Academic Program: UG

(under NEP 2020)

Academic Year 2021-22

Syllabus

I & II Semester B.E.

(Common to all branches)

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002
(An Autonomous Institution approved by AICTE & Affiliated to VTU, Belagavi)

Ph: **0836-2447465, 2255619** **Fax: 0836-2464638** **Web:** www.sdmcet.ac.in

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for I & II semester of UG program common to all branches of Engineering is recommended by Board of Studies of Basic Sciences & Board of Studies of various Engineering Departments 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.

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Sd/-
Principal

College Vision and Mission

Vision:

To develop competent professionals with human values.

Mission:

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

SDMCET- Quality Policy

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

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

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Programme Outcomes (POs):

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 the 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 and 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.

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I semester B. E. (Common to all Branches)
Physics cycle

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.
21UMAC100	BS	Engineering Mathematics-I	2 - 2 - 0	3	50	100	3	-	-
21UPHC100	BS	Engineering Physics	3 - 0 - 0	3	50	100	3	-	-
21UEEC100	ES	Basic Electrical Engineering	3 - 0 - 0	3	50	100	3	-	-
21UCVC100	ES	Elements of Civil Engineering and Mechanics	3 - 0 - 0	3	50	100	3	-	-
21UMEC100	ES	Elements of Mechanical Engineering	2 - 0 - 0	2	50	50	2	-	-
21UHUC100	HU	Functional English	1 - 2 - 0	2	50	50	2	-	-
21UPHL100	BS	Engineering Physics Lab	0 - 0 - 2	1	50	-	-	50	2
21UESL100	ES	Basic Engineering Skills Lab	0 - 0 - 2	1	50	-	-	50	2
21UAEE1XX	AE	Ability Enhancement Course	2- 0- 0	2	50	50	2	-	-
Total			**16 – 4 - 4**	**20**	**450**	**550**		**100**	

- * BS- Basic science ES- Engineering Science HU- Humanities, languages and Management AE- Ability enhancement course
- ** Semester End Examination conducted for 100 marks will be reduced to 50 marks

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Chemistry cycle

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.
21UMAC100	BS	Engineering Mathematics – I	2-2-0	3	50	100	3	-	-
21UCYC100	BS	Engineering Chemistry	3-0-0	3	50	100	3	-	-
21UECC100	ES	Basic Electronics	3-0-0	3	50	100	3	-	-
21UCSC100	ES	Problem Solving & Programming in C	3-0-0	3	50	100	3	-	-
21UMGC100	ES	Engineering Graphics	2-0-0	2	50	50	2	-	-
21UCYL100	BS	Engineering Chemistry Lab	0-0-2	1	50	-	-	50	2
21UCSL100	ES	Computer Programming Lab	0-0-2	1	50	-	-	50	2
21UAEE1XX	AE	Ability Enhancement Course	2-0-0	2	50	50	2	-	-
21UHUC101	HU	Society, Environment and Engineering	2 -0-0	2	50	50	2	-	-
Total			**17 - 2 -4**	**20**	**450**	**550**		100	

- * BS- Basic science ES- Engineering Science HU- Humanities, languages and Management AE- Ability enhancement course
- ** Semester End Examination conducted for 100 marks will be reduced to 50 marks

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II semester B. E. (Common to all Branches)
Physics cycle

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.
21UMAC200	BS	Engineering Mathematics-II	2 - 2 - 0	3	50	100	3	-	-
21UPHC200	BS	Engineering Physics	3 - 0 - 0	3	50	100	3	-	-
21UEEC200	ES	Basic Electrical Engineering	3 - 0 - 0	3	50	100	3	-	-
21UCVC200	ES	Elements of Civil Engineering and Mechanics	3 - 0 - 0	3	50	100	3	-	-
21UMEC200	ES	Elements of Mechanical Engineering	2 - 0 - 0	2	50	50	2	-	-
21UPHL200	BS	Engineering Physics Lab	0 - 0 - 2	1	50	-	-	50	2
21UESL200	ES	Basic Engineering Skills Lab	0 - 0 - 2	1	50	-	-	50	2
21UAEE2XX	AE	Ability Enhancement Course	2- 0- 0	2	50	50	2	-	-
21UHUC201	HU	Society, Environment and Engineering	2 -0-0	2	50	50	2	-	-
Total			**17 – 2 - 4**	**20**	**450**	**550**		**100**	

