment, sequential statements, and concurrent assignment problem – Data Types.

UNIT – III VHDL Programming, Subprograms and Packages – Predefined Attributes – Configurations – VHDL Synthesis – constraints and attributes.

UNIT – IV Combinational Circuit Design Multiplexers–Decoders–Encoders–Code Converters–Arithmetic Comparison Circuits– VHDL for Combinational Circuits– Flip Flops– Registers – Counters – Simple Processor.

UNIT – V Sequential Circuits Synchronous Sequential Circuits– Design steps-state assignment problem- Finite state machines using CAD tools. Asynchronous Sequential Circuits–synchronous behavior, analysis, synthesis, concept of stable and unstable states, hazards and design example– Vending machine controller.

TEXT BOOKS

1. Stephen Brown I Zvonko Vranesic, "Fundamentals of Digital Logic Design with VHDL", Tata McGraw Hill, Second Edition, 2007.
2. Douglas L.Perry, "VHDL Programming by Example", Tata McGraw Hill, Fourth Edition, 2002.

REFERENCE BOOKS

1. Charles H. Roth,Jr, "Digital Systems Design Using VHDL", Thomson Learning, 2007
2. Ben Cohen, "VHDL Coding Styles and Methodologies", Springer, 2nd Edition , 2005
3. Stainley Mazor, Patricia Langstraat, "A Guide to VHDL", Springer, 2nd Edition , 2007

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Describe the structure of Programmable Logic Devices
2. Realize the statements of VHDL programming and develop programming
3. Apply CAD tools for VHDL design
4. Design and analyze combinational digital circuits using VHDL for practical applications
5. Design and analyze sequential digital circuits using VHDL for practical applications

EE503	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objective of this course is

- To teach the usage of high voltage (HV) and introduce HV problem and HV applications.
- To provide origin of over voltages and protection against them.
- To introduce basic breakdown phenomenon and its properties of gas, liquid, solid and composite materials.
- To understand various types of Generation and measurements of high voltages and high currents
- To expose the students to various types of testing methods and standards for power apparatus

Unit I: Over Voltages and Insulation Co-ordination - Causes of over voltages: lightning and switching over voltages; effects of over voltages on power system components, Surge diverters, protection against over voltages; principles of insulation coordination, BIL.

Unit II: Generation of High Voltages and High Currents - Generation of high AC voltages: cascaded transformers. Generation of high DC voltages: Rectifier and Voltage doubler circuits, Cockroft Walton voltage multiplier circuit and its qualitative analysis. Generation of impulse and switching surges; Marx circuit; generation of high impulse current. Tripping and control of impulse generators.

Unit III: Measurement of High Voltages and High Currents - Measurement of AC, DC impulse and switching surges using sphere gaps, peak voltmeters, Potential dividers, high speed CRO and digital techniques, Opto Electronics method; Fiber optic method; Measurement of high currents.

Unit IV: Electrical breakdown in Gaseous, Solid and Liquid Dielectrics - Gaseous breakdown in uniform and non-uniform field, partial discharges and corona discharges, Vacuum breakdown, conduction and breakdown in pure and commercial liquids, breakdown mechanisms in solid and composite dielectrics.

Unit V: High Voltage Testing Practice - Indian Standards / IEC specification for testing, correction factor; power frequency, impulse voltage and DC testing, high voltage testing of power apparatus: Insulators, Bushings, Isolators, Circuit Breakers, Cables, Transformers and Surge Diverters

TEXT BOOKS

1. Naidu.M.S and Kamaraju.V, "High Voltage Engineering", Tata McGraw Hill, 5th Edition, 2013.
2. Kuffel.E and Zaengl.W.S, Kuffel.J, "High voltage Engineering fundamentals", Newness 2nd Edition 2000

REFERENCE BOOKS

1. Alston.L.L, "High Voltage Technology", Oxford University Press, First Indian Edition 2008.
2. Wadhwa.C.L, "High Voltage Engineering", New Age International, 2010.
3. Mazen Abdel Salam, Hussein Anis, Morshed and Roshday Radwan "High Voltage Engineering – Theory & Practice", Marcel Dekker Inc., 2nd Edition, 2000.
4. Ravindra Arora and Wolfgang Mosh, "High Voltage Insulation Engineering", New Age International Publishers, 1995

COURSE OUTCOMES

Students will be able to

1. Recognize the natural causes of over voltages and protection of power system components
2. Generate the High DC, AC, impulse voltages and currents for high voltage testing
3. Measure the High DC, AC, impulse voltages and currents
4. Analyze the various breakdown mechanisms in different dielectric materials
5. Express the procedure for high voltage testing of various power system apparatus

EE504	MODERN CONTROL THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To impart knowledge on

- Stability of the linear and non-linear systems using state variable techniques.
- Phase plane analysis, describing function analysis
- Basic concepts about optimal control

Unit I: Systems in state space: Concept of states and state model, State equation from transfer function, Modeling of dynamical systems, State space representation of multivariable systems, Building blocks of state space models. Modeling through energy approach of electrical, mechanical and electromechanical systems – Introduction to fractional order systems.

Unit II: Canonical forms, Solution to state-space equations, state transition matrix, properties of state transition matrix, computation of state transition matrix.

Unit III: Equilibrium points and stability concepts, stability definitions, Modeling energy of the system in terms of quadratic functions, Direct method of Lyapunov criterion for LTI systems.

Unit IV: Definition of controllability, observability, stabilizability and detectability. State feedback control for controllable canonical form, State feedback control in general, Output feedback controller. Full-order and reduced-order observers, Introduction to Linear Quadratic problems.

Unit V: Introduction to Discrete time systems , analogies with continuous-time systems, mathematical models for LTI discrete- time systems, Z- transformation of difference equation, analysis of first, second order and higher order systems. State space modelling of discrete-time dynamical systems.

TEXT BOOKS

1. Nagrath.I.J and Gopal.M, "Control System Engineering", New Age International (P) Limited Publishers, 5th Edition, 2012.
2. Richard Dorf and Robert Bishop, "Modern control system", Pearson Education, 12th Edition, 2014.

REFERENCE BOOKS

1. Dingyu Xue, YangQuan Chen, Derek P. Atherton, "Linear Feedback Control Analysis and Design with MATLAB"', Society for Industrial and Applied Mathematics, 1st Edition, 2007.
2. Norman S. Nise, "Control System Engineering", Wiley Student Edition, 6th Edition, 2012.
3. B.C Kuo, "Automatic control systems", Prentice Hall, New Delhi, 7th Edition, 2002.

COURSE OUTCOMES

The students will be able to

1. Analyse state variable concepts in continuous time format for linear and non-linear systems
2. Find the solution of state space equations
3. Analyse the stability of linear and nonlinear system using Lyapunov stability theorem
4. Design complete state variable feedback controllers and observer for the desired system characteristics
5. Represent the discrete time systems by using difference equations and state space modelling

EE505 DESIGN WITH PIC MICROCONTROLLERS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To introduce the internal structure and operation of PIC16F876 microcontroller, programming with MPLAB platform and design methodology practical applications.
- To give an exposure to the DSPIC 30F4011 controller.

Unit I: Introduction to PIC microcontrollers - PIC 16F876 microcontroller – device overview-pin diagrams memory organization – Instruction set - assembly language programming

Unit II: Special Function Registers - I/O ports - Timers – Capture/Compare/PWM modules (CCP) – Analog to-digital converter module - selection – reset – interrupts - watchdog timer.

Unit III: Introduction to MPLABIDE and C 30 compiler– Device Programming using MPLAB platform.

Unit IV: Introduction to Digital Signal Controller - DSPIC 30F4011- Multiplexing – Interrupts.

