Academic Program: UG

Academic Year 2021-22 Syllabus

V & VI Semester B. E.

Electrical & Electronics Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002
(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi
Department Accredited by NBA under Tier-1 (July 2018-June 2022)**)**

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for V & VI semester B.E. in Electrical & Electronics Engineering is recommended by the Board of Studies of Electrical and Electronics Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Principal Chairman BoS & HoD

SDM College of Engineering & Technology, Dharwad
Department of Electrical & Electronics Engineering
*(**Our motto:** Professional **C**ompetence with **P**ositive **A**ttitude)*

College Vision and Mission

Vision

To develop competent professionals with human values

Mission

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture
- To involve Industrial Expertise for connecting classroom content to real life situations.
- To inculcate Ethics and impart soft-skill leading to overall Personality Development.

QUALITY POLICY:

In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

CORE VALUES:

Competency

Commitment

Equity

Team work and Trust

DEPARTMENT VISION AND MISSION

Vision:

To develop globally acceptable Electrical and Electronics Engineering professionals with human values.

Mission:

- Adopting the state of the art curricula
- Practicing effective and innovative teaching-learning methodologies
- Initiating complementary learning activities to enhance competence
- Inculcating positive attitude and commitment to society.

Program Educational Objectives (PEOs)

I. To impart the domain knowledge and soft skills to secure employment or become entrepreneur or pursue higher studies.

II. To provide training for teamwork, leadership qualities, lifelong learning and adaptability to achieve professional growth.

III. To develop sense of positive attitude and practice ethics to contribute positively to the society as a responsible citizen.

POs and PSOs

PO 1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO 2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4.**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5.**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6.**The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7.**Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8.**Ethics:** Apply ethical principles and commit to professional ethics responsibilities and norms of the engineering practice.

PO 9.**Individual and Team work:** Function effectively as an individual and as a member or leader in diverse teams and individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11.**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12.**Life-long Learning:** long learning: Recognize the need for and have the Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PSO-1 Enhancement of professional competence in cutting edge domain through value addition activities.

PSO-2 Ability to demonstrate the skill of carrying out operation and Maintenance of electrical distribution system effectively.

PSO-3 Design and implement the electronic circuits/programs for practical applications.

Department of Electrical & Electronics Engineering

V Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UHUC500	HU	Management, Entrepreneurship and IPR	4-0-0	4	50	100	3	-	-
18UEEC500	PC	Electromagnetic Theory	3-0-0	3	50	100	3	-	-
18UEEC501	PC	Electrical Machines-II	4-0-0	4	50	100	3	-	-
18UEEC502	PC	Power Electronics	4-0-0	4	50	100	3	-	-
18UEEC503	PC	Digital Signal Processing	3-0-0	3	50	100	3	-	-
18UEEE51X	PE	Elective –I	3-0-0	3	50	100	3	-	-
18UEEL505	PC	Electrical Machines-I Lab	0-0-3	1.5	50	-	-	50	3
18UEEL506	PC	Power Electronics Lab	0-0-3	1.5	50	-	-	50	3
18UEEL507	PC	Minor Project-I	0-0-3	1	50	-	-	-	-
18UHUL507	HU	Soft Skills/Aptitude	0-0-2	1	50	-	-	-	-
		Total	**21-0-12**	**26**	**500**	**600**		**100**	

HU- Humanity, PC- Program Core and PE-Professional Elective
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

Elective-I	
18UEEE511	Data Structures and Algorithm
18UEEE512	Object Oriented Programming Structure
18UEEE513	Internet of Things (IoT)

VI Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UEEC600	PC	Power System Analysis and Stability	4-0-0	4	50	100	3	-	-
18UEEC601	PC	High Voltage Engineering and Switchgear & Protection	4-0-0	4	50	100	3	-	-
18UEEE62X	PE	Elective -II	3-0-0	3	50	100	3	-	-
18UEEE63X	PE	Elective–III	3-0-0	3	50	100	3	-	-
18UEEO604	OE	Open-Elective-I	3-0-0	3	50	100	3		
18UEEL605	PC	Electrical Machines-II Lab	0-0-3	1.5	50	-	-	50	3
18UEEL606	PC	Sensors, Control systems and simulation Lab	0-0-3	1.5	50	-	-	50	3
18UEEL607	PC	Minor Project-II	0-0-6	2	50	-	-	50	3
18UHUL605	HU	Soft Skills / Aptitude	0-0-3	1	50	-	-	-	-
		Total	**17-0-15**	**23**	**450**	**500**		**150**	

PC- Program Core, PE-Professional Elective and OE- Open Elective
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

18UEEO604	Renewable Energy System **(Open Elective-I)**		
Electives - II		**Electives - III**	
18UEEE621	Computer Organization	18UEEE631	Electrical Estimation Specification Codes and Practices
18UEEE622	Computer Communication and Networking	18UEEE632	Nonlinear Control Theory
18UEEE623	PIC Microcontrollers	18UEEE633	Energy Auditing and Demand Side Management
18UEEE624	VLSI Circuits	18UEEE634	Testing and Commissioning of Electrical Equipment
18UEEE625	Software Engineering	18UEEE635	Electrical Drawing and CAD
18UEEE626	Digital Image Processing	18UEEE636	Operating System
18UEEE627	Database Management System	18UEEE637	PLC and SCADA
18UEEE628	Digital System Design using VHDL	---	

V Semester

18UHUC500	**Management, Entrepreneurship and Protection of Intellectual Property**	**(4-0-0) 4**

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn the evolution of Management, the organization structure encompassing planning, organizing, decision making and execution. They will also learn about the concept and scope of entrepreneurship in small, medium, large and Government owned Industries and the issues related to copyright, patents, in all, protection of Intellectual property.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the Engineering and Management history and planning.	11	2	
CO-2	Explain the concepts of organizing, staffing, motivating and controlling.	11	2	
CO-3	Recite the foundations of entrepreneurship, small scale industry, Government and Institutional Support.	11		
CO-4	Exhibit the skills of writing project report and describe issues related to IPRs.	11		12
CO-5	Comprehend the concepts of patents, trademarks and industrial design.	11		

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level		2.0									3.0	1.0			

Prerequisites: 1.A course on Humanities (preferred)

Contents:

Unit-I

Engineering and Management: Historical Development of Engineering, Management, and synthesis.

Planning, Forecasting and Decision Making: Nature of Planning, the foundation of planning, some planning concepts, forecasting, nature of decision making, management science, tools for decision-making, CPM/PERT- Examples. **10 Hrs.**

Unit-II

Organizing and staffing: Nature of organizing, traditional organizational theory, technology and modern organization structures, staffing technical organization, authority and power; delegation of power, meeting & committees.

Motivating: Motivation, leadership, motivating and leading technical professionals.

Controlling: Process of control, financial controls, non-financial controls, Examples. **10 Hrs.**

Unit-III

Foundations of Entrepreneurship: Meaning, functions and types of entrepreneur. Concept of entrepreneurship, role of entrepreneurs in economic development, barriers of entrepreneurship.

Small Scale Industry: Definition, characteristics, objects, role of SSI in economic development, advantages of SSI, steps to start SSI, impact of liberalization, privatization, and globalization on SSI, definition of ancillary and tiny industry.

Government and Institutional Support: Support from government, objectives and functions of SISI, SIDBI, DIC, single window agency, KIADB, KSSIDC, KSFC. **12 Hrs.**

Unit-IV

Preparations for Project: Meaning of project identification, project report, contents and formulation, identification of business opportunities, feasibility studies, types and purpose, Case study of project report.

Intellectual Property Right: Meaning and forms of intellectual property right, competing rationale for protection, international conventions, world court.

Copyright: Meaning and content, ownership and rights, period, assignment, relinquishment, license, infringement, fair use, offenses and penalties. **10 Hrs.**

Unit-V

Patents: Concept, patentable inventions, procedure for obtaining patent, rights and obligations of patent holders, infringements and remedies, offenses and penalties.

Industrial Designs: Definition, procedure for registration, rights conferred registration, infringements. **Trademarks:** Concept and significance. **10 Hrs.**

Reference Books:

1) Thomas W. Zimmerer, “Essentials of Entrepreneurship”,2/e PHI, 2005.
2) Daniel L. Babcock, “Managing Engineering and Technology”, 4/e, PHI,2010.
3) Peter Drucker, “The Practice of Management”1/e, Business & Economics, 26-Jul-2012.
4) N.K.Acharya, ”Text book on Intellectual Property Rights”, 4/e, Asia Law House,2012.

18UEEC500	Electromagnetic Theory	(3- 0- 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about the vectors, scalars and use of the same for field analysis. They are also learning the concepts of energy and potential. They will come to know the behavioral aspects of conductors, dielectrics and capacitance. Further they will know about the time varying field and wave propagation.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO’s(1 to 12)/PSO’s(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the concepts of vectors, Coulomb’s law and its applications	1,2		
CO-2	Describe Gauss’s law and its applications, energy density and potential.	1,2		
CO-3	Exhibit the knowledge of properties of conductors, dielectrics, capacitance and applications of Poisson’s and Laplace’s equations	1,2		
CO-4	Illustrate the knowledge of steady magnetic fields and magnetic forces.	1,2		
CO-5	Comprehend the concepts of time varying fields and analyze uniform plane waves.	1,2		

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0													

Prerequisites: 1.Elementary Physics 2. Mathematics 3. Basic Electrical Engg.

Contents:

Unit-I

Vector analysis: Scalars and vectors, vector algebra, Dot & cross products, Cartesian, cylindrical and spherical coordinate system.

Coulomb's law and Electric field Intensity: Field due to a continuous volume charge distribution, Field of a line charge and of a sheet charge. **08 Hrs.**

Unit-II

Electric flux density: Gauss's law and Divergence, Electric flux density Divergence, Divergence theorem.

Energy and Potential: Energy expended in a moving point charge in an Electric field. Concept of potential and potential differences. Potential due to point charge and system of charges. Potential gradient, energy density in electric field. **09 Hrs.**

Unit-III

Conductors, dielectrics and capacitance: Continuity of current, conductor property and boundary conditions, Boundary conditions for perfect dielectric materials, capacitance calculations for different configurations.

Poisson's and Laplace's equations: Poisson's and Laplace's equations, Uniqueness theorem, examples of the solution of Laplace & Poisson equations.

08 Hrs.

Unit-IV

The steady magnetic field: Biot-Savart Law, Ampere Circuital Law, Curl, the scalar and vector magnetic potentials.

Magnetic forces: Force on a moving charge, force on a differential current element, Force Between differential current elements, magnetic boundary conditions. **07 Hrs.**

Unit-V

Time Varying Fields & Maxwell's Equations: Faraday's Law, Displacement current, Maxwell's equations in point form and integral form.

The Uniform Plane wave: Wave propagation in free space, wave propagation in dielectrics, Poynting Vector and power considerations, propagation in good conductors and skin effect. **07 Hrs.**

Reference Books:

1) William H. Hayt Jr., John A. Buck, "Engineering Electro Magnetics", 7/e TMH,2006.

2) Ganesh Rao, "Engineering Electromagnetics",1/e, Pearson Education India,2011.
3) John Krauss & Daniel A Fleisch, "Electromagnetics with Applications" 5/e, McGraw Hill,2010.