* BS- Basic science ES- Engineering Science HU- Humanities, languages and Management AE- Ability enhancement course
** Semester End Examination conducted for 100 marks will be reduced to 50 marks

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Chemistry cycle

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.
21UMAC200	BS	Engineering Mathematics – II	2-2-0	3	50	100	3	-	-
21UCYC200	BS	Engineering Chemistry	3-0-0	3	50	100	3	-	-
21UECC200	ES	Basic Electronics	3-0-0	3	50	100	3	-	-
21UCSC200	ES	Problem Solving & Programming in C	3-0-0	3	50	100	3	-	-
21UMGC200	ES	Engineering Graphics	2-0-0	2	50	50	2	-	-
21UHUC200	HU	Functional English	1 - 2 - 0	2	50	50	2	-	-
21UCYL200	BS	Engineering Chemistry Lab	0-0-2	1	50	-	-	50	2
21UCSL200	ES	Computer Programming Lab	0-0-2	1	50	-	-	50	2
21UAEE2XX	AE	Ability Enhancement Course	2-0-0	2	50	50	2	-	-
Total			**16 - 4 -4**	**20**	**450**	**550**		100	

* BS- Basic science ES- Engineering Science HU- Humanities, languages and Management AE- Ability enhancement course
** Semester End Examination conducted for 100 marks will be reduced to 50 marks

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I Semester B.E.
Detailed Syllabus

21UMAC100	Engineering Mathematics-I	(2-2-0) 3

Contact Hours:39 CIE:50 Marks SEE:100 Marks Exam Duration:3 Hrs.

Course Learning Objectives (CLOs):

This course will enable students to master the basic tools of differential &integral calculus, differential equations and elementary Linear algebra and become skilled to formulate, solve and analyze science and 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(1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Apply** the knowledge of calculus to solve problems related to polar curves, curvature and its applications in determining the bentness of a curve.	-	-	1,2
CO-2	**Learn** partial differentiation to calculate rates of change of multivariate functions, solve problems related to composite functions, Jacobians and application such as maxima and minima.	-	-	1,2
CO-3	**Apply** the concept of multiple integration and their usage in computing the area and volumes.	-	1,2	-
CO-4	**Solve** first order linear differential equations analytically using standard methods and analyze engineering applications.	-	1,2	-
CO-5	**Compute** the solution of system of equations, Eigen values and Eigen vectors and their applications.	-	1,2	-

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.6	1.6										

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Prerequisites: 1.Differentiationand differentiation of function.
2. Properties of Determinant& Matrices.
3. Elementary row/column transformations.

Contents:

Unit I

Differential Calculus-1

Polar curves-angle between the radius vector and tangent, angle between two curves, Pedal equation. Curvature and radius of curvature-Cartesian and polar forms(without proof).

Self Study: Centre and circle of curvature (formulae only).Applications to Evolute. Demonstrate curves and properties using Geogebra. **7L + 1T**

Unit II

Differential Calculus-2

Taylor's and Maclaurin's series expansions for one variable(statements only).Indeterminate forms($0\times\infty, \infty-\infty, 0^0, \infty^0, 1^\infty$).

Partial differentiation: Euler's theorem, Total derivatives, Differentiation of composite functions. Maxima and Minima for a function of two variables, Jacobians and properties (without proof).

Self Study: Method of Lagrange's multipliers with one subsidiary condition.

Demonstrate Taylor's and Maclaurin's series expansions for one variable and indeterminate forms using Geogebra. **7L + 1T**

Unit III

Integral Calculus

Multiple Integrals: Evaluation of double integrals (direct examples and with region given). Evaluation of double integrals by change of order of integration and changing into polar co-ordinates. Evaluation of Triple integrals.

Self Study: Applications to find Area and Volume. **7L + 1T**

Unit IV

Beta,Gamma functions&Ordinary Differential Equations of first order

Beta and Gamma functions: Definitions, Relation between Beta and Gamma functions.

Ordinary Differential Equations of first order

Bernoulli's equation, Exact differential equations. Orthogonal trajectories (Cartesian curves) Applications of ODE's: R-C circuit

Self Study: Orthogonal trajectories (Polar curves).Applications of ODE's: R-L circuit. **7L + 1T**

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Unit V

Elementary Linear Algebra

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Rank of a matrix- Row Echelon form. Solution of system of linear equations – Gauss-elimination method (consistency), Gauss-Seidel iterative method. Eigen values and Eigen vectors- Rayleigh's power method.
Self Study: Test for consistency for system of linear equations. **6L + 1T**

Question Paper Pattern:

1. Each question will carry 20 marks with maximum of four sub divisions
2. Each unit will consists of two full questions.
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Reference Books:

1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed.(Reprint), 2016.
3. **B.V. Ramana:** "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. **H.K.Dass ,Er. Rajnish Verma:** "Higher Engineering Mathematics",2nd revised edition, S. Chand & company Ltd.,2012.