Unit V: Assembly language programming for – Zero crossing detectors - square wave generation –- ADC program – PWM pulse generation for typical applications - hardware demonstration.

TEXT BOOKS

1. PIC16F87X datasheet, 28/40- pin 8 bit CMOS Flash Microcontrollers, Microchip Technology Inc, 2001.
2. Myke Predko, 'Programming and Customizing the PIC Microcontroller', Tata McGraw-Hill Publications, 1st Edition, 2007.
3. John B. Peatman, 'Design with PIC Microcontrollers', Pearson Education Publications, 1st Edition, 2008.
4. DSPIC 30F4011 datasheet, High-Performance 16-Bit Digital Signal Controllers, Microchip Technology Inc, 2010

REFERENCE BOOKS

MPLABIDE Quick Start Guide Microchip Technology Inc., 2007.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Describe the architecture of PIC 16F876 microcontroller and its instruction set.
2. Develop the program using MPLAB and download it to the controller chip
3. Explain the working principle of digital signal controller.
4. Generate triggering pulses for typical applications.

EE506	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objective of this course is

- To provide knowledge about the constructional features and operating principles of various types of special electrical machines.
- To compare and analyze the static and dynamic characteristics of special electrical machines.
- To provide the knowledge about the different types of drive systems and controllers used in special electrical machines.

Unit I: Synchronous Reluctance motors - Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – phasor diagram, motor characteristics – Linear induction machines.

Unit II: Stepping motors - Constructional features, principle of operation, modes of excitation torque production in Variable Reluctance (VR) stepping motor, dynamic characteristics, Drive systems and circuit for open loop control, closed loop control of stepping motor-Applications.

Unit III: Switched reluctance motors - Constructional features-principle of operation-Torque equation-Power Controllers-Characteristics and control Microprocessor based controller.

Unit IV: Permanent Magnet Synchronous motors - Permanent Magnet and characteristics-Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self-control, Vector control, Current control schemes- Sensorless control.

Unit V: Permanent magnet Brushless DC motors - Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave, Sine wave permanent magnet brushless motor drives, Torque and EMF equation, Torque-speed characteristics, Controllers-Microprocessor based controller.

TEXT BOOKS

1. Miller.T.J.E, “Brushless Permanent Magnet and Reluctance motor drives”, Clarendon Press, Oxford University, 1989.
2. Kenjo.T, “Stepping motors and their microprocessor control”, Clarendon Press, Oxford University,2nd Edition, 1994.
3. Kenjo.T and Naganori.S, “Permanent Magnet and brushless DC motors”, Clarendon Press, Oxford University, 1990.
4. Kenjo.T, “Power Electronics for the Microprocessor Age”, Oxford University Press, 1990

REFERENCE BOOKS

1. Bose.B.K, “Modern Power Electronics and AC drives”, Prentice Hall Publisher, 2002.
2. Krishnan.R, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice Hall of India Private Limited, New Delhi, 2010
3. Venkataratnam, “Special Electrical Machines”, Tayler and Francis, 2009

COURSE OUTCOMES

At the end of the course, students will be able to

1. Explain the construction and operating principles of special electrical machines.
2. Analyze the characteristics and performance of special electrical machines.
3. Design the different types of controllers and control techniques applicable to Special electrical machines

EE507	DIGITAL CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The purpose of the proposed course is to present control theory that is relevant to the analysis and design of computer-controlled systems, with an emphasis on basic concepts and ideas.

Unit I: Introduction- Comparison between analog and digital control- Importance of digital control- Structure of digital control- Examples of digital control system- Difference equations- Z-transform- MATLAB examples. Frequency response of discrete time systems- Properties of frequency response of discrete time systems-Sampling theorem.

Unit II: ADC model- DAC model- Transfer function of zero order hold- DAC, Analog Subsystem, and ADC Combination Transfer Function- Closed loop transfer function- Steady state error and its constants.(MATLAB commands).

Unit III: Definitions of stability (Asymptotic stability, exponential stability etc)-stable z-domain pole placement locations- stability conditions-Stability determination (Routh array)-Nyquist criterion.

Unit IV: Root locus- root locus design (P-control, PI- control, PD)- Z-domain root locus-z-domain root locus design-digital implementation of analog controller design (differencing methods forward and backward)- bilinear transformation-direct z- domain controller design- frequency response design- Finite time response settling time.

Unit V: Concept of state space method-state space representations of discrete time systems- solving discrete time state space equations- Pulse transfer function matrix-Discretization of continuous state space equations-Lyapunov stability analysis (discrete time) Controllability-observability-design Via pole placement-state observers

TEXT BOOKS

1. Kannan M. Moudgalya, “Digital Control”, Wiley Publishers, 1st edition, 2007.
2. M.Gopal, “Digital Control engineering”, New Age International (ltd) Publishers,1st edition reprint(2003),1998.
3. Deshpande P.B. and Ash R.H, “Computer Process Control”, ISA publication, USA 1995.

REFERENCE BOOKS

1. M. Sam Fadalli, “Digital Control Engineering Analysis And Design”, Elsiever publication, 1st edition, 2012.
2. Katsuhiko Ogata, “Discrete Time Control Systems”, Pearson Education Publications, 2nd edition, 2005.

COURSE OUTCOMES

Upon completion of this course, the students can able to

1. Distinguish the fundamental differences between continuous time control and digital control.
2. Design and simulate for digital control algorithms for simple FOPDT and SOPDT models.
3. Make the Stability analysis in Z domain.
4. Develop state space models in discrete domain and check controllability and Observability conditions
5. Design and simulate the state feedback , output feedback and observer for simple applications.

EE508	SOLID STATE DRIVES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objective of this course is

- To understand the stable steady-state operation and transient dynamics of a motor-load system.
- To study the operation of the converter / chopper fed dc drive and solve simple problems.
- To study the operation of both classical and modern induction motor drives.
- To understand the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives.
- To analyze and design the current and speed controllers for a closed loop solid-state DC motor drive and simulation using a software package

Unit I Introduction: Basic Elements of an Electric Drives, Classification of Electric Drives, Stability Consideration of Electric Drives. Energy conservation in electric drives - Use of efficient converters.

Unit II Converter and Chopper fed Drives: Control of DC motors - Single-phase and Three-phase thyristor converters in discontinuous conduction mode, control of DC motor using choppers of different configurations.

Unit III Induction Motor Drives: Control of induction motors - Stator voltage control - Control using inverters - Standard PWM techniques - slip energy recovery scheme.

Unit IV Synchronous Motor Drives: Introduction-Speed-Torque Characteristics-Speed Control Methods-True Synchronous Mode-open loop - Self-controlled Mode/self-synchronous mode open loop - Self-controlled Mode/self-synchronous mode closed loop

Unit V Traction: Nature of traction load, Main line and sub-urban train configuration, Braking, Power factor and harmonics, Calculation of traction drive rating and energy consumption, Traction motor, Conventional DC and AC traction drives. Recent trends in electric drives.

TEXT BOOKS

1. Dubey.G.K, "Fundamentals of Electric Drives", Narosa Publishers, 2nd Edition, 2007.
2. De.N.K, Sen.P.K, "Electric Drives", Prentice Hall of India Learning Private Limited, 7th Edition, 2004.
3. Bimal K. Bose, "Power Electronics and Motor Drives: Advances and Trends", Academic Press, 2006.

REFERENCE BOOKS

1. Pillai.S.K, "A first course in Electrical Drives", Wiley Eastern, 3rd Edition, 2010.
2. Subrahmanyam.V, "Electric Drives: Concepts and Applications", Tata McGraw Hill, New Delhi, 2005.