18UEEC501	Electrical Machines-II	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn the basic principle, construction, operation and performance of Induction machines, the basic principle, construction, operation and performance of synchronous machines, the transient behavior and dynamics of machines.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the Principle of operation with Phasor diagram, & Torque - slip curves, Equivalent circuit and carry out performance calculations. Understand the operation of Induction Generators.	1,2		
CO-2	Understand aspects of starting, braking and Speed control of 3-phase induction motor and explain role of Deep bar rotor and double cage ions for performance control Explain and analyze Construction, working and starting of 1 phase induction motor	1,2		
CO-3	Understand and analyze construction, working and performance of synchronous generator.	1,2		

CO-4	Determine voltage regulation of synchronous generator by different approaches Understand and analyze Parallel operation and operation on infinite bus.	1,2		
CO-5	Understand and analyze the starting, working and performance of synchronous motor Understand aspects of Dynamic Performance of Synchronous machine.	1,2		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0													

Prerequisites: 1.Basic Electrical Engineering 2. Network analysis

Contents:

Unit-I

Basics and performance of 3 phase induction machine: Principle of operation of 3 phase induction motor, Phasor diagram, Torque - slip curves, Equivalent circuit and performance calculations. No load and locked rotor tests. Circle diagram. Starting of 3 phase induction motor. Types of starters. Induction Generators.

12 Hrs.

Unit-II

Single Phase Induction Motor: Construction, Double revolving field theory. Equivalent circuit, Determination of parameters of equivalent Circuit by tests, Methods of starting.

Control of Induction Motors: Speed control types. Control of rotor slip power of wound rotor induction motors. Electrical braking. Deep bar rotor and double cage induction motors. **10 Hrs.**

Unit-III

Basics of Synchronous Generators: Construction, Advantages of rotating field, emf equation, effects of harmonics on generated emf. Poly-phase armature windings, Phasor diagram of a synchronous generator with cylindrical rotor. **08 Hrs.**

Unit-IV

Performance of Synchronous Generators: Voltage regulation by emf, mmf, Potier triangle and ASA methods. Parallel operation. Operation on Infinite bus, operating characteristics and Power flow equations. **12 Hrs.**

Unit –V

Synchronous Motors : Principle of operation, Methods of starting, phasor diagram, effect of changing excitation, two reaction model, Synchronous Condensers**.**

Electrical transients in synchronous machines: Effect of damper windings. Effect of D.C. components. Expressions for reactance and time constants. Dynamics of Synchronous machines pull in phenomenon. Oscillations in synchronous machines. **10 Hrs.**

Reference Books:

1) D. P Kothari & I. J. Nagrath, "Electrical Machines", 3/e, TMH,2010.
2) M. G. Say "Performance and Design of A.C Machines", 3/e, CBS publications 2004.
3) P. S. Bimbra, " Electric Machinery", 3/e, Khanna publishers,2003.
4) Ashfaq Hussain "Electric Machines", 2/e, Dhanpathrai & Sons, 2004.
5) Electrical Machinery fundamentals by Stephen J. Champan 4th edition TATA Mcgraw- Hill

18UEEC502	Power Electronics	(4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn the concept of Power Electronics and different types of switching devices, their control, performance characteristics & applications. They also learn about the principle of commutation of SCRs, the working principles of AC-AC, AC-DC, DC-DC and DC-AC converters and to analyze the working of various types of converter circuits with different types of loads connected across them.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the basics and significance of Power Electronics with the important devices &circuits.	1		

CO-2	Analyze the performance and protection aspects of power MOSFET and IGBT.	1,2		
CO-3	Describe the performance of SCR and its firing circuits.	1,2		
CO-4	Carry out performance analysis of AC Voltage Controllers.	1,2		
CO-5	Carry out performance analysis of DC Choppers.	1,2		
CO-6	Carry out performance analysis of 1-phase & 3-phase Controlled Rectifiers.	1,2		
CO-7	Carry out performance analysis of1-phase & 3-phase inverters and explain PWM technique and CSI.	1,2		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0													

Prerequisites: 1. Basic Electronics

Contents:

Unit-I

Introduction: Types of Power Electronic circuits; Important Power semiconductor devices and their control characteristics; Applications of Power Electronics; Peripheral effects.

Power Transistors: Power MOSFET and Power IGBT: Switching characteristics; Gate drive; Heat Sinks. **10 Hrs.**

Unit-II

Power Transistor Protection & Application: di/dt limitations, Snubbers, Inductor design, MOSFET & IGBT Applications.

Thyristors: SCR: Working; Characteristics; Two transistor model; Firing circuits using op-amps and digital IC'S. **10 Hrs.**

Unit-III

AC Voltage Controllers: TRIAC characteristics and applications; Single-phase bi-directional controllers with R, R-L loads; Principle of working Cyclo converter.

DC Choppers: Step-down chopper: Principle of operation; Performance parameters, Chopper classification, Analysis with R, R-L, R-L-E_b loads; Applications. Step-up chopper: Principle of operation; Analysis; **12 Hrs.**

Unit-IV

Controlled Rectifiers: Principle of operation of controlled rectifier; Performance of Single phase semi converters and full converters; Working of dual converters; Performance of Three phase half Controlled and full Controlled converters. **10 Hrs.**

Unit-V

Inverters: Single phase inverters: Bridge configuration; Principle of operation; Performance parameters; Voltage control; PWM techniques; Applications. Current Source Inverter: Working; Applications. Three phase inverters: Performance; Applications. **10 Hrs.**

Reference Books:

1) M. H. Rashid “Power Electronics”, 3/e, Prentice Hall of India Pvt. Ltd, Pearson, 2009.
2) G. K. Dubey, S. R. Doradla, A Joshi & Sinha ”Thyristorised Power Controllers”, 2/e, New Age International (P) Ltd., Publishers, 2003.
3) M. D. Singh and Khanchandani K. B. Power Electronics, 2/e TMH, 2001.
4) Daniel W. Hart “Power Electronics”,1/e,McGraw-Hill, 2011.
5) P. C. Sen–“Power Electronics”,1/e, Tata McGraw-Hill Education, 1987.

18UEEC503	Digital Signal Processing	(3- 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn to analyze sampled data, compare DFT and FFT algorithms in terms of computation burden and memory requirement. Further, they learn to design IIR filters, FIR filters, make use of IIR and FIR filters for different Applications, realize filters in different forms and about the Architecture and capabilities of DSP.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to exhibit :		Mapping to PO's(1 to 12)/PSO's(1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Computation of DFT, IDFT by direct method. Application of properties. Computation of circular and linear convolution.	2		
CO-2	Computation of DFT, IDFT using DIT and DIF algorithms. Comparison of algorithms with direct method with direct method.	2		
CO-3	Realization of digital systems.	2		
CO-4	Design IIR filters for given specifications.	3		
CO-5	Design FIR filters for given specifications. Architecture of Fixed point and floating point Digital signal processors and their applications.	3		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level		3.0	3.0												

Prerequisites: 1.Engineering Mathematics 2. Signal and Systems 3. Network Analysis

Contents:

Unit-I

Discrete Fourier transforms (DFT) and its properties-linearity, shift and symmetry etc., circular convolution-periodic convolution, use of tabular arrays, circular arrays, stock ham's methods, linear convolution-two finite duration sequences, one finite & one infinite duration **08 Hrs.**

Unit-II

Fast Fourier transforms (FFT) algorithm: Decimation in time algorithm, decomposition, number of computations, continuation of decomposition, number of multiplications, computational efficiency, decimation in frequency algorithm. **08 Hrs.**

Unit-III

Realization of digital systems using block diagrams & SFGs, matrix representation, realization of IIR systems-direct form, cascade form, parallel form, realization of FIR systems-direct form, cascade form, linear phase realizations. **08 Hrs.**

Unit-IV

Design of IIR Digital filters by Impulse Invariant & Bilinear Transformations, all pole analog filters – Butterworth & Chebyshev, design of digital Butterworth & Chebyshev filters, frequency transformations. **08 Hrs.**

Unit-V

Design of FIR Digital filters by using rectangular, modified rectangular, Hamm, Hamming, generalized hamming windows, Kaiser window, frequency sampling technique. Fixed and floating DSP processors and their applications. **07 Hrs.**

Reference Books:

1) Proakis - Digital Signal Processing: Principle, Algorithms and Applications, 4/e, Pearson Education, PHI, 2007.
2) Oppenheim - Digital Signal Processing, 2/e, Pearson Education, PHI, 2008.
3) Salivahanan, Vallavaraj, Gnanapriya - Digital Signal Processing,2/e TMH,
4) Ifeachor & Jervis - Digital Signal Processing,3/e Pearson Education, 2004.
5) A Nagoorkani, “Digital Signal Processing”,2/e Tata McGraw Hill Education Pvt. Ltd,2013.

18UEEL505 Electrical Machines- 1 Lab (0–0–3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The students are expected to learn realization of theoretical concepts and verify practically. They will be learning to conduct experiments on DC machines, single phase and three phase transformers to determine the performance characteristics.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO’s(1 to 12)/PSO’s(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Conduct experiments to	9	2	4,8

	determine the performance parameters of DC machines			
CO-2	Conduct experiments to determine the performance parameters of single phase transformers.	9	2	4,8
CO-3	Conduct experiments to determine the performance parameters of three phase transformers.	9	2	4,8
CO-4	Carry out phase conversion	9	2	4,8

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level		2.0		1.0				1.0	3.0						

Prerequisites: 1. Electrical machines

Contents: Minimum of 10 experiments to be conducted from the list given below.

Prescribed Experiments:

OCC and external characteristics of DC shunt generator.

1. Speed control of DC shunt motor by a) Rheostat control b) Flux control.
2. Load test on DC shunt motor.
3. Field test on DC series machines.
4. Swinburne test.
5. Hopkinson test.
6. Ratio and Polarity test on transformer.
7. OC and SC tests on 1- Φ transformers.
8. Sumner's test.
9. Scott connection.
10. Parallel operation of 1- Φ transformers.
11. Load test on 3-phase transformers.

Reference Books:

1) Lab. Manual.
2) D.P. Kothari & I.J. Nagrath- "Electrical Machines", 3/e, TMH,2010.
3) Ashfaq Hussain- "Electric Machines", 2/e, Dhanpatrai & Sons, 2004.

18UEEL506	Power Electronics Lab	(0 - 0 - 3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The students are expected to learn conducting experiments on power semiconductor devices plot the characteristics and compare the same with the theoretical characteristics. They will learn to rig up different triggering circuits and commutation circuits. They learn to verify for the waveforms and other performance parameters of the converter circuits with different loads.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Relate the theoretical concepts to the experiment	1,2,3	5	4
CO-2	Choose and use appropriate equipment's, tools and procedures for the execution of the experiment	5		4
CO-3	Design and conduct the experiments and infer results	3	5	4
CO-4	Committed to professional ethics, self-learning, punctual and confident	8,9,12	5	4
CO-5	Neat representation of the experiment in oral and written form	10	5	4

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	3.0	3.0	3.0	1.0	2.2			3.0	3.0	3.0		3.0			

Prerequisites: Power Electronics.

Contents: Minimum of 10 experiments to be conducted from the list given below.

Prescribed Experiments:

1) Static Characteristics of SCR.
2) Static Characteristics of MOSFET and IGBT.
3) SCR turn-on circuit using synchronized UJT relaxation oscillator.
4) SCR turn-off circuits using (i) LC Circuit(ii) auxiliary commutation.
5) Synchronized UJT firing circuit for HWR circuits.
6) Generation of Firing Signals using TL494 IC.
7) Generation of firing signals for thyristors using Microprocessor.
8) AC voltage controller using Triac – Diac combination.
9) Single phase FWR with R and RL loads.
10) Voltage (Impulse) commutated chopper – both constant frequency and variable
11) frequency operations.
12) Speed control of a separately excited DC motor.
13) Speed control of single phase induction motor.
14) Parallel/Series Inverters.