21UPHC100/200	Engineering Physics	(3-0-0) 3

Contact Hours:39 CIE:50 Marks SEE:100 Marks Exam Duration:3 Hrs.

Course Learning Objectives (CLOs):

Engineering Physics course is designed to deliver optimum knowledge of materials and energy concepts. Content explores the fundamental theories, experimental demonstrations and their applications in various engineering fields. Scope of the curriculum includes the study of special theory of relativity, quantum mechanics, electrical properties of materials and photonics.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs (1,12)		
	Substantial Level (3)	Moderate Level (2)	Slight Level (1)

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CO-1	Explore the basics of theory of relativity and their significance in understanding material properties.	2	1	
CO-2	Demonstrate the concept of dual natures of energy and matter, one-dimensional wave equation and its relevance in understanding quantum structures.	1	2	
CO-3	Understand the electrical properties of metals and superconductors for engineering applications.	1	2	
CO-4	Elaborate the behavior of material at nano-size and concept of semiconductors, which supports for their applications.	1	2	
CO-5	Discuss the optical phenomena *vis a vis* interaction of radiation with matter, lasing action, and the basics of optical fibers and their applications.	1		

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	**2.8**	**2.25**										

Prerequisites: Nil

Contents:

Unit I

Theory of Relativity

Classical theory of relativity-Frames of reference (Inertial and Non-inertial) and Galilean transformations. Michelson-Morley experiment, Postulates of Special theory of relativity, Lorentz transformations. Consequences of Lorentz transformations-length contraction, time dilation(twin paradox) and addition of velocities. Relativistic mass and mass- energy equivalence (qualitative).Numerical examples. **7 Hrs.**

Unit II

Quantum Mechanics

Introduction to quantum mechanics, de-Broglie hypothesis, Davisson-Germer's experiment (demonstration).Concept of phase velocity, group velocity and particle velocity (qualitative).Relation between group velocity and particle velocity.Application of de-Broglie hypothesis. Heisenberg's uncertainty principle

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and applications. Wave function, properties and physical significance of a wave function. Probability density and normalization of wave function, setting up of 1-dimensional time independent Schrödinger wave equation. Applications of Schrödinger wave equation – (a) Energy Eigen values and (b) Eigen functions of a particle in a one-dimensional potential well of infinite height and free particle. Numerical examples.

8 Hrs.

Unit III

Quantum theory of Conductivity

Conductors: Review of classical free electron theory- Assumptions and failures. Quantum free electron theory (QFET) – assumptions, Distribution of electrons, Fermi level, Fermi energy, Fermi velocity, Fermi temperature, concept of density of states (in bulk), Fermi-Dirac statistics- Dependence offermi factor and Occupation of density of states on temperature. Expression for electrical conductivity, success of QFET. Numerical examples.

Superconductors: Appearance of residual resistivity in typical metal – Concept of zero resistivity and superconductivity – critical temperature, persistent current, BCS theory. Meissner effect, Critical field, Soft and Hard superconductors, Applications.

8 Hrs.

Unit IV

Materials Science

Semiconductors: Direct and indirect band gap semiconductors, Fermi level in semiconductor, carrier concentration and electrical conductivity in semiconductors (qualitative). Hall effect– determination of Hall voltage and Hall coefficient .Numerical examples.

Nanomaterials: Introduction, size dependent properties of nanomaterials, classification – based on electron confinement, variation of DOS. Syntheses of nanomaterials by top down and bottom up approaches (one example for each). Characterization techniques (qualitative).Carbon nanostructures-Graphene, fullerene and CNTs. Applications of nanomaterials- Super-capacitors, LED and Solarcells.

8 Hrs.

Unit V

Photonics

Laser: Basics of light amplification, Einstein's coefficients (expression for energy density), principle and operation of CO_2 and semiconductor diode laser. Applications - LIDAR, laser cooling, laser fusion.