COURSE OUTCOMES

Students should be able to

1. Analyze the operation of the various controlled rectifier and chopper fed DC drive.
2. Design and analyze the current and speed controllers for a closed loop solid state DC motor drives.
3. Analyze the various methods to control the speed of induction motor drive from the stator and rotor side.
4. Analyze the speed control methods of synchronous motor drives.

EE509	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students with the knowledge on various sub systems of human body and the characteristics of signals generated in each sub system
- To make the students to learn about the suitable transducers and electrodes for physiological parameters of human body.
- To know how to form measurement and record set up for physiological parameters of human body.
- To understand the fundamentals and usage of imaging systems for diagnosing the abnormalities of internal organs of human body
- To understand the significance of suitable devices for patient care and monitoring system of a hospital when the patients are admitted in IC unit or as inpatient

Unit I: Electro physiology: Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and uni-polar electrodes, surface electrodes, physiological transducers.

Unit II: Bioelectric potential and cardiovascular measurements: EMG - Evoked potential response, EEG, foetal monitor. ECG phonocardiography, vector cardiograph, BP, blood flow cardiac output, plethysmography, impedance cardiology, cardiac arrhythmia's, pace makers, defibrillators.

Unit III: Respirator and pulmonary measurements and rehabilitation: Physiology of respiratory system, respiratory rate measurement, artificial respirator, oximeter, hearing aids, functional neuromuscular simulation, physiotherapy, diathermy, nerve stimulator, artificial kidney machine.

Unit IV: Imaging systems: Medical imaging, X-rays, laser applications, ultrasound scanner, echo cardiography, CT Scanning, MRI/NMR, cine angiogram, colour Doppler systems, Holter monitoring, endoscopy.

Unit V: Patient monitoring systems: Intensive cardiac care, bedside and central monitoring systems, patient monitoring through bio-telemetry, implanted transmitters, telemetering multiple information. Sources of electrical hazards and safety techniques.

TEXT BOOKS

1. Leslie Cromwell, Fred J.weibell and Erich A.Pfeiffer "Bio-medical Instrumentation and measurements", PHI Learning, 2011
2. M.Arumugam, "Bio-medical Instrumentation" Anuratha Agencies Publishers, 1994.
3. R.S. Khandpur, "Hand book on Bio-medical Instrumentation", Tata McGraw Hill Company Ltd., Second Edison, 2003

REFERENCE BOOKS

1. Geddes L. A. and Baker L. E., "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley, New York, 2008.
2. Richard Aston, "Principles of Bio-medical Instrumentation and Measurement", Merril Publishing Company, New York, 1990.

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Describe the working and related electrical, mechanical and chemical characteristics of human body and suggest suitable transducers and electrodes for measurements
2. Identify and describe the procedure to use suitable devices for measurement of parameters and recording the bio electrical signals generated in the heart.
3. Identify the equipment and measure the parameters related to respiratory and neuromuscular system
4. Explain the working and applications of imaging systems in diagnosing the diseases in internal organs.
5. Describe the instrumentation systems in clinical laboratory and demonstrate the safety issues to be followed while using instruments for medical applications.

EE510	INTELLIGENT TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To expose the concepts of various intelligent techniques and its applications in the field of electrical engineering.

UNIT I: Introduction- Classical sets, fuzzy sets-operation, properties. Fuzzy relations-Equivalence and tolerance relation, Fuzzification- membership function-types- Building Blocks of a Fuzzy system, fuzzification, fuzzy Rule-based Systems. Composition of rules, types of fuzzy inference, defuzzification methods.

UNIT II: Introduction-Biological Neuron-artificial neuron-transfer functions-multiple inputs neurons-layer of neurons-neural architectures-types.

UNIT III: perceptron neural network-perceptron learning rule-linear seperability limitation-solutions-back propagation learning algorithm- Adaline neural network-LMS algorithm.

UNIT IV: Genetic Algorithm-Introduction- Basic concepts of Genetic algorithm – biological background- detailed algorithm-encoding-fitness function-GA operators-Simple numerical problems.

UNIT V: Intelligent techniques applications to power systems, power electronics and control.

TEXT BOOKS

1. Martin T.Hagan, Howard B.Demuth, Mark Beale, “Neural Network Design”, Cenage Learning, 2008.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, Wiley Student edition, 3rd edition, 2010.
3. S.Rajasekaran and G.A.Vijayalakshmi Pai,“Neural Networks, Fuzzy Logic, and Genetic Algorithms”, PHI Learning, 2014.

REFERENCE BOOKS

1. Simon Haykin, “Neural Networks: A Comprehensive Foundation”, Prentice Hall of India, 2008.
2. Kevin M. Passino and Stephen Yurkovich, “Fuzzy Control”,Addison Wesley, 1998.
3. Melanie Mitchell,“An Introduction to Genetic Algorithms”, MIT Press, 1998.
4. Juh Shing Roger Jang, Cheun Tsai Sun, Eiji Mizutani, “Neuro fuzzy and soft computing” ,Prentice Hall, 1997.
5. Bimal K.Bose, “Modern Power Electronics and AC Drives”, Pearson Education (Singapore) Ltd., New Delhi, 2005.
6. Dinko Vukadinovic and Mateo Basic, “Artificial Neural Network Applications in Control of Induction Machines”, Nova Science Publishers, Inc. New York, 2006.

COURSE OUTCOMES

1. Characterize the fuzzy concept and fuzzy logic systems
2. Characterize the concept of artificial neural networks and its topologies and illustrate their learning methods
3. Enlighten the concept of genetic algorithm and its functional components.
4. Develop Fuzzy logic, neural network and genetic algorithm-based controller for electrical engineering applications.

EE511	POWER SYSTEM RESTRUCTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objective of this course is

- To provide the students a systems perspective of modern electricity markets and a systems approach to address various issues faced by the electricity sector.
- To provide the students an in-depth knowledge of how electricity markets operate from short-term system dispatch to long-term asset investments.
- To present the student a vision of how Smart Grid will transform the current electricity grid to a reliable and sustainable modern energy system

UNIT I: INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production – Market models:

UNIT II: TRANSMISSION CONGESTION MANAGEMENT Congestion management– Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

UNIT III: LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS Locational marginal pricing– Lossless DCOPF model for LMP calculation –Financial Transmission rights – Risk hedging functionality - Simultaneous feasibility test and revenue adequacy – FTR issuance process: FTR auction, FTR allocation — Flow gate rights – FTR and market power

UNIT IV: ANCILLARY SERVICE MANAGEMENT Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service

UNIT V: PRICING OF TRANSMISSION NETWORK Transmission pricing – Principles – Classification – Rolled in transmission pricing methods – Marginal transmission pricing paradigm – Composite pricing paradigm – Merits and demerits of different paradigm

TEXT BOOKS

1. Loi Lei Lai, “Power System Restructuring and Deregulation”, John Wiley & son LTD, New York, 2001.
2. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, “Restructured electrical power systems: operation, trading and volatility” Pub., 2001

REFERENCE BOOKS

1. Sally Hunt,” Making competition work in electricity”, John Willey and Sons Inc. 2002
2. Steven Stoft,” Power system economics: designing markets for electricity”, John Wiley & Sons, 2002.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen,” Operation of restructured power systems”, Kluwer Academic Pub., 2001

COURSE OUTCOMES

At the conclusion of this course, the students should be able to:

1. Describe the structure of an electricity market in either regulated or deregulated market conditions.
2. Realize the electricity pricing (wholesale) in a transmission network.
3. Evaluate the trade-off between economics and reliability of an electric power system.
4. Analyze the impacts of renewable resources to the grid and the various issues associated with integrating such resources to the grid.
5. Evaluate various investment options (e.g. generation capacities, transmission, renewables, demand-side resources, etc) in electricity markets.
6. Elucidate the concepts and principles of Smart Grid, technology enabling, and demand participation.