Reference Books:

1) Lab. Manual.
2) M. H. Rashid, "Power Electronics", 3/e, Prentice Hall of India Pvt. Ltd, Pearson, 1988.
3) G. K. Dubey, S. R. Doradla, A Joshi & Sinha," Thyristorised Power Controllers", New Age International (P) Ltd., Publishers, 2003.

18UEEL507	Minor Project-1	(0-0-3) 1

Contact Hours: 36

Course Learning Objectives (CLOs):

The course is included to provide an exposure, focusing more on the domain related problem definitions, building prototypes which can lead to take up the project in the higher semester(s). The work based on using the concepts studied in the core/elective courses studied shall be used to formulate the problem. They are also required to learn to find related material, use appropriate tool to obtain the solution and prepare a report based on the work carried out.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify the domain related problem and formulate a	6		9

	problem statement			
CO-2	Propose the technical approach towards the solution.	11	4	9
CO-3	Implement the solution.	4	11	9,10
CO-4	Prepare the report in a specified format.	10		9

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level				2.5		3.0			1.0	2.0	2.5				

Contents:

Domain related problems, Technical solutions and recommendations.

Evaluation:

The team consisting of 10-12 students shall be asked to identify the problems related to community and try to propose the solution. The faculty members handling the courses for that semester shall guide the students. A committee consisting of minimum 3 faculty members shall evaluate at the end for CIE. There is no SEE for Minor project-1.

18UHUL507 Soft Skills/Aptitude (0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs):

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the significance of communication in the profession.		10	
CO-2	Use the English language with proficiency		10	12
CO-3	Solve Aptitude related problems		9	12

CO-4	Demonstrate the competency in the placement activities.		9	

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level									2.0	2.0		1.0			

Contents:

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

18UEEE511 Data Structures and Algorithm (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn basic features of programming language, a abstract data types and its use in solving given any problem. They will be learning how to use of data structures in application development. They are exposed to standard algorithms and analysis.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain different features of programming language in C & C++.	1	2	
CO-2	Code to implement stack and operations of stack using arrays and pointers.	5	2	
CO-3	Code to implement Queues and	5	2	

	tree using arrays and pointers.			
CO-4	Explain the operations of searching and sorting techniques using code	5	2	
CO-5	Design an algorithm for different optimization techniques and applications.	5	2	

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	2.0			3.0										

Prerequisites: Programming experience in C/C++.

Contents:

Unit-I

Basic Programming Features: Data types, Memory allocation, arrays, structures, unions, pointers, recursion and file operations**,** **08 Hrs.**

Unit-II

Abstract Data Types: Conceptualization. Implementation of operations on Stack including display and searching using arrays and pointers(Linked List) **08 Hrs.**

Unit-III

Implementation of: Queues, Circular queues, double ended queue, priority queue and Trees using arrays and pointers(Linked List). **08 Hrs.**

Unit-IV

Searching and Sorting Techniques: Conceptualization, Implementation of: Linear and Binary search, Hashing, sorting techniques: bubble sort, insertion sort, selection sort, quick sort, merge sort, heap sort. **08 Hrs.**

Unit-V

Algorithm Design: Divide and Conquer method and applications (Max-Mm), Greedy strategy method and applications (Job sequencing, Optimal merge patterns),Dynamic Programming method and applications (Multistage graphs, travelling sales problem), Backtracking method and applications (Sum of sets) Branch and Bound method and applications (Travelling Sales problem. **07 Hrs.**

Reference Books:

1) Yedidyah, Augenstein and Tenenbaum, "Data Structures Using C and C++',2/e, PHI- India,2011.
2) E. Balagurusamy, "Programming in ANSI C", 4/e, Tata McGraw-Hill.
3) Sartaj Sahni, "Data Structures, Algorithms and Application in C++", 2/e,University Press, 2005.

4) Thomas H Coreman, Charles E Leiserson& Ronald L Rivest, "Introduction to Algorithms", 1/e, Prentice Hall of India, August 2000.
5) Adam Drozdek, "Data Structures & Algorithms in C++", 2/e, Vikas Publishing House, 2004.

18EEE512 Object Oriented Programming Structure (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

Define Encapsulation, Inheritance and Polymorphism. Solve the problem with object oriented approach. Analyze the problem statement and build object oriented system model. Describe the characters and behavior of the objects that comprise a system. Explain function overloading, operator overloading and virtual functions. Discuss the advantages of object oriented programming over procedure oriented programming.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the basics of Object Oriented Programming concepts	1,2		
CO-2	Use the concepts of Functions, Classes and Objects	2	1,5	
CO-3	Describe the concept of Constructors, Destructors and Operator Overloading	2	1,5	
CO-4	Effectively use concept of functions and abstract class in programs.	2,5	1	
CO-5	Utilize I/O operations and file streams in programs.	2,5	1	

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	2.2	3.0			2.25										

Prerequisites: C Programming

Contents:

Unit-I

Beginning with C++ and its Features: What is C++?, Applications and structure of C++ program, Different Data types, Variables, Different Operators, expressions, operator overloading and control structures in C++ . **08 Hrs.**

Unit-II

Functions, Classes and Objects: Functions, Inline function, function overloading, friend and virtual functions, Specifying a class, C++ program with a class, arrays within a class, memory allocation to objects, array of objects, members, pointers to members and member functions. **08 Hrs.**

Unit-III

Constructors, Destructors and Operator Overloading: Constructors, Multiple constructors in a class, Copy constructor, Dynamic constructor, Destructors, Defining operator overloading, Overloading Unary and binary operators, Manipulation of strings using operators. **08 Hrs.**

Unit-IV

Inheritance, Pointers, Virtual Functions, Polymorphism: Derived Classes, Single, multilevel, multiple inheritance, Pointers to objects and derived classes, this pointer, Virtual and pure virtual functions. **08 Hrs.**

Unit-V

Streams and Working with Files: C++ streams and stream classes, formatted and unformatted I/O operations, Output with manipulators, Classes for file stream operations, opening and closing a file, EOF. **07 Hrs.**

Reference Books:

1) Object Oriented Programming with C++ E. Balaguruswamy, TMHTMH 6thEdition, 2013
2) Object Oriented Programming with C++ Robert Lafore Galgotia publication 2010
3) Object Oriented Programming with C++ SouravSahay Oxford University 2006.

18EEE513	Internet of Things (IoT)	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn the basic concept of Internet of things, its general architecture, technology and the design principles behind it.The students are required to get exposure to the handling of data and understand the concept of cloud paradigm being used in IoT environment. Students are also required to understand the role of sensors in IoT and the basics of embedded computing besides understanding certain case studies on IoT application.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the fundamental concept of IoT, design principles and different communication technologies used in IoT paradigm.	1,5		
CO-2	Recite the different data handling protocols and aspects of cloud computing as applicable to IoT.	1,5		2,3
CO-3	Explain the different types of sensors and the data communication protocols for these sensors as applicable to IoT.	1,5		2,3
CO-4	Select a suitable embedded platform for the IoT application.	1,5		2,3
CO-5	Analyze the smart grid technology and different other case studies based on IoT applications.	2		

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	3.0	1.5	1.0		3.0	3.0									

Prerequisites: 1.Any one basic programming language 2. Digital Electronics
3. Microcontrollers

Contents:

Unit-I

Overview of IoT: Definitions, vision, smart and hyper connected devices. IoT conceptual framework, IoT architectural view. Technology behind IoT, major components of IoT system, sources of IoT. M2M communication

Design principles for connected devices: Introduction, systems, layers and design standardization-modified OSI model for IoT. ITU-T reference model.

Communication technology: Wireless communication technology, RFID, ZigBee IP, Wi-Fi, Wired communication technology, Comparison of communication technologies. **08 Hrs.**

Unit-II

Data handling and Cloud computing paradigm: Introduction to internet based communication, protocols, version 4 and 6, TCP IP suite, IP addressing in IoT.

Data handling: Introduction, data acquiring and storage, organizing data, data analytics.

Cloud computing: Introduction, computing methods, deployment methods, everything as a service, service models, services using Nimbits, public platforms. **08 Hrs.**

Unit-III

Sensors and network: Sensor technology, analog and digital sensors, examples, sensing the things-barcodes, QR codes, motion sensors, pressure sensors, environmental monitoring sensors, participatory sensing, industrial IoT, actuators.

Data communication protocols for sensors: RFID technology-Principle, design challenges, wireless sensor networks technology. **08 Hrs.**

Unit-IV

Embedded computing basics: Embedded software and hardware units, embedded platform for prototyping-Arduino, Intel Galileo, Intel Edison, Raspberry Pi, Beagle bone, things always connected to the cloud. Prototyping embedded device software, Devices, gateways, Internet and web/cloud services **08 Hrs.**

Unit-V

IoT applications and Case studies: Introduction to smart grid and a possible IoT based smart grid, Smart home, smart cities, Street light control and monitoring. **07 Hrs.**

Reference books:

1) Internet of Things, Architecture and design principles, Raj Kamal, McGraw Hill Publication, 2017
2) David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome
3) Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
4) Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017
5) Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN: 978-8173719547)

VI Semester

18UEEC600 Power System Analysis and Stability (4 - 0- 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn the importance of per unit computation. How to draw per unit diagram of a given power system. How to analyze symmetrical three phase short circuit on an unloaded synchronous generator. How the circuit breakers are rated? About the symmetrical components of currents and voltages. How to analyze the unsymmetrical faults in a power system. About the steady state & transient stability analysis of power system.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the basics of power system and compute per unit representation.	1,2		
CO-2	Analyze symmetrical faults.	1,2		
CO-3	Describe concepts of symmetrical components & sequence network and solve related numerical.	1,2		
CO-4	Analyze unsymmetrical faults.	1,2		
CO- 5	Analyze steady state and transient stability.	1,2		

PO's	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO - 1	PSO - 2	PSO - 3
Mapping Level	3.0	3.0													

Prerequisites: 1.Network Analysis
2.Switchgear and Protection
3.Electrical Power Generation & Transmission
4. Electrical Machines.

Contents:

Unit-I

Representation of Power system Components: Standard symbols of power system components, one line diagram, impedance and reactance diagram, per unit quantity-definition, per-unit impedance of three phase components, selection of base value, change of base, equivalent load impedance, per unit impedance of two-winding transformer referred to primary and secondary, method to draw p. u. impedance diagram of a power system and advantages of p. u. computations.

09 Hrs.

Unit-II

Symmetrical 3 - Phase faults:3-phase short circuit at the terminals of unloaded generator, definition of sub- transient, transient and steady state reactance, examples on sub- transient current calculations in unloaded power systems, internal emfs of loaded machines, selection of circuit breaker ratings- momentary current and interrupting capacity. **09 Hrs.**

Unit-III

Symmetrical components: Definition of symmetrical components as applied to 3-phase unbalanced systems, operator 'a' and its properties, resolution of unbalanced phasors into their symmetrical components. Expressions for sequence components, examples on calculations of symmetrical components of unbalanced load against balanced 3-phase supply. Phase shift of symmetrical components in star-delta transformer bank, Power in terms of symmetrical components.