Optical Fiber: Principles of optical fiber (total internal reflection), Angle of acceptance, Numerical aperture, Fractional Index change, V-number and Modes

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of propagation. Types of Optical fibers, Attenuation co-efficient and fiber losses (qualitative). Numerical examples.

8 Hrs.

Question Paper Pattern:

1. Each question will carry 20 marks with maximum of four sub divisions.
2. Each unit will consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Reference Books:

1) Avadhanalu and Kshirasagar, Text book of Engineering Physics, S. Chand Publishers.
2) Kenneth S. Krane,, Modern Physics, 3rd Edition, John Wiley & Sons Publishers
3) M. Ali Omar, Elementary Solid State Physics, Addison-Wesley Publishers
4) C. P. Poole, Introduction to Nanotechnology, John Wiley & Sons Publishers
5) J. C. Upadyaya, Classical Mechanics, 2nd Edition, Himalaya Publishing House

21UEEC100/200	Basic Electrical Engineering	(3-0-0) 3

Contact Hours:39 CIE: 50 Marks SEE: 100 Marks Exam Duration: 3 Hrs.

Course Learning Objectives (CLOs):

The student is expected to learn the concepts of dc circuits, magnetic circuits, fundamentals of single phase and poly phase ac systems including power factor improvement measures. They are required to understand the meaning of balanced and unbalanced supply system and different electrical loads. Further, they need to know the power apparatus viz. transformer, generator, motor etc. and be able to determine the performance and use for different applications. They are required to know the sources of energy, power flow, to develop wiring scheme, protection of the equipment and personnel safety.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)		
	Substantial Level (3)	Moderate Level (2)	Slight Level (1)

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CO-1	Recite the electric and magnetic circuit basic laws and solve the numericals.	1		
CO-2	Describe AC fundamentals and analyze the single-phase series and parallel circuits with numericals and also know significance of PF.	1		
CO-3	Analyze the three phase circuits with numericals.	1	2	
CO-4	Exhibit the knowledge of single-phase transformers and three phase Synchronous generator with numericals.	1	2	
CO-5	Exhibit the knowledge of three phase Induction Motors with numericals and recite types of energy sources, supply systems, domestic wiring with protective features.	1	2	6,7

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	3.0	2.0				1.0	1.0					

Prerequisites: Knowledge of Matrices, Complex numbers, Differentiation & Integration

Contents:

Unit I

D. C. Circuits& Network Theorems: Review of basics, series-parallel network reduction and mesh analysis (maximum three mesh), Superposition & Thevenin's theorems, Relevant Numericals. **04 Hrs.**

Magnetic Circuits: Electromagnetic induction-laws and applications**,** dynamically and statically induced emf. Electromagnets-series magnetic circuit with and without air gap (leakage and fringing can be mentioned & while solving problems it can be neglected), Relevant Numericals. **03 Hrs.**

Unit II

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Single phase AC Circuits: Review of AC fundamentals– definitions of RMS and Average Values, form factor, phasor algebra, j-operator. Analysis of circuits with different loads such as R-L, R-L-C connected in Séries and Parallel. Power triangle. signifiance of Power factor & its improvement using parallel capacitor, Relevant Numericals. **08 Hrs.**

Self Study: Problems on series parallel circuits and effect of power factor on electricity bill.

Unit III

Three phase Circuits: Three phase supply system-3 wire and 4 wire**,** Necessity and advantages of three phase systems, Meaning of Phase sequence. Balanced supply and load. Relationship between line and phase values for balanced star and delta connections. Power in balanced three-phase circuits, Relevant Numericals. **07 Hrs.**

Unit IV

Synchronous Generator: Principle of operation, types & constructional features, EMF equation (excluding derivation of K_d and K_p), illustrative examples. **03 Hrs.**

Self Study: Synchronization- necessity and conditions.

DC Motors: Construction of Permanent Magnet DC Motor, Principle of operation & torque equation. **02 Hrs.**

Single phase transformer: Principle, types & construction, expression for induced Emf, transformation ratio, losses and efficiency, condition for maximum efficiency (excluding derivation), voltage regulation (no derivation). Applications, Relevant Numericals. **04 Hrs.**

Unit V

Three Phase Induction Motors: Concept of rotating magnetic field, principle of operation, types, construction and working, applications of squirrel cage and slip ring motors, Motor starters- necessity & types and star delta starter, Relevant Numericals. **04 Hrs.**

Miscellaneous Topics: Sources of energy- conventional and renewable energy sources, Single line diagram of power flow from generation to consumer premises, , Fuses-need, types & selection, MCB, Earthing-need and types-pipe and plate earthing, Batteries: types, rating and applications, Study of UPS with schematic diagram. **04 Hrs.**

Self Study: load calculation of domestic installation and wiring diagram.