EE512	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To cover the fundamentals of vehicle electrical and electronic system, components and sub systems
- To discusses working principle of sensors and actuators, concepts of diagnostics and communication protocols, and gives exposure to Quality, Reliability and Safety aspects

Vehicle Electrical and Electronic system and components: Overview of vehicle system and aggregates, Schematic diagram of automotive electrical system - function of starting system, Ignition system, charging system and lighting system -Schematic diagram of electronic system Function of EMS, ABS, ICL, Body Controls, Infotainment System-Environmental conditions: Electrical and operating-key requirements of automotive systems.

Electrical and Electronic Subsystems: Starter motor, Relay, Battery, Pulser coil, TCI/CDI, Ignition coil, Spark Plug, Magneto, Battery, Headlamp and indicators-Requirements of Wiring harness, connectors, fuses-ECU architecture-Sensor Interface-Actuator Interface-Automotive Electronic Application - ABS, EMS, Body control and ICL.

Sensors and Actuators: sensors-Temperature, Pressure, Speed, Position and Acceleration Actuator-Solenoid valve, motor drive, power relay, Fuel injector.

Diagnostics and Communication protocols: Diagnostics- Importance, tasks, Fault storage and system action-Communication networks-CAN, LIN, MOST, Flex ray-communication protocols- KWP2000, OBD-II-Diagnostic tester and fault codes

Quality, Reliability and Safety aspects: Quality-Component and Product-Reliability-concepts and estimation-Safety by design-Safety Process-Product validation-EOL.

TEXT BOOKS

1. Bosch "Automotive Electrics and Automotive Electronics. System and components, Networking and Hybrid drive", Fifth edition, Springer view 2014
2. William B. Ribbens, "Understanding Automotive Electronics" Sixth Edition, Elsevier Publishing, 2002

REFERENCE BOOKS

1. Ronald K Jurgen, "Automotive Electronics Handbook", Tata McGraw Hill, 1999.
2. Tom Denton," Automobile Electrical and Electronics Systems", Elsevier Publications,2004
3. Ronald K Jurgen, "Automotive Microcontrollers", Progress in technology, 2008.
4. Najamuz Zaman, "Automotive Electronics Design Fundamental'' first edition, Springer 2015.
5. Hillier's, "Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics", Fifth Edition, Nelson Thrones, 2007.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Describe the vehicle electrical and Electronic systems and their components
2. Explain the working of electrical and electronic subsystems
3. Explain the working principles of sensors and actuators in automotive
4. Calculate sensors and actuator outputs under given operating conditions
5. Explain the concepts of diagnostics and communication protocols
6. Describe the Quality, Reliability and Safety aspects of automotive electrical and electronic system requirements

EE513	UTILIZATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To impart knowledge on

- Generation of electrical power by conventional and non–conventional methods.
- Electrical energy conservation, energy auditing and power quality.
- Principle and design of illumination systems and methods of heating and welding.
- Electric traction systems and their performance.
- Industrial applications of electric drives.

Unit I: Illumination - lighting calculations - Design of lighting schemes - factory lighting - flood lighting - electric lamps.
Unit II: Electric Heating - Electric furnaces and welding - Resistance, inductance and Arc Furnaces - Construction and fields of application – induction heating.
Unit III: Electric drives and control - Group drive - Individual drive - selection of motors - starting characteristics - Running characteristics.
Unit IV: Traction system – tractive effort calculations - electric braking - recent trend in electric traction.
Unit V: Refrigeration and Air – Conditioning - Various types of air conditioning system, domestic refrigerator and wiring system

TEXT BOOKS

1. Uppal.S.L, "Electrical Power", Khanna publishers, New Delhi, 1992.
2. Gupta.J.B, "Utilisation of Electrical Energy and Electric Transaction", S.K.Kataria and Sons, 1st Reprint Edition, 2004.
3. Partab.H, "Art and Science of Utilization of Electrical Energy", Dhanpat Rai and Sons, New Delhi, 1986.

REFERENCE BOOKS

1. Suryanarayana.N.V, "Utilisation of Electric Power", Wiley Eastern Limited, New Age International Limited, 1993.
2. Rai.G.D, "Non-Conventional Energy Sources", Khanna Publications Limited, New Delhi 1997.
3. Rajput.R.K, "Utilisation of Electric Power", Laxmi Publications Private Limited, 2007.
4. Wadhwa.C.L, "Generation, Distribution and Utilization of Electrical Energy", New Age International Private Limited, 3rd Edition, 2011.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Analyze the illumination system and design lighting schemes.
2. Explain the working of heating systems, furnaces and welding, and identify their applications.
3. Select an industrial drive with relevance factors
4. Analyze electric traction system.
5. Realize the importance of electrical energy on working of refrigeration and air condition systems.

EE514	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objectives of this course are

- To introduce the basic concepts, different types of FACTS controllers in power transmission.
- To understand the scope and applications of FACTS controllers.

Unit I: Fundamental of AC transmission system, transmission problem and needs, emergence of FACTS-Basic types of FACTS controllers –benefits from FACTS technology – Comparison of HVDC and FACTS

Unit II: Objectives of Shunt Compensation – Methods of Controllable Var Generation – Static Var compensators – SVC, STATCOM – Compensator Control – Comparison Between SVC & STATCOM.

Unit III: Objectives of Series Compensation – Variable Impedance type series compensators – GCSC, TSSC and TCSC – basic control schemes –Switching converter type Series compensator: SSSC – internal and external control.

Unit IV: Principles of operation – Steady state model and characteristic of a static voltage regulators and phase shifters – power circuit configuration.

Unit V: UPFC – Operating principles, conventional transmission control capabilities, independent real and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters. IPFC –operating principles, characteristics and control structure.

TEXT BOOKS

1. N.G Hingorani , L.Gyugyi, " Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems", Wiley India Pvt Ltd.2011
2. Y.-H. Song and A.T. Johns, " Flexible A.C. Transmission Systems (FACTS)", IEE Book series,1999
3. P.Kundur, " Power System Stability and Control", McGraw Hill ,2006

REFERENCE BOOKS

1. John.A.T, "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. Mohan Mathur.R and Varma Rajiv. K, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley and Sons Incorporation, 2011.
3. Sood.V. K, "HVDC and FACTS controllers - Applications of Static Converters in Power System", Kluwer Academic Publishers, 2004
4. J. Arrillaga and N.R. Watson, " Computer modeling of Electric Power Systems", John Wiley & sons, 2001

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- Realize various control issues and select appropriate FACTS controllers.
- Apply the concepts in solving problems of simple power systems with FACTS controllers.
- Design simple FACTS controllers

EE514	POWER QUALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the quality of power and various power quality issues.
- To expertise the students about the necessity of providing quality power to the industry and consumers.
- To provide the solutions for all the power quality issues.

UNIT I INTRODUCTION TO POWER QUALITY

Power Quality phenomenon -Terms and definitions-Various Power events in power quality - causes for reduction in power quality.

UNIT II VOLTAGE SAGS

Sources of sags – Magnitude & duration of sag-effect of sag on computer and consumer Electronics- Monitoring and mitigation of voltage sag.

UNIT III INTERRUPTIONS

Origin of Long & Short interruption – influence on various equipments- Basic reliability indices - monitoring and mitigation of interruption.