Sequence Networks: Sequence impedances and sequence networks. Sequence impedance of power system elements, positive, negative and zero sequence networks of 3-phase generator, transmission lines, 3-phase loads and transformers**.**

12 Hrs.

Unit-IV

Unsymmetrical faults: L-G, L-L, L-L-G faults on an unloaded alternator without and with fault impedance, Derivation of connection of sequence networks, Unsymmetrical faults on power system without and with fault impedance, Derivation

of connection of sequence networks, examples on calculation of unsymmetrical fault currents. **12 Hrs.**

Unit-V

Power System Stability: Definition of Steady state stability – Transient state stability, Stability limits, Assumptions made in Transient Stability studies, classification, power angle equation, swing equation, synchronizing power co-efficient, equal area criterion (EAC) of stability and EAC applications, numerical problems, factors affecting transient stability and recent trends. **10 Hrs.**

Reference Books:

1) W. D. Stevenson, "Elements of Power System Analysis", 4/e, TMH, 1982.
2) I. J. Nagrath and D. P. Kothari, "Modern Power System Analysis", 4th Edition, TMH, 2011.
3) Hadi Saadat, "Power System Analysis", 2nd Edition, TMH, 2005.
4) Stag, G. W. and EI-Abiad A. H., "Computer Methods in Power System Analysis", International Student Edition, McGraw Hill, 1988.
5) P .M. Chandrashekaraiah, "Power System Analysis and Stability", First Edition, 2009.
6) V. Neelakantan "Power System Analysis and Stability", First Edition, 2002.

18UEEC601 High Voltage Engineering and Switchgear & Protection (4 –0–0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn the advantages high voltage systems, applications and generation of high voltages. They will learn different methods of measuring high voltages, breakdown mechanism in dielectrics.They are also expected to learn need for protection, different types of relays and circuit breakers,

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Classify high voltage systems and describe applications.	1		
CO-2	Explain different types of generation of and demonstrate different methods of measuring HVAC and HVDC.	1, 2		

CO-3	Explain the different breakdown phenomenon occurring in dielectrics and describe the need for protection of power system.	1, 2		
CO-4	Explain arcing in CBs, importance of arcing, arc quenching theories and types of circuit breakers	1, 2		
CO-5	Describe and analyze different types of relays.	1, 2		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0													

Prerequisites: 1.Electrical Power Distribution & Utilization
2. Electrical Measurements

Contents:

Unit-I

HV Systems: Classification, important applications of high voltage.
Generation of HV for testing: HVDC: voltage doubler circuit, Cockcroft- Walton type. Calculation of percentage voltage regulation, percentage ripple and optimum number of stages, examples. HVAC: HV transformer - working of transformer connected in cascade. Series resonant circuit. Tesla coil. **10 Hrs.**

Unit-II

Generation of Impulse Voltage and Current: Introduction to standard lightning and switching impulse voltages, Analysis of single stage impulse generator, Multistage impulse generator working of Marx impulse generator and components. Generation of switching impulse voltage and high impulse current.

Measurement of high voltages: Measurement of Voltage and currents using voltage divider, current shunt, rogowski coils. Standard sphere gap measurements Electrostatic voltmeter-principle & construction. Generating voltmeter- Principle of operation & construction. Series resistance micro ammeter **10 Hrs.**

Unit–III

Breakdown phenomena: Classification and Properties of HV insulating media. Gaseous dielectrics, Ionizations, primary and secondary ionization processes. Townsend's theory, Streamer's theory. Corona discharges. Expression for disruptive and visual critical voltages and corona power loss. Breakdown in electro negative gases. Panchen's law.

Power system protection: Principles, Block diagram of power system protection, Switchgears, Zones of protection, Requirement of good protection system, Types of protection schemes, Power transformer protection. **12 Hrs.**

Unit-IV.

Circuit breakers: Initiation, maintenance and interruption of arc, arc interruption theories, arc chopping. problems encountered in DC circuit breaking. Rating of CBs. Air break and Air blast CBs, Bulk oil & minimum oil CBs, SF6 CBs, vacuum CB voltage, restriking voltage and recovery voltage, resistance switching, current characteristics, HVDC CBs. **10 Hrs.**

Unit-V

Relays: Relay settings, Torque equations and characteristics of Over current relay, Directional over current relay, Differential relay, Percentage differential relay, Impedance relay, Mho relay. **10 Hrs.**

Reference Books:

1) E. Kuffel and W.S. Zaengl, “High voltage engineering fundamentals”, 2/e, Elsevier, press, 2005.
2) M.S.Naidu and Kamaraju, “High Voltage Engineering”, 3/e, THM, 2007.
3) C.L.Wadhwa, “High voltage engineering”, New Age International Private limited, 1995.
4) Sunil S. Rao–“Switch Gear & Protection”, 1/e, Khanna Publication, 2004.
5) Ravindranath & Chander - Power System Protection & Switch Gear, New Age Publications, 2005.
6) Chakraborthy, Soni, Gupta &Bhatnagar–“A Course in Electrical Power”,3/e, Dhanapat Rai Publication, 1999

18UEEL605	Electrical Machines-2 Lab	(0 - 0 - 3) 2

Contact Hours: 36

Course Learning Objectives (CLOs):

The students are expected to learn to conduct experiments to measure the line and phase voltages and currents in Star and delta connections. Further, they will be learning to conduct experiments on 3 phase squirrel cage and wound rotor induction motors, single phase induction motors, alternators and synchronous motors and evaluate the performance.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to PO's(1 to 12)/PSO's(1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Test and obtain performance characteristics of single phase induction motors.	9	2	4,8
CO-2	Test and obtain performance characteristics three phase induction motors.	9	2	4,8
CO-3	Determine regulation of large capacity alternator by different methods	9	2	4,8
CO-4	Synchronize the alternator with the busbar	9	2	4,8

PO's	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO - 1	PSO - 2	PSO - 3
Mapping Level		2.0		1.0				1.0	3.0						

Prerequisites: 1. Electrical Machines

Contents: Minimum of 10 experiments to be conducted from the list given below.

Prescribed Experiments:

1. Load test on 3-phase induction motor.
2. Load test on 1-phase induction motor.
3. Performance predetermination of 3-phase induction motor by equivalent circuit.
4. Performance predetermination of 3-phase induction motor by Circle diagram.
5. Speed control of wound rotor induction motor.
6. Load test on induction generator.
7. Regulation of alternator by emf and mmf methods.
8. Regulation of alternator by Potier triangle method and ASA methods.
9. Synchronization of alternator.
10. Slip test on alternator.
11. V and inverted V curves of synchronous motor.
12. Study of 3-phase winding and speed change by changing number of poles of induction motor.

Reference Books:

1. Lab. Manual
2. D.P. Kothari & I.J. Nagrath, “Electrical Machines”, 3/e,TMH,2010.
3. Ashfaq Hussain,” Electric Machines”, 2/e, Dhanpatrai & Sons, 2004.

18UEEL606 Sensors, Control systems and simulation Lab (0 - 0 - 3) 2

Contact Hours: 36

Course Learning Objectives: (CLOs)

The automation in the power systems and also in many of the industrial applications has gained lots of importance in the recent times. Hence it is necessary to understand the operation of sensors in the measurement applications and also to have hands on experience of using the different types of sensors in control system. The students are expected to learn conducting experiments to be able to use different types of sensors for the measurement of various analog quantities specified. They are also expected to obtain the performance characteristics of the sensors used. They shall also conduct the experiments to study the response of the electrical system to different types of inputs and simulate the same using MATLAB SIMULINK.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO’s(1 to 12)/PSO’s(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Demonstrate the fundamental skill of using the sensors and measure their characteristics	4		9,PSO3
CO-2	Obtain the characteristics of servomotors.	4		9, PSO3
CO-3	Design and analyze the performance of the second order systems	4		3,9, PSO3
CO-4	Simulate the second order systems and obtain the time domain response.	4	5	9, PSO3

PO's	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO - 1	PSO - 2	PSO - 3
Mapping Level			1.0	3.0	2.0				1.0						1.0

Prerequisites: 1. Control Systems 2. Microcontrollers

Contents:

Prescribed Experiments:

Note: Minimum of 10 experiments is to be conducted.

1. Study of capacitive sensors using Opamps.
2. Measurement of temperature using Opamp based sensor.
3. Measurement of displacement using LVDT.
4. Measurement of Distance using Distance sensor interfaced to Arduino.
5. Obtain parameter under consideration vs voltage characteristics of the following sensors i) Thermistor ii) LDR iii) proximity sensor
6. Obtain parameter under consideration vs voltage characteristics of the following i) Photo transistor ii) Strain gage iii) smoke sensor
7. Demonstration of a system or circuit using a sensor. Viz; timer circuit using LDR.
8. Obtaining characteristics of DC and AC servomotors.
9. Design and performance analysis, of second order system, analytically and experimentally.
10. Obtaining frequency response of second order system & sketching Bode plot.
11. Simulation of 3rd order system using MATLAB to obtain Phase Margin & Gain Margin with the help of Bode plot.
12. Simulation of 2nd order system using MATLAB & obtaining time domain Response.

Reference Books:

1) Sensors, control systems and simulation Laboratory Manual.
2) Roy & Choudary, "Operational amplifiers and Linear Integrated circuits", 2/e, New Age International 01-Jan-2003.
3) Cooper D & A D Heifrick, "Modern Electronic Instrumentation and Measuring Techniques", PHI, 1998.
4) I. J. Nagrath and M. Gopal "Control Systems Engineering: 3/e, Wiley Eastern Ltd, 2003.7.K. Ogata, "Modern Control Engineering", 4/e, PHI, 2004.

18UEEL607	Minor Project-2	(0-0-4) 2

Contact Hours: 24

Course Learning Objectives (CLOs):

This course is included having had an exposure to the project work in the previous semesters. The students are expected to locate the state of the art technology in his/her domain of interest by an extensive literature survey and select a topic from an emerging area relevant to their branch/interdisciplinary and define the problem for the project work. They are also expected to provide solutions through developing prototypes for industrial needs.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify the domain related preferably real time problem and formulate a problem statement	4	6	9
CO-2	Propose the technical approach towards the solution.	4	11	9
CO-3	Implement the solution / demonstrate the working of prototype, execution of codes, etc.	4	11	9,10
CO-4	Prepare the project report in a specified format.	10		9

PO's	**PO -1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO -3**
Mapping Level				3.0		2.0			1.0	2.0	2.0				

Contents:

Domain related problems, real time problems, Technical solutions and recommendations. This project work is to supplement and prepare the students to take up major project work at higher semesters

Evaluation:

A team consisting of not more than 4 students shall be guided by a faculty member. A committee consisting of minimum 3 faculty members (guide as one member) shall evaluate at the end for CIE with suitable rubrics. The weightage of marks shall be 50% for the committee and 50% for the guide. There is a SEE (viva voce) examination which shall be examined by two internal examiners appointed by COE based on the suggestions by the respective HoD.