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Question Paper Pattern:

1) Each question will carry 20 marks with maximum of four sub divisions
2) Each unit will consists of two full questions
3) Students have to answer one full question from each unit and total five questions to be answered.
4) The question paper will have built in choice in the unit.

Reference Books:

1) E. Hughes - Electrical Technology, 8th Edition, Pearson, 2006.
2) B. L. Theraja- Fundamentals of Electrical & Electronics Engineering, SChand, 2006.
3) R.L. Chakrasali- Basic Electrical Engineering, Prism Books Pvt. Ltd,Bangalore.
4) B.H. Khan- Non Conventional Energy Sources, TMH publishing, 2006.

21UCVC100/200 Elements of Civil Engineering and Mechanics (3-0-0) 3

Contact Hours:39 CIE: 50 Marks SEE:100 Marks Exam Duration: 3 Hrs.

Course Learning Objectives (CLOs):

The objectives of this course is to make students to learn basics of civil engineering concepts and infrastructure development, solve problems involving Forces, loads & moments and know their applications in allied subjects. It is a pre-requisite for several courses involving Forces, Moments, Frictional forces, Centroids and Moment of inertia.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Know basics of Civil Engineering, its scope of study, knowledge about Roads, Bridges and Dams			1
CO-2	Summarize, sketch different force systems Analyze problems related to coplanar concurrent and non-concurrent force system	1,2		12

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CO-3	Comprehend the action of Forces, Moments and other loads on systems of rigid bodies and compute the reactive forces that develop as a result of the external loads	1,2		12
CO-4	Understand laws of friction and solve problems related to blocks, inter connected blocks, wedges, ladder and belt	1,2		12
CO-5	Calculate geometric properties – CG and MI of planar elements	1,2		12

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	2.6	3										1

Prerequisites:

1. Basics of trigonometry.
2. Basics of calculus.
3. Newton's laws of motion.

Contents:

Unit I

Introduction to Civil Engineering, Scope of different fields of Civil Engineering - Surveying, Building Materials, Construction Technology, Geotechnical Engineering, Structural Engineering, Hydraulics, Water Resources and Irrigation Engineering, Transportation Engineering, Environmental Engineering. Infrastructure: Types of infrastructure, Role of Civil Engineer in the Infrastructural Development, Effect of the infrastructural facilities on socioeconomic development of a country.

Roads: Classification of Roads and their functions

Bridges: Types of Bridges and Culverts.

Dams: Different types of Dams. **7Hrs.**

Unit II

Analysis of Force Systems- Concurrent &Non-Concurrent System:

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Concurrent Force System : Composition of forces - Definition of Resultant; Composition of coplanar - concurrent force system, Parallelogram Law of forces, Principle of resolved parts; Numerical problems on composition of coplanar concurrent force systems.

Non-Concurrent Force System: Composition of coplanar - non-concurrent force system, Varignon's principle of moments Numerical problems on composition of co planar non-concurrent Force system. **8 Hrs.**

Unit III

Equilibrium of Concurrent and Non-concurrent Forces:

Equilibrium of forces - Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent and non-concurrent force systems.

Support Reaction:

Types of Loads and Supports, statically determinate beams, Numerical problems on support reactions for statically determinate beams subjected to point load, uniformly distributed loads, uniformly Varying loads and moments. **8 Hrs.**

Self-study: Types of supports- smooth, hinge, roller and fixed.

Unit IV

Friction:

Definitions: Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined planes; Numerical Problems on single and two blocks on inclined planes. Numerical problems on Ladder and Wedge friction. **7 Hrs.**

Self-study: Lifting machines like screw jack and pulley**.**

Unit V

Centroid and Moment of Inertia of Engineering Sections

Centroids:

Introduction to the concept, centroid of area, centroid of basic geometrical figures, computing centroid for planar areas, composite planar sections with Numerical problems.

Moment of Inertia:

Introduction to the concept, Radius of gyration, Parallel axis theorem, Perpendicular axis theorem, Moment of Inertia of basic planar figures, computing moment of Inertia for planar and composite sections. **9 Hrs.**

Self-study:Centroid and moment of inertia for built up sections

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Question Paper Pattern:

1. Each question will carry 20 marks with maximum of four sub divisions
2. Each unit will consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Reference Books:

1) Bhavikatti S. S. & Rajashekarappa K. G., "Engineering Mechanics", New Age International (P) Ltd.