UNIT IV HARMONICS

Harmonic distortion: Voltage and current distortion- harmonic indices- harmonic sources from commercial and industrial loads- Effects of harmonics on various equipments- harmonic distortion evaluation- Devices for controlling harmonic distortion.

UNIT V POWER QUALITY MONITORING

Monitoring considerations: Power line disturbance analyzer, power quality measurement equipment, harmonic spectrum analyzer, flicker meters, disturbance analyzer.

TEXT BOOKS

1. Arindam Ghosh,"Power Quality Enhancement Using Custom Power Devices Power Quality Enhancement Using Custom Power Devices", Springer, 2002.
2. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, "Electrical Power Systems Quality" McGraw Hill, 2003.

REFERENCE BOOKS

1. Math H.J.Bollen, "Understanding Power Quality Problems-Voltage sag & Interruptions", IEEE Press, 2000

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Identify the various power quality issues and their sources.
2. Evaluate the performance of voltage sags in transmission system.
3. Recognize various sources of interruptions and mitigation techniques.
4. Analyze the harmonics in power system network.
5. Illustrate the need of power quality monitoring and the various power quality measuring equipment

EE516	ELECTRICAL ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To impart knowledge on the following Topics

- Conservation of electrical power and energy efficient equipment.
- Principle, design of illumination systems and energy efficiency lamps.
- Concepts behind economic analysis and Load management.
- Energy management on various electrical equipment and metering.

Unit I: Importance of lighting – properties of good lighting scheme – laws of illumination – photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting – LED lighting and energy efficient lamps.

Unit II: Refrigeration-Domestic refrigerator and water coolers - Air-Conditioning-Various types of air-conditioning system and their applications, smart air conditioning units - Energy Efficient motors: Standard motor efficiency, need for efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor.

Unit III: Basics of Energy – Need for energy management – Energy accounting - Energy monitoring, targeting and reporting Metering for energy management – Energy management for electric motors – Transformer and reactors - Capacitors and synchronous machines, energy management by cogeneration Electrical interconnection.

Unit IV: Energy management in lighting systems – Task and the working space - Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards.

Unit V: Units of measure - Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples

TEXT BOOKS

1. Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
2. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
3. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, Longman Scientific & Technical, ISBN-0-582-03184, 1990.

REFERENCE BOOKS

1. Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
3. Energy Efficiency in Electric Utilities, BEE Guide Book, 2010
4. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
5. National Productivity Council Guide Books

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Recognize the main aspects of conservation and management.
- Identify an appropriate method of heating for any particular industrial application.
- Evaluate domestic wiring connection and debug any faults occurred.
- Construct an electric connection for any domestic appliance like refrigerator as well as to design a battery charging circuit for a specific household application.
- Realize the appropriate type of electric supply system

EE517	VIRTUAL INSTRUMENT DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main objectives of this course are

- To introduce the concept of Virtual Instrumentation
- To learn the programming techniques of VI
- To understand how to send and receive data from the real time system
- To study the different interfacing techniques used for VI
- To study the applications of VI

Unit I: Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

Unit II: VI programming techniques: VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

Unit III: Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

Unit IV: VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office and Industrial applications, VISA and IVI.

Unit V: VI toolsets, Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

TEXT BOOKS

1. Gary Johnson, "LabVIEW Graphical Programming", 2nd Edition, McGraw Hill, New York, 1997.
2. Lisa K. wells & Jeffrey Travis, "LabVIEW for everyone", Prentice Hall, New Jersey, 1997.
3. Jane W. S. Liu, "Real-time Systems", Pearson Education India, 2001.
4. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-to-use Modules in C", 2nd Edition, CMP Books, 1999.

REFERENCE BOOKS

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2000.
2. Jean J. Labrosse, "MicroC/OS-II. The Real-time Kernal", CMP Books, 2002.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Identify the components of virtual instrumentation system and realize its significance in real time
2. Develop programs using various programming techniques of VI
3. Identify the different components used for data acquisition and its interfacing
4. Recognize various interfacing devices with their features used in VI system
5. Design, develop and manage VI's for real time applications

EE518	STATIC RELAYS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To enable the students to acquire knowledge about the static relays for protection.

UNIT I INTRODUCTION

Static Relay-construction-applications-Protection-Influence of static protective relays on associated equipment-comparator types.

UNIT II SOLID STATE POWER SUPPLY CIRCUIT

Introduction- Voltage Regulation (Voltage stabilization)-Current Regulators (Constant current Stabilizers)-power supply and voltage regulator circuits for static relays

UNIT III DIRECTIONAL RELAYS

Phase Comparator Directional Units-Amplitude comparator directional units-Polyphase Directional Relays-Applications.

UNIT IV OVER CURRENT RELAYS

Instantaneous over current relays-Time current relays-Characteristics-Principles-Practical circuits.

UNIT V DIFFERENTIAL RELAYS AND DISTANCE RELAYS

Differential Relay Operating Characteristics-Types-Static Relay Scheme-distance Relays

Characteristics-Types-poly phase Distance Relay

TEXT BOOKS

1. Ram.B., `Fundamentals of Microprocessors and Microcomputers', M/s. Dhanpat Rai & sons, New Delhi, 1992.
2. Madhava Rao, T.S., 'Power System Protection - Static Relays', McGraw Hill, New Delhi, 1991

REFERENCE BOOKS

1. Badri Ram and Vishwakarma.D. N, “Power System Protection and Switchgear”, Tata McGraw Hill publishing company Limited, 2nd Edition, 2011.
2. Van.C.Warrington, 'Protective Relays - Their Theory and Practice', Vols. I & II, Chapman & Hall Ltd. London, 1994.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Differentiate conventional and static relays in terms of construction, operation and features
2. Recognize various protection schemes using static relays.

EE1001	ELECTRICAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide a comprehensive exposure to electrical hazards, various grounding techniques, safety procedures and various electrical maintenance techniques.

Unit I: Electrical Hazards And Safety Equipment : Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs - voltage measuring instruments - proximity and contact testers-safety electrical one line diagram- electrician's safety kit.

Unit II: Grounding And Bonding Techniques: General requirements for grounding and bonding- definitions- grounding of electrical equipment- bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment- system grounding- needs - use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems.

Unit III : Electrical Safety Methods: The six step safety methods - pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment, procedure for low, medium and high voltage systems- the one minute safety audit.

Unit IV: Electrical Safety Programme: Electrical safety programme structure, development- company safety team- safety policy programme implementation - safety meetings- safety audit and accident prevention- first aid- rescue techniques-accident investigation.

Unit V: Electrical Maintenance and Standards: Safety related case for electrical maintenance - reliability cantered maintenance (RCM) - eight step maintenance programme - frequency of maintenance - maintenance requirement for specific equipment and location- regulatory bodies- national electrical safety code - standard for electrical safety in work place - Indian Electricity Acts related to Electrical Safety.

TEXT BOOKS

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, 'Electrical Safety Handbook', McGraw-Hill Education, 4th Edition, 2012.
2. David J. Marne, P.E., B.S.E.E ,'National Electrical Safety Code (NESC) 2017Handbook', McGrawHill's

REFERENCE BOOKS

1. Maxwell Adams.J, 'Electrical Safety- a guide to the causes and prevention of electric hazards', The Institution of Electric Engineers, IET 1994.
2. Ray A. Jones, Jane G. Jones, 'Electrical Safety in the Workplace', Jones & Bartlett Learning, 2000.
3. HSC- A Practical guide VOL. 1 to 4, National Safety Council, India.

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Describe electrical hazards and safety equipment.
2. Analyse and apply various grounding and bonding techniques.
3. Select appropriate safety method for low, medium and high voltage equipment.
4. Participate in a safety programme
5. Carry out proper maintenance of electrical equipment by understanding various standards.