18UHUL608	Soft Skills & Aptitude	(0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs):

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the significance of communication in the profession.		10	
CO-2	Use the English language with proficiency		10	12
CO-3	Solve Aptitude related problems		9	12
CO-4	Demonstrate the competency in the placement activities.		9	

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	1.0		1.0		3.0	2.0				2.0	1.0				

Contents:

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

18UEEE621	Computer Organization	(3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn the basic structure of computers, machine instruction and simple programs. They will also learn the concept of Instruction Set architecture and machine level instructions, use of resources (registers and memory), the relationship between Instruction set architecture, micro architecture, and system architecture and their roles in the development of the computer.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explore the basics of computer architecture and analyze the performance issues of a computer system.	1, 2		
CO-2	Illustrate the usage of machine instructions, addressing methods, memory structure and its operation	1, 2		
CO-3	Explain pipelining and analyze various hazards affecting performance.	1	2	
CO-4	Demonstrate data representation formats and analyze processor performance for arithmetic operations	1, 2		

CO-5	Explain the functions of the processing unit and formulate control signals for instruction execution.	1	2	PSO1

Prerequisites: Digital Electronics (preferred), Microcontrollers and Microprocessors

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	2.6											1.0		

Contents:

Unit-I

Basic Structures of Computers: Computer types, Functional units, Input unit, Memory unit, Arithmetic & logic unit, Output unit, Control unit; Basic Operational Concepts, Bus Structures, Performance, Processor clock, Basic Performance equation, Pipelining & Superscalar operation, Clock rate Some Basic Concepts, Semiconductor RAM Memories, Internal Organization of Memory Chips, Static Memories, Asynchronous DRAMs, Synchronous DRAMs, Structure of Larger Memories. **09 Hrs.**

Unit-II

Memory &Machine Instructions: Memory System Considerations, RAM bus memory; Read-only Memories: ROM, PROM, EPROM, EEPROM, Flash memory; Speed, Size & Cost: Cache Memories, Input /Output organization, Direct Memory Access Numbers, Arithmetic operations and characters, Memory Locations & Addresses' Byte addressability, Big-endian & Little-endian assignments, Word Alignment, Accessing Numbers, Characters & Character strings; Memory Operation: Instruction & Instruction Sequencing: Register Transfer Notation, Assembly Language Notation, Basic Instruction Types, Instruction Execution & Straight line sequencing, Branching, Condition Codes, Generating Memory Addresses; Addressing Modes. **09 Hrs.**

Unit-III

Pipelining: Basic concepts, data hazards, instruction hazards, influence on instructions sets, performance considerations: effect of instruction hazards, number of pipeline hazards. **07 Hrs.**

Unit-IV

Arithmetic: Addition & Subtraction of Signed Numbers: Addition/Subtraction Logic Unit; Design of fast adders: Carry-Look ahead addition; Multiplication of Positive numbers: Signed-Operand Multiplication: Booth Algorithm; Fast Multiplication: Bit-pair Recoding of Multipliers; Integer division**.** **07 Hrs.**

Unit-V

Processing Unit: Some Fundamental Concepts, Register Transfers, Performing an Arithmetic or Logic operation, Fetching a Word from Memory, Storing a Word in Memory; Execution of a Complete Instruction, Branch instruction; Multiple-Bus Organization, Hardwired Control, A Complete Processor; Micro-programmed Control, Micro-instruction, Micro-program Sequencing, Exposure to recent trend in processors development as a value addition. **07 Hrs.**

Reference Books:

1) Carl Hamacher, Z. Vranesic & S Zaky, “Computer Organization”, 5/e, TMH, 2002.
2) Morris Mano, “Computer System Architecture”, 2/e, PHI, 1986.
3)Heuring & H. Jordan, ”Computer System Design & Architecture”, 2/e, Addison-Wesley, 1999

18UEEE622 Computer Communication and Networking (3 - 0 - 0) 3

Contact Hours:39

Course Learning Objectives (CLOs):

The students are expected to learn about the interconnection of autonomous computers making reference to OSI and TCP/IP reference models. The students will understand the need of stack of layers from physical through application layer, their design issues, functions and significance. They are expected to know different LAN structures, MAN, WAN and Internet. They will also be aware of blue tooth, wireless LAN etc.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO’s(1 to 12)/PSO’s(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the basics of computer networks, reference models and standardization of networks.	3		
CO-2	Describe the design issues such as timing, electrical, mechanical specifications at physical layer, switching techniques and transmission media.	3	4	
CO-3	Explain Data link layer design issues, medium access, data	3	4	5

	link protocols including CSMA/ CD and CSMA/CA protocols, LAN protocols and specifications &verification of protocols.			
CO-4	Explain Network layer design issues such as Routing, congestion control algorithms and Internet working .	3	4	5
CO-5	Describe design issues and protocols of transport, presentation and Application layers.	3	4	

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level			3.0	2.0	1.0									

Prerequisites: 1. Digital Electronics
2. A course on Basic communication (preferred)

Contents:

Unit-I

Introduction: Uses of computer network, network structure, the OSI reference model. The TCP/IP reference model, services, network standardization. **08 Hrs.**

Unit-II

The Physical layer: Transmission and switching, Frequency and time division multiplexing, circuit switching, packet switching, Hybrid switching. **07 Hrs.**

Unit-III

The medium access sub layer: The local and metropolitan area networks, the protocols, LAN protocols, IEEE standard 802 for LAN, fiber optic networks, satellite networks, packet radio networks. The data link layer: Elementary data link protocols- sliding window protocols, protocols specifications and verifications.

09 Hrs.

Unit-IV

The network layer: Network layer design issues. Routing algorithms, congestion control algorithms. Internet working, network layer in the internet and ATM networks**.** **08 Hrs.**

Unit-V

The transport, presentation and application layers: Design issues and protocols.

07 Hrs.

Reference Books:

1) Tanenbaum," Computer Networks", 3/e edition PHI 1993
2) Farozan," Data Communication"1/e, Huga Media, 2007
3) W Stalling," Data and Computer Communications", 1/e,PHI.2007
4) Micheal A," Computer Communications and Network Technologies",2/e, Hancock, Thomson Publications, 2003.

18UEEE623	PIC Microcontrollers	(3 – 0 – 0) 3

Contact Horus: 39

Course Learning Objectives (CLOs):

The students are expected to learn microcontroller architecture, Data Transfer between a Microcontroller and outside Peripherals, Support Devices, Microchip PIC Family of Devices,PIC18F Instructions and Assembly Language. Further they will study and learnPIC18F Programming Model and Its Instruction Set Data transfer, Arithmetic & Branch instructions, Bit Manipulation, and Multiply-Divide Operations**,** Stack and Subroutines and Application Programs and Software Design.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the Architecture of PIC18F family and recite Assembly instructions.	1		
CO-2	Use Assembly instructions and Illustrate Addition program with C check.	1, 2		5
CO-3	Use stack concept and Demonstrate simple Assembly programs.	1, 2	5	
CO-4	Illustrate Assembly programs using logical and bit manipulation instruction and Demonstrate code conversion programs.	1, 2		
CO-5	Demonstrate the assembly programs with interfacing for I/O and multiplication and	1, 2	5	

	Division operations.			

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	3.0	3.0			1.67									

Prerequisites: 1. C Programming 2.Digital Electronics and some fundamentals of Microprocessors/Microcontroller

Contents:

Unit-I

Microcontroller Architecture: PIC18FMicrocontroller families, Processes of Data Transfer between a Microcontroller and outside Peripherals. Support Devices. Microchip PIC Family of Devices.PIC18F Instructions and Assembly Language Illustration: Displaying a Byte at an I/O Port of PIC18F452 Microcontroller. **07 Hrs.**

Unit-II

PIC18F Programming Model: Instruction Format, Its Instruction Set, PIC18F Programming Model. Approach to Problem Solving with programming. Illustrative Program: for Addition with C check. Illustrative Program: Addition with Carry check. **07 Hrs.**

Unit-III

Data transfer, Arithmetic & Branch instructions: Data copy, set/clear operations, arithmetic operations, Branch & skip operations, generating time delays, programs to generate waveforms, transferring a block of data, addition of data bytes, searching of a character in a string, application programs**.**

Stack and Subroutines: Stack concept, Subroutine, Macros and Software Stack. Illustrative Programs for Copying and Adding Data Bytes, Calculating Average Temperature. **10 Hrs.**

Unit-IV

Logical and Bit Manipulation Instruction: Logic Operations Bit Operations, Illustrative Program finding the Highest Temperature in a Data String.

Code conversion programs: BCD to Binary Conversion, Binary to BCD Conversion, ASCII Code to Binary Conversion, and Binary to ASCII Code Conversion. Illustrative Program: Division of Two 8-Bit Unsigned Numbers **08 Hrs.**

Unit-V

Multiply & Divide operations, Input /Output (I/O) Ports, some and Interfacing: Program to find the Average Temperature of Data Readings; Basic Concepts is I/O Interfacing: Interfacing Output Peripherals, Input Peripherals. Illustration: Interfacing Push-Button Keys. Illustration: Interfacing an LCD. **07 Hrs.**

Reference Books:

1) Ramesh Gaonkar, “Fundamentals of Microcontrollers”, Penram International India,2/e, 2007.
2) Mike Predko, “Programming & Customizing PIC Microcontrollers”, 3/e, MGH, 2002.
3) Ajay Deshmukh, “Microcontrollers Theory, Applications”, 1/e, TMH, 2009.
4) Kenneth Ayala, “The 8051 Microcontrollers”, 2/e, Thomson publishing co., 2002.

18UEEE624	VLSI Circuits	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to recall the basics of microelectronics. Furner to know the electrical properties of different devices at different operating conditions. They are to learn regarding basics circuit concepts, scaling of MOS circuits and sub system design. They are to learn the VLSI circuit design concepts and use of CAD tools. They will also be aware of special purpose sub systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO’s(1 to 12)/PSO’s(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the concepts of MOS family & fabrication and Analyze basic electrical properties.	1, 2		
CO-2	Explain the concepts of pull-up, Bi-CMOS inverters, latch up in CMOS circuits and Illustrate VLSI design rules for n-MOS & CMOS circuits.	1		
CO-3	Apply the concept of sheet resistance and area capacitance to VLSI circuits design and comprehend the concept of scaling the device parameters	3	1, 2	
CO-4	Demonstrate VLSI sub system design	3, 5	1, 2	

CO-5	Learn clock distribution, concept of L di/dt noise; Understand TG and CPL logic used in VLSI circuits.	5		1, 2, 3
CO-6	Synthesize VLSI circuits using basic components.		PSO-3	

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	2.2	2.0	2.33		3.0										2.0

Prerequisites: 1 Digital Electronics. 2. HDL (preferred.)

Contents:

Unit-I

Review of Microelectronics: MOS family and fabrication technology, Production of E-beam masks.

Basic Electrical properties of MOS: Drain to source current Id versus V_{ds} relationships, MOS g_m derivation, pass transistor, n-MOS Inverter, Pull-up to Pull-down ratio of inverter. **06 Hrs.**

Unit-II

Forms of pull-up and Bi-CMOS inverter: Resistance pull-up, n-MOS depletion pull-up, n-MOS enhancement pull-up, CMOS pull-up; CMOS inverter, Bipolar and CMOS parameters comparison, Bi-CMOS inverters, latch up in CMOS.

MOS and Bi-CMOS circuit design processes: Stick diagrams, n-MOS and CMOS-design rules, Double metal process, CMOS λ based rules, Micron rules, Lay-outs. **09 Hrs.**

Unit-III

Basic circuit concepts: Sheet resistance concept, Silicide, Area capacitance Delay concept, Inverter delay, rise and fall time derivation of CMOS inverter, cascaded drivers, super buffers, Bi-CMOS drivers, Propagation delays, wiring capacitances, Numerical.

Scaling of MOS circuits: Scaling model and scaling factors for device parameters, Limitations of scaling, Limit due to current density. **09 Hrs.**

Unit-IV

Subsystem design and layout: Some architecture issues, Switch logic, Gate logic, other forms of CMOS logic; Structured design: parity generator, bus arbitration logic, Multiplexers, Gray to Binary code conversion; Clocked sequential circuit, Other system consideration. **08 Hrs.**

Unit-V

Special purpose subsystems: Power distribution - On chip clock distribution network, IR drops, Ldi / dt noise, chip bypass capacitance; I/O – Basic I/O pad circuits, CPL, CMOS with T Gcircuits. **07 Hrs.**

Reference Books:

1) Pucknell, Eshraghian, “Basic VLSI design”-3/e PHI1985.
2) Kang Leblebici,” CMOS Digital integrated circuits” ,4/e, Tata McGraw-Hill publication, 2014
3) David Harrison, Neil Weiste, Banerjee, “CMOS VLSI Design” 3/e, Pearson publication, 2011.
4) Yuan TaunTakH Ning, “Fundamentals of Modern VLSI Devices”, Cambridge Press, South Asia Edition, 2003.