2) Singer F.L., "Engineering Mechanics", Harper & Row Publication, London.

3) Ferdinand P. Beer and E. Russell Johnston "Mechanics for Engineers: Statics", McGraw-Hill Book Company, New York.

4) M.N.Shesha Prakash and Ganesh. B. Mogaveer, “Elements of Civil Engineering and Engineering Mechanics”, PHI Learning, 3rd Revised edition

21UMEC100 /200 Elements of Mechanical Engineering (2-0-0) 2

Contact Hours:26 CIE:50 Marks SEE:50 Marks Exam Duration: 2Hrs.

Course Learning Objectives(CLOs):

The objectives of this course are to make the student to learn basic concepts and principles in mechanical engineering like IC engines, refrigeration and Air conditioning, Transmission of power by belt and gears, Metal cutting operations, and systems in automobiles.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the working principles of different prime movers.	-	1	2
CO-2	Describe the working principle of refrigeration and air-conditioning systems.	-	-	1
CO-3	Calculate proper size of pulleys / gears to obtain the required velocity ratio and vice versa.	-	1	2
CO-4	Describe different manufacturing processes.	-		1
CO-5	Explain different types of simple bearings and methods of lubrication.	-	-	1

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CO-6	Explain the working of various systems in automobiles.	-		1

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.3	1	-	-	-	-	-	-	-	-	-	-	-	-

Prerequisites:

Contents:

Unit I

Prime Movers: Classification of IC engines, working of 2 & 4 stroke IC engines and performance parameters.

Boiler & Turbines: Classification of turbines, Francis turbine and Pelton wheel, working of modern boiler & De' Laval Impulse steam turbine. **06 Hrs.**

Unit II

Power Transmission: Classification

Belt drives: Ratio of tensions, velocity ratio and power transmitted. (Simple Numericals).

Gear drives: Types of gears, and their application, Gear trains. (Simple Numericals). **06 Hrs.**

Unit III

Basic Manufacturing processes:

a) Casting, Forming (forging, rolling and sheet metal work)

b) Machining – Lathe Specifications, plain & taper turning operations. Sensitive drilling machine, reaming and boring operations. **06 Hrs.**

Unit IV

Bearings and Lubrication: Function of a bearing, bushed bearing and ball bearing.

Lubrication: Classification of lubricants, properties of lubricants, siphon wick lubricator.

Refrigeration and Air Conditioning: Principle and working of vapour compression refrigerator and window air conditioner. **04 Hrs.**

Unit V

Joining Process: Welding – Arc welding and TIG welding,

Systems in automobiles-

a) Transmission system
b) Braking system
c) Steering system

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d) Cooling system **04 Hrs.**

Question Paper Pattern:

1. Each question will carry 10 marks with maximum of three sub divisions
2. Each unit will consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Text Book:

1) K. R. Gopalakrishna, Sudheer Gopala Krishna and S C Sharma, “Elements of Mechanical Engineering”, 30th edition, Subhas stores, 2019.

Reference Books:

1) Manglik V. K, “Elements of Mechanical Engineering”, PHI Learning Pvt. Ltd., 2014.
2) K. P. Roy, S. K. HazraChoudhary and A. K. HazraChoudhary, “Elements of Mechanical Engineering", 6th edition, Media Promoters and Publishers, 2003.

21UHUC100/200	**Functional English**	**(1-2-0) 2**

Contact Hours: 26 CIE: 50 Marks SEE: 50 Marks Exam Duration: 2Hrs.

Course Learning Objectives (CLOs):

This course provides a platform to the students to enhance their English Language skills, spoken and written Communication skills and language proficiency through Language Laboratory.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Exhibit essentials of language skills and identify the nuances of pronunciation and phonetics	10		
CO-2	Implement English vocabulary and basic English grammar		10	
CO-3	Identify common errors in spoken and written communication and show familiarity with language proficiency		10	

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CO-4	Use sensible writing skills through Précis/Essay/Report/Letter Writing (Personal, Official and Applications) acquire employment and workplace communication skills	10		
CO-5	Demonstrate their technical communication skills and perform well in campus selection	10		

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	-	-	-	-	-	-	-	-	-	2.6	-	-

Prerequisites: A course on English of Pre-University level

Contents:

UNIT-I

Fundamentals of Communicative English: Barriers to Effective Communicative English, Different styles in Communicative English, Interpersonal Communication Skills, How to improve Interpersonal Communication Skills, Developing Interpersonal Skills.