EE1002	POWER ELECTRONIC SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To Introduce the characteristics of power electronic devices
- To Design various types of power converter circuits
- To acquaint the speed control concept of DC and AC drives

Unit-I: Power Semiconductor Devices –power diodes, power transistors, SCRs, TRIAC, GTO, power MOSFETs, IGBTs-Principle of operation, characteristics, ratings, protection and gate drive circuits.

Unit-II: Power Converters – AC to DC, AC to AC converters

Unit-III: PWM based Power Converters: DC to DC, DC to AC converters

Unit-IV: Introduction to motor drives – Solid-state speed control of DC motor drive system

Unit-V: Solid-state speed control of induction motor drive system.

TEXT BOOKS

1. Rashid, M.H, 'Power Electronics - Circuits, Devices and Applications', Prentice Hall Publications, 3rd Edition, 2003.
2. P.C Sen, 'Thyristor DC Drives', John Wiley and Sons, New York, 1991.

REFERENCE BOOKS

1. R. Krishnan, 'Electric Motor Drives – Modeling, Analysis and Control', Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
2. P.S. Bhimbra, 'Power Electronics', Khanna Publishers, 4th Edition, 2010

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Identify various power electronic devices and plot their switching characteristics.
2. Design DC power conversion circuits for simple applications.
3. Analyze inverter and cyclo-converter circuits
4. Perform speed control of dc and induction motors.

EE1003	POWER SYSTEM ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart knowledge on power generation, transmission, distribution and protection systems.
- To overview the power system economics and regulations.

Unit-I: Outline of power generation systems: Sources of Energy, working principle of Steam, Diesel, Nuclear and Hydro power plants – site selection – Layout – merits and demerits.

Unit-II: Transmission and Distribution systems: HVAC and HVDC Transmission system – overhead lines – towers, insulators and conductors – Underground cables – types – laying methods and fault location, comparison of over-head and underground systems, distribution system – types – components.

Unit-III: Basic protection and switchgears: Need for protective schemes, types of faults and abnormal conditions, system grounding, overview of apparatus protection, switch gear elements and working principles – switch, fuse, circuit breakers and isolators.

Unit-IV: Economics on power systems: Factors affecting cost of generation – load curve – load duration curve – load factor – demand factor, base load and peak load stations – reduction of generation cost by interconnection of power stations, Tariff – types of tariff for HT and LT consumers.

Unit-V: Regulation / Electricity Act: Evolution of Indian electricity act – regulatory commissions, grid code, Restructuring of power system – advantages – GenCo, TransCo and DisCo, Independent power producers, and smart grid initiatives in India.

TEXT BOOKS

1. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt Ltd, New Delhi, 2002

REFERENCE BOOKS

1. A Chakrabarti, M L Soni, P V Gupta and U S Bhatnagar, ' Power System Engineering', Dhanpat Rai & Co., Ltd., 2010.
2. S N Singh. 'Electric Power Generation, Transmission and Distribution', PHI Publications, 2008.
3. B.R. Gupta, 'Power System Analysis and Design', S. Chand Limited, 5th Edition, 2008.
4. R K Rajput, 'Power System Engineering', Laxmi Publications Ltd., 2006

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Illustrate the layout and operation of various power plants.
2. Infer the modes of transmission and distribution of electrical energy.
3. Select the appropriate protection scheme for various power apparatus.
4. Identify tariff structure and calculate the energy pricing.
5. Discuss about Indian electricity act and regulations.

EE1004	MAINTENANCE AND TROUBLESHOOTING OF ELECTRICAL APPLIANCES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand working principle of basic domestic appliances
- Understand construction & working principle of electrical domestic appliances.
- Test & perform maintenance of Consumer Electrical Appliance.

Unit-I: Introduction: Fundamentals of basic electrical laws and series -parallel circuits, 555 timer, IC741, Types and use of Fuses and its rating, Relays and Switches, Panel Components.

Unit-II: Tools and equipment use for Repairing and maintenance of Electrical Equipment: Screw Driver Set, Tweezers, Different Types of Tweezers, Nose Pliers, Wire Cutter, Hot air gun, Liquid solder pest, Magnifying Lamp and Measuring Tools, Brush, CRO, Nipper, Test and Measurement Equipment, Multimeter Operation etc. Soldering/ De-soldering Techniques. First aid requirement in case of electrical shocks and other injuries.

Unit-III: Basic functionality, Fault identification, Repair and Maintenance of Washing machine: Working principle, Main parts of washing machines and their functionalities, Different types of technologies being used in Washing machines – Pulsator, Agitator, Agipellar, Tumble wash. Testing & identification of the faulty block on the basis of symptom, rectifying common faults by replacing the damage components, Testing of the damage block after repair.

Unit-IV: Basic functionality, Fault identification, Repair and Maintenance of Microwave Oven: Basic working principle of circuit and block description of Microwave Oven. Tips & Safety precautions. Common occurring faults with the Microwave Oven and their identification & repair. Maintenance of Microwave Oven, the electric power socket, switch rating and place for microwave oven installation.

Unit-V: Basic functionality, Fault identification, Repair and Maintenance of mixer /grinder/ceiling fan : Working principle of mixer /grinder/ceiling fan. Identification of various parts and their functionalities. functioning of motor and circuit breaker, Common occurring faults, identification and repair, maintenance of Mixer/ Grinder/Ceiling Fan.

TEXT BOOKS

1. Consumer Electronics, *S P Bali*, Pearson edition.
2. Handbook of Repair & Maintenance of domestic electronics appliances: BPB Publications.

REFERENCE BOOKS

1. Electrical Safety Handbook, 4th Edition, *John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield*

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Plan and organize work processes, identify necessary materials and tools
2. Perform task with due consideration to safety rules.
3. Identify and rectify errors in domestic electrical appliances.

EE1005	RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. Understanding of renewable energy sources
2. Knowledge of working principle of various energy systems
3. Capability to carry out basic design of renewable energy systems

Unit-I: In Global and National Energy Scenario: Overview of conventional & renewable energy sources, need, potential &development of renewable energy sources, types of renewable energy systems, Global and Indian Energy scenario, Energy for sustainable development, renewable electricity and key elements, CO2 reduction potential of renewable energy- concept of Hybrid systems.

Unit-II: Solar Energy: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Solar-Electrical Power Generation, general Solar Photo Voltaic (SVP) system, Different configurations, SPV system components and their characteristics, Stand-Alone and Grid Connected SPV systems, other Miscellaneous Applications of Solar Energy.

Unit-III: Wind Energy: Wind Energy Conversion, Potential, Nature of the wind, Wind Data and Energy Estimation, Site selection, Types of wind turbines, Wind farms, Wind Generation and Control., classification of wind, characteristics, offshore wind energy – Hybrid systems, wind energy potential and installation in India.

Unit-IV: Fuel cell system: Principle of operation of fuel cell, technical parameters of fuel cell, Type of fuel cell –advantages of fuel cell power plants, energy output, efficiency and emf of fuel cell – operating characteristics, applications and environmental impacts.

Unit-V: Hybrid energy systems: Need for hybrid systems, types, configuration and coordination, electrical interface – PV-Diesel, Wind-diesel, wind-PV, wind-PV- fuel cell.