18UEEE625	Software Engineering	(3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn Professional and ethical responsibility, Software Processes Models, requirements engineering processes and software prototyping. They are also learning Architectural design, Object-Oriented design, User Interface design, Software testing and Critical systems about availability & reliability. They are to learn managing the project including quality, software cost estimation, software reengineering and Legacy systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO’s(1 to 12)/PSO’s(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the software requirement	1		
CO-2	Explain and analyze engineering process requirements, system models and software prototyping	1,2		
CO-3	Illustrate architectural, object oriented and user interface Design aspects.	1,2		
CO-4	Explain software specifications and carryout software testing.	3	5	

CO-5	Comprehend the aspects of software project management including risk, quality and legal dimensions.	1,2		11

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0	3.0		2.0						1.0				

Prerequisites: 1. Computer Organization 2. Operating System (Preferred)

Contents:

Unit-I

Introduction: Software engineering, Professional and ethical responsibility. Software Processes: Software Process Models, Process iteration, Software specification, Software design and implementation, Software validation, Software evolution, Automated Process support.

Software Requirements: Functional and Non-functional requirements, User requirements, System requirements, The software requirements document. **08 Hrs.**

Unit-II

Requirements of engineering processes: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

System models: Context models, Behavioural models, Data models, Object models, CASE workbenches.

Software prototyping: Prototyping in software process, Rapid prototyping techniques, User interface prototyping. **08 Hrs.**

Unit-III

Architectural design: System structuring, Control models, Modular decomposition, Domain specific architectures.

Object-Oriented design: Objects and Object Classes, An Object Oriented design process, Design evolution.

User Interface design: User interface design principles, User interaction, Information presentation, User support, Interface Evaluation Verification and validation planning, Software inspections, Automated static analysis, Clean room software development. **07 Hrs.**

Unit-IV

Software testing: Defect testing, Integration testing, Object Oriented testing, Testing Workbenches.

Critical systems: Critical system, Availability and reliability, Safety and Security.

Critical system Specification: Software reliability, specification, safety specification . **08 Hrs.**

Unit-V

Project management: Management activities, Project planning, Project Scheduling, Risk management.

Software cost estimation: Productivity, Estimation techniques, Algorithmic, cost modelling, Project duration and staffing.

Quality Management: Quality assurance and standards, Quality Planning, Quality Control, Software measurements and metrics.

Legacy systems: legacy system structures, Legacy system design and assessment. **08 Hrs.**

Reference Books:

1) Roger. S. Pressman," Software Engineering-A Practitioners approach", Tata-McGraw Hill, 4/e,2008.
2) Pankaj Jalote, "An Integrated Approach to Software Engineering",1/e, Narosa Publications, 2011.
3) Stephen R. Schach," Object Oriented & Classical Software Engineering",8th Tata McGraw-Hill, 2010.
4) Ian Sommerville," Software Engineering", 6/e Edition, Person Education Ltd., 2001

18UEEE626	Digital Imaging Processing	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

Understand the fundamentals of digital image processing. Understand the image transforms used in digital image processing. Understand the image enhancement techniques used in digital image processing. Understand the image restoration techniques and methods used in digital image processing. Understand the Morphological Operations used in digital image processing.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to PO's(1 to 12)/PSO's(1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Understand image formation and the role human visual system plays in perception of gray and color image data.	1		
CO-2	Apply image processing techniques in both the spatial domains	1,2		
CO-3	Apply image processing techniques frequency (Fourier) domains	1,2		5
CO-4	Design and evaluate image analysis techniques	1,2	3	5
CO-5	Conduct independent study and analysis of Image Enhancement and restoration techniques	1,2		5

PO's	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO - 9	PO - 10	PO - 11	PO -12	PSO -1	PSO -2	PSO -3
Mapping Level	3.0	3.0	2.0		1.0										

Prerequisites: Digital Signal Processing

Contents:

Unit-I

Digital Image Fundamentals: What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition. **08 Hrs.**

Unit-II

Image Enhancement in the Spatial Domain: Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations. Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters **08 Hrs.**

Unit-III

Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the2-DDFT,Filteringinthe Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering. **08 Hrs.**

Unit-IV

Restoration: Noise models, Restoration in the Presence of Spatial Filtering and Frequency Domain Filtering, Linear ,Position Invariant degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering. **08 Hrs.**

Unit-V

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing. Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing. **07 Hrs.**

Reference Books:

1) Digital Image Processing Rafel C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010.
2) Digital Image Processing- S. Jayaraman, S. Esakkirajan, T. Veerakumar, Tata McGraw Hill 2014.
3) Fundamentals of Digital Image Processing- A. K. Jain, Pearson 2004.
4) Image Processing analysis and Machine vision with Mind Tap by Milan Sonka and Roger Boile, Cengage Publications, 2018.

18UEEE627	Database Management System	(3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn Structure of a DBM Sand database systems, Storing Data in a DBMS; Queries in a DBMS, Entity -relationship model, Relational model and relational algebra**.** Further, they will understand SQL-The Relational Database Standard**,** Database Design**,** Database security, Transaction management.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify, analyze and define database.	5	1, 2,	
CO-2	Define objects, enforce integrity constraints on a database using RDBMS	5	1,2	
CO-3	Use Structured Query Language (SQL) for database manipulation.	5	1,2	
CO-4	Design and build simple database systems	5	1, 2	
CO-5	Develop application to interact with databases.	5	1, 2	

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	2.0	2.0	2.0		3.0										

Prerequisites: 1. Computer Organization2.Basics of Digital Computer Technology

Contents:

Unit-I

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. Conceptual Data Modeling using Entities and Relationships: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, examples, Specialization and Generalization. **08 Hrs.**

Unit-II

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. Relational Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in

relational algebra. Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping. SQL: SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL. **08 Hrs.**

Unit-III

SQL: Advances Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL. Database Application Development: Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Case study: The internet Bookshop. Internet Applications: The three-Tier application architecture, The presentation layer, The Middle Tier **08 Hrs.**

Unit-IV

Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Normalization Algorithms: Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Nulls, Dangling tuples, and alternate Relational Designs, Further discussion of Multivalued dependencies and 4NF, Other dependencies and Normal Forms

08 Hrs.

Unit-V

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL. Concurrency Control in Databases: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking. Introduction to Database Recovery Protocols: Recovery Concepts, NO-UNDO/REDO recovery based on Deferred update, Recovery techniques based on immediate update, Shadow paging, Database backup and recovery from catastrophic failures. **07 Hrs.**

Reference Books:

1) Raghu Ramakrishnan and Johannes Gehrke, ”Database Management Systems” Third Edition, McGraw-Hill,1/e, 2003

2) Elmasri and Nava the," Fundamentals of Database Systems" Fourth Edition Pearson Education, 1/e, 2003.

18UEEE628 Digital System Design using VHDL (3– 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to know the need for HDL, history of HDL development and capabilities of VHDL. They are required to learn the basic elements of the language, different styles of modeling used in VHDL. Further, they learn design and develop the code for combinational, sequential circuits, and Programmable Logic Devices.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the need, evolution and capabilities of HDL, basic elements of the language, code structure and styles of modeling	3		
CO-2	Write the code using concurrent statements	5		12
CO-3	Design simple systems and write the code using sequential statements	5		12
CO-4	Write the code using structural style and create package	5		12
CO-5	Write the functions & procedures and write the code for PLDs.	5		12

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level			3.0		5.0							1.0			

Prerequisites: 1. Digital Electronics.

Contents:

Unit-I

Introduction: Need for HDL, evolution of VHDL and capabilities of the language. Code structure: Fundamental building blocks; library, entity, architecture, package declaration, and package body.

Basic Elements of the Language: Object types: signal, variable, constants. Data types- Scalar, composite, access and file types & sub types. VHDL operators, Generics and attributes. **08 Hrs.**

Unit-II

Concurrent Code: Concurrent statements: operators, WHEN/ELSE, WITH select WHEN, simple BLOCK and Guarded BLOCK, GENERATE statements. Inertial delay, transport delay & simulation delta. Example codes for combinational and sequential circuits (Encoder, Mux, Decoder, arithmetic circuits, comparators, ALU, code converters, latches, flip flops, counters, registers etc.) **09 Hrs.**

Unit-III

Sequential Code: structure of Process**,** Sequential statements: BNF of IF, LOOP, CASE, WAIT, ASSERT, NEXT, EXIT, NULL, POSTPONE**.** Example codes for combinational and sequential circuits (Encoder, Mux, Decoder, arithmetic circuits, comparators, ALU, code converters, latches, flip flops, counters, registers etc.). Design and development of state diagram for serial adder, sequence detector, BCD to XS-3 code converter etc. **09 Hrs.**

Unit-IV

Structural Code: components, port map, generic MAPAND examples (Encoder, Mux, Decoder, arithmetic circuits, comparators etc.).

Packages: Package declaration and package body. Simple examples. **07 Hrs.**

Unit-V

Sub programs: Function: syntax, location and examples. Procedures: syntax, location and examples.

Introduction PLDs: Basic structure of CPLDs and FPGAs. **06 Hrs.**

Reference Books:

1) Volnei A. Pedroni, ”Circuit Design with VHDL”,Reprinted,EEE,PHI,2005.
2) Douglas Perry, ”VHDL Programming by examples”, 4/e, TMH, 2005.
3) Bhasker, ”VHDL Primer”, 3/e, Pearson, 2002.
4) C. H. Roth,”Digital System Design using VHDL”, 8th reprint,Brooks/Cole Publishing, 2008.

18UEEE631 Electrical Estimation Specification Codes and Practices (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are required to learn and practice specifications, significance of specifications, power installations, industrial wiring, load calculations and estimation of wiring schemes. Further, they will come to know about costing, calculation of depreciation and valuation of machinery, materials and goods.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the significance of specifications, relevant IE rules and estimate installation of wiring.	1,2	6	11
CO-2	Describe the procedure to estimate Load, select wire size and wiring materials for power installations.	1		
CO-3	Estimate Load, select wire size and wiring materials for pump, workshop & heater installations.	2,3		1
CO-4	Estimate Load, and select transformers for HT and LT consumers.	3	1,2	
CO-5	Carry out cost benefit analysis.	2,11		

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	2.25	2.25	3.0			2.0					2.0				

Prerequisites: 1) Electrical Machines 2) Electrical Drawing 3) Electrical Power Distribution and Utilization

Contents:

Unit-I

Introduction: Significance of specifications, relevant Indian Electricity rules.

Interior wiring system: Wiring system, earthing, estimation of wiring installation.

07 Hrs.

Unit-II

Motor Installation: Load calculation, wire size selection, power circuit wiring material used and the estimate for motor installation. **08 Hrs.**

Unit-III

Pump Installation: Load calculation, wire size selection, power circuit wiring Material used and the estimate for pump set, work shop, heater etc. **08 Hrs.**

Unit-IV

Distribution Substation: Estimation of Load, capacity of transformer for LT and HT consumers, selection of transformers materials and accessories required.

09 Hrs.

Unit-V

Depreciation and valuation of machinery, Inventory, Economic order quantity, break even analysis.

Costing: need for costing and types of costing. **07 Hrs.**

Reference Books:

1) S.S. Chatterjee, Introduction to management, 1/e, World Press, 1962.
2) N. Narasimhaswamy, Engineering economics andmanagement.2/e, Dynaram Publications, 1990.
3) T.R. Banga& S.C. Sharma, “Industrial organization and engineering economics”1/e, 2003.
4) RaghavendraRao,“Electrical Estimation Specification & Costing“,1/e,Sapna,2002.