Grammar: Basic English Grammar and Parts of Speech - Nouns, Pronouns, Adjectives, Verbs, Adverbs, Preposition, Articles, Conjunctions.

6Hrs

UNIT-II

Introduction to Phonetics: Speech Sounds, Vowels and Consonants - Exercises on it. Sounds Mispronounced, Silent and Non silent Letters, Homophones and Homonyms, One-word equivalents, Idioms & Phrases: Meaning & Usage in sentences (Language Lab). 5Hrs

UNIT - III

Conversation and Dialogues: Question Tags, Question Tags for Assertive Sentences(Statements) – Some Exceptions in Question Tags and Exercises. Vocabulary – Synonyms and Antonyms, Exercises on it. Words formation - Prefixes and Suffixes. The Sequence of Tenses (Rules in use of Tenses) and Exercises on it.

5Hrs

UNIT-IV

Writing skills: Organizing Principles of Paragraphs in Documents, Writing Introduction and Conclusion, Importance of Proper Punctuation, The Art of

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Condensation (Precise writing) and Techniques in Essay writing, Common Errors due to Indianism in English Communication. 5Hrs

UNIT-V

Speaking Skills: Non-Verbal Communication Skills (Body Language), Presentation skills and Formal presentations by Students, Situational Dialogues (Practical Sessions by Students), Voices (Active and Passive) and Reported Speech, Listening Comprehension, Exercises on Spotting Errors, Exercises on Sentence Improvement. 5Hrs

Question Paper Pattern:

1. Each question will carry 10 marks with maximum of two sub divisions .
2. Each unit consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper should have built in choice in the unit.

Text Books:

1) M.L.Tichoo, A.L.Subramanian, P.R. Subramanian. Intermediate Grammar, Usage and Composition, Orient Black Swan – 2016
2) Sanjay Kumar and PushpLata. Communication Skills, Oxford University Press - 2018.
3) Sanjay Kumar and PushpLata. Communication Skills – A Workbook, OUP – 2018

Reference Books:

1) Wren & Martin. High School English Grammar & Composition, S Chandh & Co. Ltd – 2015.
2) Meenakshi Raman and Sangeetha Sharma. Technical Communication – Principles and Practice, Third Edition, Oxford University Press 2017
3) English Language Communication Skills – Lab Manual cum Workbook, Cengage learning India Pvt Limited [Latest Revised Edition] – 2019
4) M Ashraf Rizvi. Effective Technical Communication – Second Edition, McGraw Hill Education (India) Private Limited – 2018
5) N.P.Sudharshana and C.Savitha. English for Engineers. Cambridge University Press– 2018
6) Jones “New International Business English,published. Cambridge university Press. 2003
7) John Seely. The Oxford Guide to Writing and Speaking: OUP, 2004

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21UPHL100/200	Engineering Physics Lab	(0-0-2) 1

Contact Hours: 26 CIE: 50 Marks SEE: 50 Marks Exam Duration: 2 Hrs.

Course Learning Objectives (CLOs):

Engineering Physics laboratory course provides real time experience in handling equipments and measurement techniques. Experiments are designed to learn the material characterization techniques and realization of material properties. Basic objective of the course is to learn the experimental procedure and execution skills.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Develop the stepwise flowchart for the conduction of experiment	1		
CO-2	Perform the experiment and tabulate the observations.		2	
CO-3	Obtain an expected experimental result by computing the tabulated data.	1	2	
CO-4	Interpret the experimental results and conclusions.	2		
CO-5	Understand the relevant theory.	1	2	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	**3**	**2.25**										

Prerequisites: Nil

Contents:

1) Determination of the value of Young's modulus of the given wooden bar by single cantilever method.
2) Study of Photocell and determination of the Plank's constant.
3) To study the frequency response of series and parallel LCR circuits.

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4) Determination of the Fermi Energy of a given metal.
5) Verification of Stefan-Boltzmann's Law by electrical method.
6) Determination of the energy gap of a given semiconductor.
7) Determination of numerical aperture and acceptance angle of an optical fiber.
8) Determination of the dielectric constant of a dielectric material by charging & discharging method.
9) Study of the characteristics of a given laser source using diffraction method.
10) Determination of resistivity of semiconductor using Four Probe method.
11) Study of Basic and Universal Logic gates.
12) Study of transistor characteristics.