TEXT BOOKS

1. Solar Energy: Principles of Thermal Collection and Storage, *S. P. Sukhatme and J. K. Nayak*, TMH, New Delhi, 3rd Edition.
2. Renewable Energy Resources, *John Twidell and Tony Weir*, Taylor and Francis - second edition, 2013.
3. Non-Conventional Energy Sources */G.D. Rai*, Khanna Publishers

REFERENCE BOOKS

1. Renewable energy technologies – A practical guide for beginners – *Chetong Singh Solanki*, PHI
2. Handbook of renewable technology, *Ahmed and Zobaa, Ramesh C Bansal*, World scientific, Singapore

COURSE OUTCOMES

1. Explain the process of PV generation and design stand-alone and grid connected system.
2. Explain the process of wind and fuel power generation and choose stand-alone and grid connected configuration.
3. Suggest and configure the various hybrid systems.

EE1006	INDUSTRIAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to introduce students about the applications of electronics in industries.

UNIT I: DC Motor, induction motor-construction-working principle-characteristics-governing equations- Speed control of DC and induction motors-conventional methods.

UNIT II: Controlled rectifiers, inverters, AC Voltage regulators, DC Choppers- basic operation and output voltage equations

UNIT III: Speed control of DC motors using controlled rectifier and choppers. Speed control of induction motor using AC voltage regulator and inverters

Unit IV: Uninterrupted power supplies-battery driven vehicles. Gate driver circuits – Optical isolators, smoke detector, liquid level indicators

Unit V: Programmable Logic controllers - input and output contact program symbols, numbering system, program format, introduction to logic and ladder design.

TEXT BOOKS

1. Schuler and Mc. Namee, “Industrial Electronics and Robotics‟, McGraw - Hill International Edition, 1986.
2. Ralph E.Tarter, “Principles of Solid State Power Conversion”, Howard W.Sams and Co, 1986

REFERENCE BOOKS

1. Dubey.G.K, “Fundamentals of Electrical Drives”, Narosa, New Delhi , 2010.
2. Krishnan.R, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall,2002.
3. Frank D. Petruzella, Industrial Electronics, McGraw Hill International Editions, 1996

COURSE OUTCOMES

On completion of this course, the student will

- Gain knowledge on speed control of motors using conventional and power electronics based methods.
- Gain knowledge on UPS, electrical vehicles, gate drivers and opto couplers.
- Gain knowledge on PLC

EE1007	SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To provide the students an overview knowledge of soft computing techniques and their applications.

UNIT I: Introduction to fuzzy logic- Classical sets, fuzzy sets-operation, properties. Fuzzy relations- Equivalence and tolerance relation, Fuzzification- membership function-types-Building Blocks of a Fuzzy system, fuzzification, fuzzy Rule-based Systems. Composition of rules, types of fuzzy inference, defuzzication methods

UNIT II: Introduction to neural network-Biological foundation-artificial neuron-transfer functions-multiple inputs neurons-layer of neurons-neural architectures-types.

UNIT III: perceptron neural network-perceptron learning rule-linear separability limitation-solutions- backpropagation learning algorithm- Adaline neural network-LMS algorithm.

UNIT IV: Genetic Algorithms (GA): adaptation and evolution; a simple genetic algorithm; genetic algorithms in optimization.

UNIT V: Soft computing techniques applications to various branches of engineering and science

TEXT BOOKS

1. Martin T.Hagan, Howard B.Demuth, Mark Beale, “Neural Network Design”, Cenage Learning, 2008.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, Wiley Student edition, 3rd edition, 2010.
3. S.Rajasekaran and G.A.Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic, and Genetic Algorithms”, PHI Learning, 2014.

REFERENCE BOOKS

1. Simon Haykin, “Neural Networks: A Comprehensive Foundation”, Prentice Hall of India, 2008.
2. Melanie Mitchell,“An Introduction to Genetic Algorithms”, MIT Press, 1998.
3. Juh Shing Roger Jang, Cheun Tsai Sun, Eiji Mizutani, “Neuro fuzzy and soft computing” ,Prentice Hall, 1997
4. Zimmermann.H.J, “Fuzzy set theory and its applications”, Allied publishers limited, Madras, 4th Edition, 2001.
5. Amit Konar, "Computational Intelligence: Principles, Techniques and Applications", Springer, 2007.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Characterize the fuzzy concept and fuzzy logic systems
2. Characterize the concept of artificial neural networks and its topologies and illustrate their learning methods
3. Enlighten the concept of genetic algorithm and its functional components.
4. Develop Fuzzy logic, neural network and genetic algorithm-based controller for engineering applications.

EE1008	MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To provide adequate knowledge in biomedical instrumentation.

Unit I: Electro physiology: Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and uni-polar electrodes, surface electrodes, physiological transducers.

Unit II: Bioelectric potential and cardiovascular measurements: EMG - Evoked potential response, EEG, foetal monitor. ECG phonocardiography, vector cardiograph, BP, blood flow cardiac output, plethysmography, impedance cardiology, cardiac arrhythmia's, pace makers, defibrillators.

Unit III: Respirator and pulmonary measurements and rehabilitation: Physiology of respiratory system, respiratory rate measurement, artificial respirator, oximeter, hearing aids, functional neuromuscular simulation, physiotherapy, diathermy, nerve stimulator, artificial kidney machine.

Unit IV: Patient monitoring systems: Intensive cardiac care, bedside and central monitoring systems, patient monitoring through bio-telemetry, implanted transmitters, telemetering multiple information. Sources of electrical hazards and safety techniques.

Unit V: Recent trends: Medical imaging, X-rays, laser applications, ultrasound scanner, echo cardiography, CT Scan MRI/NMR, cine angiogram, colour doppler systems, Holter monitoring, endoscopy.

TEXT BOOKS

1. Leslie Cromwell, Fred J.weibell and Erich A.Pfeiffer "Bio-medical Instrumentation and measurements", PHI Learning, 2011
2. M.Arumugam, "Bio-medical Instrumentation" Anuratha Agencies Publishers, 1994.
3. R.S. Khandpur, "Hand book on Bio-medical Instrumentation", Tata McGraw Hill Company Ltd., Second Edison, 2003

REFERENCE BOOKS

1. Geddes L. A. and Baker L. E., "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley, New York, 2008.
2. Richard Aston, "Principles of Bio-medical Instrumentation and Measurement", Merril Publishing Company, New York, 1990.

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Describe the working and related electrical, mechanical and chemical characteristics of human body and suggest suitable transducers and electrodes for measurements
2. Identify and describe the procedure to use suitable devices for measurement of parameters and recording the bio electrical signals generated in the heart.
3. Identify the equipment and measure the parameters related to respiratory and neuromuscular system
4. Explain the working and applications of imaging systems in diagnosing the diseases in internal organs.
5. Describe the instrumentation systems in clinical laboratory and demonstrate the safety issues to be followed while using instruments for medical applications.

EE1009	APPLIED ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To enable the students to gain knowledge about electrical and electronics engineering

UNIT I: Constructional details of DC machine – working principle of DC generator – Types of Generators – EMF equation –characteristics. Principle of operation of DC motors – Back emf – Torque equation – characteristics– speed control & starters.

UNIT II: Transformers: EMF Equation – Equivalent circuit – Voltage regulation - OC and SC Test – Efficiency – condition for maximum efficiency – All day efficiency – Autotransformer – introduction to three phase Transformer. 3 phase Induction motor - constructional details-working principle – torque equation- characteristics- starting methods – speed control methods –single phase Induction motor – stepper motor – AC series motor.

UNIT III: Alternator-Constructional features– types – emf equation – brief idea of armature reaction – voltage regulation (EMF method only) – Phasor diagram– Parallel operation of alternators.

UNIT IV: Adders – substractors- Flip Flops- Counters - Multiplexes –De multiplexes. Integrated circuits-Op. amp – Characteristics – Inverting amplifier - Non-inverting amplifier – differentiatorintegrator- I/V converter - V/I converter - Instrumentation amplifier - filters using op-Amp.