18UEEE632	Nonlinear Control Theory	(3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to study and understand concept of state, state variables and state model, state model of linear systems, linearization of state equations and state variable analysis and design. They will learn to derive transfer function from state models and know about controllability and observability. They also learn the concept of pole placement techniques for improvement of stability. Further, they understand the behavior of nonlinear systems and carry out stability analysis using various techniques.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to PO’s(1 to 12)/PSO’s(1 to 3)		
	Substantial Level (3)	Moderate Level (2)	Slight Level (1)

CO-1	Compute the state model for linear systems and analyses for transfer function from state model. State space representation using different methods.	1,2		
CO-2	Obtain the state transition matrix and solve using different methods.	1,2		
CO-3	Improve stability by state feed-back, obtain the necessary and sufficient conditions for pole placement, design state regulator.	1,2		
CO-4	Compare different non-linear systems and analyze for singular points for stability. Construction of phase trajectories.	1,2		
CO-5	Examine the stability criteria for non-linear systems using Liapunov and Krasovskii's methods.	1,2		

PO's	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0													

Prerequisites:

1. Linear system Analysis 2. Mathematics

Contents:

Unit-I

Variable analysis: Introduction, concept of state, state variables and state model, state model of linear systems, linearization of state equations.

State space representation: using physical variables, state space variables, Jordon canonical model, derivation of transfer function from state model, Digonalization, Eigen values, Eigen vectors, generalized Eigen vectors. **08 Hrs.**

Unit-II

Solution of state equations: state transition matrix and its properties, computation using Laplace transformation, Cayley-Hamilton method, concept of controllability and observability, methods of determining the same. **08 Hrs.**

Unit-III

Pole placement techniques: stability improvements by state feed- back, necessary and sufficient conditions for arbitrary pole placement, state regulator design, Ackraman's formula. **07 Hrs.**

Unit-IV

Non-Linear Systems: Introduction, Characteristics and behavior of non-linear system, common physical non linearities-saturation, friction, backlash, dead zone, relay, multi variable non-linearity

Phase plane method: singular points, stability of nonlinear system, limit cycles, construction of phase trajectories- graphical method. **08 Hrs.**

Unit-V

Non-linear system stability analysis: direct method of Liapunov and Liapunov candidates, Liapunov functions, construction of Liapunov functions for nonlinear system by KRASOVSKII'S method. **08 Hrs.**

Reference Books:

1) M. Gopal, "Digital control & state variable methods", 2/e, TMH 2003.
2) I.J.Nagrath & M.Gopal, "Control system engineering", 5/e, New Age International, 2008.
3) Katsuhiko Ogata, "Modern Control Engineering" 4/e, PHI, 2004.
4) K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.

18UEEE633 Energy Auditing and Demand Side Management (3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

Students are expected to be aware of the current energy scenario, significance of energy management and conservation. The students are required to know the need for energy auditing and the procedure to carry out the same. The students are expected to apply the knowledge of different components of electrical system in the context of energy efficiency. They are also to be aware of energy efficient technologies.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Know about energy scenario and salient aspects of Electricity and Energy Conservation Acts.	1		
CO-2	Carry out, prepare report and present orally a case study/project work relating to energy audit/energy conservation/demand side management.	11		
CO-3	Analyze energy related economic issues and be able to solve related numericals.	2		
CO-4	Know about energy auditing, different methods, preparing audit report and measurement of related parameters.	2, 5		
CO-5	Know about analysis of PF and its improvement, Energy efficient motor, efficient illumination and tariff structure.	2		
CO-6	Know about Demand Side Management, Different techniques, preparing audit report and measurement of related parameters, Energy	2, 5		

	Conservation Awareness Programs			

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0			3.0						3.0				

Contents:

Unit-I

Introduction: Global and Indian Energy scenario; Energy consumption and conservation aspects. Electricity Act 2003. Energy Conservation Act 2001.

Case study /Project. Initiate a case study/project relating to energy audit/energy conservation/demand side management. This is to progress across the semester and to be completed by the end of the semester with proper reporting and presentation. **09 Hrs.**

Unit-II

Energy Economic Analysis: Payback analysis; The concept of "time value of money"; Internal Rate of Return; Cash flow models; Depreciation, Numericals. **07 Hrs.**

Unit-III

Energy Auditing: Introduction; Elements of energy audits; Energy use profiles; Measurements in energy audits; Presentation of energy audit results. **08 Hrs.**

Unit-IV

Power factor and Electrical Equipment: Power factor correction; Location of capacitors. Energy efficient motors. Lighting basics and efficient illumination approaches. Electric tariff; Factors affecting tariff. Numericals. **07 Hrs.**

Unit-V

Demand Side Management: Concept of DSM; Benefits of DSM; Different Techniques of DSM. Different approaches for load management: Time of daypricing; Availability based tariff; Strategic conservation; Energy efficient equipment. Management and organization of Energy Conservation Awareness Programs. **08 Hrs.**

Reference Books:

1) "General Aspects of Energy Management 2nd Energy Audit", Bureau of Energy Efficiency, New Delhi, Fourth Edition-2015
2) "Energy Efficiency in Electric Utilities", Bureau of Energy Efficiency, New Delhi, Fourth Edition-2015

3) D.P.Sen Gupta, K.R.Padiyar, Indranil Sen, M.A. “Recent Advances in Control and Management of Energy Systems”, Interline Publishers, Bangalore, 1993.
1) Munasinghe, Mohan Desai, Ashok V –“Energy Demand: Analysis, Management and Conservation”, Wiley Eastern Ltd., New Delhi, 1990.
2) Jyothi Prakash, "Demand Side Management", TMH Publishers, 1/e, 1997.

18UEEE634 Testing & Commissioning of Electrical Equipment (3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about different tests to be carried out on various electrical equipment’s like transformers, induction motors, synchronous machines, switchgears. They learn to carry out factory, routine, commissioning and special tests. They learn to monitor equipment health for smooth operation over the life time. Further, they must aware of importance of maintenance and schedule of maintenance off line and online.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to exhibit :		**Mapping to PO’s(1 to 12)/PSO’s(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Knowledge of specifications of electrical equipment standards, tests, code of practice, commissioning.	1, 2		
CO-2	Knowledge of testing and commissioning of Transformers.	2, PSO-2		
CO-3	Knowledge of testing and commissioning of Induction motors.	2, PSO-2		
CO-4	Knowledge of testing and commissioning of Synchronous generators.	2, PSO-2		
CO-5	Knowledge of testing and commissioning of CBs.	2, PSO-2		

PO's	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	POS -1	POS -2	POS -3
Mapping Level	3.0	3.0												3.0	

Prerequisites: 1. Electrical machines 2. Switchgear and Protection

Contents:

Unit-I

Introduction: Specifications, standards, national standards, International standards, codes, transportation ,storage, inspection, testing, standard test conditions, development tests, reliability tests, Type tests, Routine tests, Special tests, installation, commissioning, Commissioning tests, periodic maintenance checks and tests, maintenance, repair, service, overhaul, degree of protection, IP code, installation manual **08 Hrs.**

Unit-II

Transformers: Specifications, **l**ocation & sites, selection & design of foundation details (like bolts size, their number, etc.,) for Installation, code of practice for terminal plates, polarity & phase sequence, oil tanks, drying of windings with & without oil, general, inspection.

Commissioning tests as per national & international standards: volt ratio test, earth resistance oil strength, Bochholz & other relays, tap changing gear, fans & pumps, insulation test, impulse test, polarizing index, load & temperature raise test. Specific Tests - Determination of performance curves like efficiency, regulation etc, and determination of mechanical stress under normal & abnormal conditions.**08 Hrs.**

Unit-III

Induction motors: Specifications, Duty, I.P code for protection. Installation - Location of the motors (including the foundation details) &its control apparatus, shaft &alignment for various coupling, fitting of pulleys & couplings, drying of windings.

Commissioning Tests - Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations & balancing. Electrical Tests - Insulation test, earth resistance, high voltage test, starting up failure to speed up to take the load type of test, routine test, factory test & site tests (in accordance with ISI code).

Specific Tests - Performance & temperature raise tests, stray load losses, shaft elements, re- rating & special duty capability. Maintenance Schedule. **08 Hrs.**

Unit-IV

Synchronous machines: Specifications, Installation - Physical inspection, rating Nameplate details, foundation details, alignments, excitation systems, cooling &control gear, drying of windings.

Commissioning Tests: Insulation, Resistance measurement of armature & field

wings, wave from & telephone interference factors, line charging capacity.
Performance tests: Various tests to estimate the performance for generator & motor operations slip maximum lagging currents, maximum reluctance power tests, sudden short circuit tests, transient & sub transient parameters, measurements of sequence impedances, capacitive reactance, separation of losses, temperature raise tests, and retardation tests. Factory tests: Gap length, balancing vibration, bearing performance. **08 Hrs.**

Unit-V

Switchgear & protective devices: Standards, types, specification, installation, commissioning tests, maintenance schedule, type & routine tests. **07 Hrs.**

Reference Books:

1) S. Rao, "Testing & Commissioning of electrical equipment", 1/e, Khanna Tech. Publications,2004.
2) R. L. Chakrasali, "Testing & Commission of electrical equipment".1/e, Prism engineering Education Series, 2014.
3) Latest Relevant code books, Bureau of Indian Standards.
4) BHEL Handbook," Transformers", 2005.
5) B. J. Chalmers "J & P transformer & J & P Switch gear Handbook, 1/e, Butterworth, 1987.

18UEEE635 Electrical Drawing and CAD (1-0-2) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn to develop single line diagram representation of the power system, different windings used in electrical machines. They will come to know how to use AUTO CAD Graphics package. It is required that they must be able to assemble different parts of electrical equipment. They will be aware of different components of power systems and diagrammatic representation of the same.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify the components of substations and using components develop the single line diagram of substation using	1, 5 , PSO1		12

	AutoCAD software tool.			
CO-2	Develop winding diagrams of DC machines and AC machines using AutoCAD software tool.	1, 5, PSO1	2,3	12
CO-3	Assembling of parts of Single phase and three phase transformer and drawing various sectional views of Single and three phase transformer using AutoCAD software tool.	1, 2, 5, PSO1	3	12
CO-4	Assembling of parts of DC machines and drawing various sectional views of DC machine using AutoCAD software tool.	1, 2, 5, PSO1	3	12
CO-5	Assembling of parts of AC machines and drawing various sectional views of AC machine using AutoCAD software tool	1, 2, 5, PSO1	3	12

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	2.75	2.0		3.0							1.0	3.0		

Prerequisites:

Electrical Power Generation & Transmission, Electrical Power Distribution and Utilization, Electrical Machines

Contents:

Unit-I

Single line diagram of substation and Computer aided drawing of single line diagram for a typical substation. **07 Hrs.**

Unit-II

Computer aided drawing of Winding diagrams: Developed winding diagrams for DC machines, Simplex lap and wave single and double layer windings, Developed winding diagrams for AC machines, Integral slot single layer and double layer full pitched lap and wave windings, Integral slot single layer and double layer fractional pitched lap and wave windings, Fractional slot lap and wave windings **08 Hrs.**

Unit-III

Assembly and sectional views of single phase transformers: core, shell and distributed core types. Computer aided drawing of half sectional views of transformer. **08 Hrs**

Unit-IV

Assembly and sectional views of yoke, fields system, armature and commentator of DC machines. Computer aided drawing of half sectional views of DC machines.