UNIT V: 555 timer - Design of astable and mono-stable multivibrator using 555 IC. Introduction to Microprocessor – 8085 Architecture, simple programming.

TEXT BOOKS

1. Huges, “Electrical and Electronics Technology”, Pearson, 10th Edition, 2011.
2. Albert Malvino and David Bates, “Electronic Principles”, 7th Edition, Tata Mc-Graw Hill, New Delhi, 2006.
3. Theraja B.L., Theraja A.K., “ A Textbook of Electrical Technology: Volume 2 AC and DC Machines: AC and DC Machines - Vol. 2”, S. Chand, 23rd Edition, 2006.

REFERENCE BOOKS

1. Smarajit Ghosh,“Fundamentals of Electrical and Electronics Engineering”, PHI, 2nd Edition, 2010.
2. Jacob Millman, Christos Halkias, Chetan Parikh, “Integrated Electronics”, McGraw Hill Education; 2nd edition, 2009.
3. Ramakant A Gayakward, Operational Amplifiers and Linear Integrated circuits, 4th Edition,PHI Learning, Delhi, 2009.
4. Ramesh Gaonkar, “Microprocessor Architecture, Programming and applications with the 8085/8080A”, Penram International Publishing House, 3rd Edition, 2002.

COURSE OUTCOMES

At the end of this course, the students will be able to

1. Explain the construction and operation of electrical machines.
2. Acquire knowledge about flip flops, counters, multiplexers, de-multiplexer, operational amplifiers and its applications.
3. Acquire knowledge about 555 IC and its applications.
4. Acquire knowledge about microprocessor and its programming**.**

EE1010 CONSERVATION OF ELECTRICAL ENERGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To know the necessity of conservation of energy
- To generalize the methods of energy management
- To illustrate the factors to increase the efficiency of electrical equipment
- To detect the benefits of carrying out energy audits.

UNIT- I: Basic Principles of Energy Audit:

Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries-energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT- II: Energy Management:

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

UNIT- III: Energy Efficient Motors:

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit.

UNIT- IV: Power Factor Improvement, Lighting and Energy Instruments:

Power factor – methods of improvement, location of capacitors, pf with non-linear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice, lighting control, lighting energy audit – Energy Instruments-wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

UNIT- V: Economic Aspects and Analysis:

Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis- Energy efficient motors-calculation of simple payback method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

TEXT BOOKS

1. Energy management by W.R. Murphy AND G. Mckay Butter worth, Heinemann publications.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1999.

REFERENCE BOOKS

1. Energy efficient electric motors by John.C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995-
2. Energy management hand book by W.C.Turner, John wiley and sons
3. Energy management and good lighting practice: fuel efficiency- booklet 12-EEO

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Describe the significance of energy audit in industries
2. Predict management of energy systems
3. Sequence the methods of improving efficiency of electric motor
4. Analyze the power factor and to design a good illumination system
5. Determine pay back periods for energy saving equipment

EE1011	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the basic issues, policy and challenges in the Internet
- To get an idea of some of the application areas where Internet of Things can be applied.
- To understand the cloud and internet environment.
  To understand the various modes of communications with Internet.

Unit – I Introduction: Challenges and Issues - Identification - Security. Components in internet of things: Control Units – Sensors – Communication modules –Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks –Mobile Internet – Wired Communication-IoT Platform Overview-Raspberry pi-Arduino boards.

Unit – II IoT Protocols: Protocol Standardization for IoT-M2M and WSN Protocols-SCADA and RFID Protocols-Issues with Iot Standardization-Protocols-IEEE 802.15.4-BACNet Protocol-Zigbee Architecture - Network layer – APS Layer – Security.

Unit – III Resource Management in the Internet of Things: Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object – Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things

Unit – IV Case Study and IoT Application Development: IoT applications in home-infrastructures security-Industries- IoT electronic equipments. Use of Big Data and Visualization in IoTIndustry 4.0 concepts - Sensors and sensor Node –Interfacing using Raspberry Pi/Arduino- Web Enabled Constrained Devices.

Unit – V Web of Things: Web of Things versus Internet of Things-Architecture Standardization for WoT-Platform Middleware for WoT- WoT Portals and Business Intelligence-Cloud of Things: Grid/SOA and Cloud Computing-Cloud Standards –Cloud of Things Architecture-Open Source e-Health sensor platform.

TEXT BOOKS

1. Honbo Zhou," The Internet of Things in the Cloud: A Middleware Perspective" — CRC Press-2012.
2. Dieter Uckelmann, Mark Harrison, "Architecting the Internet of Things", Springer2011.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.

REFERENCE BOOKS

1. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
2. Luigi Atzori, Antonio Lera, Giacomo Morabito, "The Internet of Things: A Survey", Journal on Networks, Elsevier Publications, October, 2010.

COURSE OUTCOMES

At the end of the course, the students will be able to

1. Identify the components of IoT
2. Analyze various protocols of IoT
3. Design portable IoT using appropriate boards
4. Develop schemes for the applications of IOT in real time scenarios
5. Design business Intelligence and Information Security for WoT

EE1012	DIGITAL CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the importance of sample data control system.
- To give adequate knowledge about signal processing in digital control.
- To study the importance of modelling of discrete systems and stability analysis of discrete data system.
- To study the importance of state space representation for discrete data system.
- To introduce the design concept for digital controllers

UNIT I PRINCIPLES OF CONTROLLERS

Review of frequency and time response analysis and specifications of control systems, need for controllers, continues time compensations, continues time PI, PD, PID controllers, digital PID controllers.

UNIT II SIGNAL PROCESSING IN DIGITAL CONTROL

Sampling, time and frequency domain description, aliasing, hold operation, mathematical model of sample and hold, zero and first order hold, factors limiting the choice of sampling rate, reconstruction.

UNIT III MODELING AND ANALYSIS OF SAMPLED DATA CONTROL SYSTEM

Difference equation description, Z-transform method of description, pulse transfer function, time and frequency response of discrete time control systems, stability of digital control systems, Jury's stability test, state variable concepts, first companion, second companion, Jordan canonical models, discrete state variable models, elementary principles.

UNIT IV DESIGN OF DIGITAL CONTROL ALGORITHMS

Review of principle of compensator design, Z-plane specifications, digital compensator design using frequency response plots, discrete integrator, discrete differentiator, development of digital PID controller, transfer function, design in the Z-plane.

UNIT V PRACTICAL ASPECTS OF DIGITAL CONTROL ALGORITHMS

Algorithm development of PID control algorithms, software implementation, implementation using microprocessors and microcontrollers, finite word length effects, choice of data acquisition systems, microcontroller-based temperature control systems, microcontroller-based motor speed control systems.

TEXT BOOKS

1. M.Gopal, "Digital Control and State Variable Methods", 4th Edition, Tata McGraw Hill, New Delhi,2012.
2. Constantive Houpis and Stuart N Shelton, "Linear Control System Analysis and Design with MATLAB", 6th Edition, CRC Press, 2013.
3. Kenneth J Ayala, "The 8051 Microcontroller Architecture Programming and Applications", Penram International, 2nd edition, 2005.

REFERENCE BOOKS

1. B.C. Kuo, "Digital control systems", Second Edition, Oxford University press, 2007.
2. P.B. Deshpande and R.H.Ash, 'Computer Process Control', ISA Publication, USA, 1995.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

1. Realize the importance of controllers in controlled system design.
2. Recognize the need of signal processing in digital control design
3. Represent discrete time systems under the form of z-domain transfer functions and state-space models.
4. Analyze stability, transient response and steady state behaviour of linear discrete-time systems, analytically and numerically
5. Develop control algorithm for implementation of digital control in practical applications