08 Hrs.

Unit-V

Assembly and sectional views of stator and rotor of induction machines. sectional views of stator and rotor of synchronous machines. Computer aided drawing of half sectional views of the same. **08 Hrs.**

Reference Books:

1) Bhatacharya S.K, "Electrical Engineering Drawing",2/e, Wiley Eastern Ltd,2007.
2) K. L. Narang, Staya Prakashan, "Electrical Engineering Drawing"4/e, ND Publications,1983.
3) Mark Dix, Paul Riley, "Introduction to Auto CAD 2000", 2/e,PearsonEducation,2000
4) Newman and Sporule, "Principle of Interactive computer graphics", 2/e, TMH, 1979.

18UEEE636 Operating System (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

Understand the services provided by an operating system. Explain how processes are synchronized and scheduled. Understand different approaches of memory management and virtual memory management. Describe the structure and organization of the file system. Understand interprocess communication and deadlock situations.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the goals, structure and operation of different operating systems.	1, 2		
CO-2	Apply scheduling techniques in different scenario.	2,5	1	

CO-3	Select suitable techniques for memory management	2	1	
CO-4	Explain organization of file systems.	1		
CO-5	Describe and analyze message passing, deadlock detection and prevention	2,5	1	

PO's	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO - 9	PO - 10	PO - 11	PO -12	PSO -1	PSO -2	PSO -3
Mapping Level	2.4	3.0			3.0										

Prerequisites: 1. Computer Organization 2. System software (preferred)

Contents:

Unit-I

Introduction to Operating Systems: OS, Goals of an OS, Operation of an OS, Computational Structures, Resource allocation techniques, Efficiency, System Performance and User Convenience, Classes operating System, Batch processing, Multi programming, Time Sharing Systems, Real Time and distributed Operating Systems **08 Hrs.**

Unit-II

Process Management: OS View of Processes, PCB, Fundamental State Transitions of a process, Threads, Kernel and User level Threads, Non-preemptive scheduling- FCFS and SRN, Preemptive Scheduling- RR and LCN, Scheduling in Unix and Scheduling in Linux **08 Hrs.**

Unit-III

Memory Management: Contiguous Memory allocation, Non-Contiguos Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, VM handler, FIFO, LRU page replacement policies, Virtual memory in Unix and Linux. **08 Hrs.**

Unit-IV

File Systems: File systems and IOCS, File Operations, File Organizations, Directory structures, File Protection, Interface between File system and IOCS, Allocation of disk space, Implementing file access. **08 Hrs.**

Unit-V

Message Passing and Deadlocks: Overview of Message Passing, Implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling deadlocks, Deadlock detection algorithm, Deadlock Prevention **07 Hrs.**

Reference Books:

1) D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
2) Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7th edition, Wiley-India, 2006
3) Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
4) P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI (EEE), 2014.
5) William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

18UEEE637	PLC and SCADA	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives: (CLOs)

The automation in the power systems and also in many of the industrial applications has gained lots of importance in the recent times. The Programmable Logic Controllers (PLC) is one of the important resources of automatic process control systems. The complex control strategies can be effectively realized by means of PLCs. The students shall be able to understand the concept of PLC based systems, the general architecture of PLCs and the operation of PLCs. Apart from this the students shall know the basic ladder programming of PLCs and understand the different logical concepts as applicable to industrial automation. The students shall also understand the basic concept of SCADA system and its components.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the fundamentals aspects programming logic controllers and the I/O devices uses in PLC system.	1		
CO-2	Construct the ladder diagrams for different process control applications using PLC		1,2	3
CO-3	Write the programs based on simple logical applications based		2,3	PSO-3

	on PLC.			
CO-4	Use the timers and counters for the practical applications in the PLC based system.		2,3	PSO-3
CO-5	Understand the basics of SCADA and the SCADA systems.	1		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	2.67	2.0	1.67												1.0

Prerequisites:1. Digital Electronics2. Control Systems3. Microcontrollers

Contents:

Unit-I

Programmable Logic Controllers: Introduction, Hardware, Architecture and PLC systems. Input output devices: Sourcing and sinking, Signal conditioning, remote connections, Networks Processing inputs, I/O addresses **07 Hrs.**

Unit-II

Fundamental PLC Wiring Diagrams and Ladder diagram: Ladder programming-ladder diagrams, logic functions, latching, multiple outputs, entering ladder programs, functional blocks, program examples, location of stop and emergency switches **08 Hrs.**

Unit-III

Programming in PLC: Instruction lists, Sequential function charts, structured text

Internal relays: Ladder programs, battery- backed relays, one - shot operation, set and reset, master control relay, example programs, jump and call subroutines **08 Hrs.**

Unit-IV

Timers and counters in PLC system: Different types of timers, programming the timers, OFF- delay timers, pulse timers, programming examples, forms of counter, programming, up and down counting, timers with counters, sequencer.

Shift register and data handling: Shift registers, ladder programs, registers and bits. Case studies in PLCs. **08 Hrs.**

Unit-V

Application of PLC in power system SCADA: SCADA SYSTEM- Introduction, definition and history of Supervisory Control and Data Acquisition, typical power system SCADA Architecture, Communication Requirements, Desirable properties of

SCADA system, advantages, disadvantages and applications of SCADA. SCADA Architecture. **08 Hrs.**

Note: The Ladder programs shall be written based on a suitable PLC configuration.

Reference books:

1) Programmable Logic Controllers –W. Bolton-Elsevier publisher
2) Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI.
3) Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning.
4) PLC and SCADA theory and practice, Rajesh Verma, University Science Press, Laxmi Publications Pvt Ltd; First edition (1 January 2016)
5) Programmable Logic Controllers – Programming Method and Applications by J. R. Hackworth and F.D. Hackworth Jr. – Pearson, 2004

18UEEO604	**Renewable Energy System**	**(3- 0 - 1) 3**

Contact Hours:39

Course Learning Objectives: (CLOs):

The students are expected to know the world and Indian energy scenario, the energy storage mechanisms. Further, they will be learning the concept of power from solar, wind, biogas, ocean and other renewable energy sources and prevailing technologies.

Course Outcomes: (COs)

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's(1 to 12)/PSO's(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the significance of renewable energy sources and Energy storage methods.	1,5		2
CO-2	Describe the basics of solar energy and analyze the performance of solar thermal systems.	1,5	2	
CO-3	Analyze the performance of solar Photovoltaic systems with relevant numericals.	1,5	2	
CO-4	Analyze the performance of wind based power generation with	1,5	2	

	relevant numericals.			
CO-5	Describe the operation of bio-mass and ocean based power generation and solve relevant numericals.	1,5	2	

Prerequisites: 1.Basic Electrical engineering 2. Electrical Power Generation &

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.00	1.8			3.0										

Transmission 3.Electrical Power Distribution & Utilization

Contents:

Unit-I

Fundamentals of Energy Science and Technology: Introduction, Advantages and Disadvantages of Conventional Energy Sources, Salient Features of Non-conventional Energy Sources, Environmental Aspects of Energy, World Energy Status, Energy Scenario in India.

Energy Storage: Introduction, Necessity of Energy Storage, Energy Storage Methods. Numericalson flywheel energy storage.

Emerging Technologies: Introduction, Fuel Cell, Hydrogen Energy. **09 Hrs.**

Unit-II

Solar Energy Basics: , Extraterrestrial and Terrestrial Radiations, Solar Time, Basic Sun-Earth Angles, Solar Day Length, Estimation of Intensity of Terrestrial Radiation, Solar Radiation on Inclined Plane Surface, Solar Radiation Data, Measurements of Solar Radiation Data. Numericals on solar day length, LST, Solar Geometry.

Solar Thermal Systems: Introduction, Solar Collectors, Solar Water Heater, Solar Thermo-Mechanical Systems. **08 Hrs.**

Unit-III

Solar Photovoltaic Systems: Introduction, Solar Cell Fundamentals, characteristics, classification. Solar Cell, Module, Panel and Array Construction. Maximizing the Solar PV Output and Load Matching, Maximum Power Point Tracker (MPPT), Balance of System Components, Solar PV Systems & Applications.**07 Hrs.**

Unit-IV

Wind Energy: Introduction, Wind Turbine location, applications, types, construction. Wind Energy Conversion Systems, Environmental Aspects, Wind Energy Program in India. Numerical on power available in wind. **07 Hrs.**

Unit-V

Biomass Energy: Introduction, Biofuels, Biomass Resources Biomass Conversion Technologies, Biomass Gasification, Biomass Energy Programme in India. Drum and Dome type digesters, simple calculations regarding drum type digester.

Ocean Energy: Introduction, Tidal Energy, Wave Energy, Ocean Thermal Energy. Numerical on energy and power from tidal plant single effect type. **08 Hrs.**

Reference Books:

1) B. H. Khan, "Non Conventional Energy Resources", 3/e, TMH, 2008.
2) G. D. Rai, "Non Conventional Sources of Energy", 2/e, Khanna publishers, 2007.
3) Twiddle," Renewable Energy Sources", 1/e ,ELBS, 1986.
4) Mukherjee D. & Chakraborti S, "Fundamentals of Renewable Energy Systems", 2/e New Age International Publishers, 2005.

18UMAO675 Applied Mathematics (3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about mathematical modeling, use of numerical techniques to deal with engineering systems. Further, they need to learn LPP and statistical tools for interpretation. They are also expected to carry out sampling distribution analysis and use of graph theory for engineering problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1 to 12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Obtain Mathematical model of Engineering Systems using different domains.		1,2	
CO-2	Formulate LPP and obtain optimal solutions using different tools.		1,2	

CO-3	Apply statistical tools to Interpret the data using different tools.		1,2	
CO-4	Determine Type errors and test for goodness of fit using different methods.		1,2	
CO-5	Use graph theory to obtain solution for engineering problems.		1,2	

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	2.0	2.0													

Pre-requisites:

Courses on the concepts of algebra, geometry, calculus, trigonometry and laws of physics, statistical averages and probability theory.

Contents:

Unit- I

Introduction to Mathematical Modelling and Numerical Techniques: Introduction, Modelling technique, classification and characteristics. Mathematical modelling through algebra, geometry, calculus, trigonometry. Mathematical model of engineering system. **08 Hrs.**

Unit-II

Linear and Non-Linear programming

Introduction, Mathematical formulation of a L.P.P, basic solution. Geometric(or graphical) method, Simplex method. Assignment problem. Non Linear Programming –Constrained extremal problems-Lagrange's multiplier method- Kuhn- Tucker conditions and solutions. **08 Hrs.**

Unit-III

Statistical Techniques Co-efficient of Variation, Skewness, Karl Pearson's co-efficient of Skewness, Moments, Pearson's Beta and Gamma co-efficient, Kurtosis. Time series and Forecasting. **07 Hrs.**

Unit-IV

Sampling distribution: Introduction, population and samples. Type-I and Type- II errors. Test of hypothesis for means, student's t-distribution, Chi-square Distribution as a test of goodness of fit. **08 Hrs.**

Unit-V

Graph Theory: Definition of a graph theory, incidence and degree, walks, paths, circuits, Connectedness, Eulerian and Hamiltonian graphs, Trees, basic properties of trees, Binary trees, Preorder and post order traversals, Spanning and Minimal spanning trees, Connectivity and Separability, fundamental circuits and cut sets Isomorphism of graphs, Matrix representation of graphs, adjacency and incidence matrix Graph theoretical algorithms: Dijkstra, Prims and Kruskal. **08 Hrs.**

Reference Books:

1) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers,44th edition, 2017.
2) E. Kreyszig Advanced Engineering Mathematics John Wiley & Sons,10th edition, 2016.
3) Srimanta Pal et al, Engineering Mathematics, Oxford University Press,3rd edition, 2016.
4) Dougas B. West, Introduction to Graph theory, second edition,PHLearnig Private Limited,2009.