Note: Minimum ten experiments are to be performed to complete the course.

Reference Books:

1) Edward R. Shaw, Physics by Experiment, Create Space Independent Publishing Platform, 2014.
2) Kakani S. L., Engineering Practical Physics, CBS Publishers & Distributors

21UESL100/200	Basic Engineering Skills Lab	(0-0-2) 1

Contact Hours: 25 CIE: 50 Marks SEE: 50 Marks Exam Duration: 02 Hrs.

Course Learning Objectives (CLOs):

The student is expected to acquire basic minimum engineering skills with hands on in multiple disciplines of engineering like Civil, Mechanical, Electrical, electronics, computer Science etc. Further, the student will come to know about the role of different streams of engineering in practical systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Recite the general Engineering principles, laws and applications.		1,2	

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CO-2	Perform skill exercises to implement simple engineering systems in Civil, Mechanical, Electrical, Electronics, Computer Science and demonstrate the working.	4	3	9
CO-3	Use computer skills to generate/prepare technical write up/report.			10

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	2.0	2.0	2.0	3.0					1.0	1.0		

Contents:

Skill Exercises:

1) Acquire the skills of soldering, develop scheme to charge battery employing transformer & conversion circuits and make observations using suitable display equipment.

2) Acquire the skills of setting up of simple circuits with power control, measure electrical quantities, understand electrical behavior of different types of load along with safety and protection aspects.

3) Acquire the skills to set up a circuit to run 3 phase electrical motor and demonstrate the operation with load, record the speed and establish the relation between speed and load.

4) Acquire engineering skills to select sensors (temperature, flow, level etc.), develop an application set up to demonstrate the use of sensors.

5) To Calculate area of a given map/ plan

6) To understand and carry out plumbing activity

7) To prepare a building plan for given requirements

8) To make a fit from given raw material as given in the model drawing.

9) To make sheet metal model using GI sheet as given in development drawing.

10) Disassembling and assembling of components of a given system

Demonstration:

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11) Demonstration of working of Public Address (PA) system, different electrical appliances, report generation using word, Excel and interfacing of computer peripherals (Demonstration only).

12) To determine water quality of the given sample of water

13) Demonstration of welding process

Reference Books:

1) Write up prepared by the Departments

2) E. Hughes - Electrical Technology, 8th edition, Pearson, 2006.

Mode of carrying out the skill exercises:

1. There shall be three faculty members one each from Civil, Mechanical and Circuit stream (preferably from Electrical &Electronics Engineering department) to train the students.
2. The contents are developed taking inputs from Chemical, Civil, Mechanical, E&E, E&C, Computer Science & Engg., Information Science &Engineering.
3. There shall be 10 skill exercises and 2 demonstration sessions
4. Three exercises from Civil, three exercises from Mechanical and four exercises from circuit streams form the list of 10 exercises. One each from circuits and Mechanical / Civil will form demonstration list.
5. A common facility shall be created in the department of Mechanical Engineering to carry out this course.
6. Preparation to carry out all 10 exercises shall be done and kept ready for the students to work
7. A batch of about 35 students will come to this lab once in every week during the allotted time of 2 hrs as per the time table.
8. A batch will be divided in to 10 sub batches each batch consisting of 3 to 4 students
9. All the 10 exercises shall be implemented in cyclic fashion.
10. A total of three faculty members, one each from Civil, Mechanical and Electrical will train the students in their related skill exercise.
11. The students shall prepare the report on the skill exercises conducted using word / excel (computer skills) and submit at the end of the semester for evaluation.
12. There shall be Semester End Examination consisting of one examiner from Civil, one from Mechanical and one from Electrical Engineering.

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Preferably the examiners shall be the faculty involved in training the students.

The students are expected to wear boiler suit and should use insulated shoes.

21UAEE100	Biology for Engineers	(2-0-0) 2

Contact Hours: 26 CIE: 50 Marks SEE: 50 Marks Exam Duration: 2 Hrs.

Course Learning Objective (CLO):

To enable learners to understand the basic organization and functioning of living organisms from an engineering perspective.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1,12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the fundamentals of living things.	-	-	1
CO-2	Apply the concept of plant, animal and microbial systems and growth in real life systems.	-	2	1
CO-3	Analyze the cause of symptoms, and treatment of common diseases.	-	2	1
CO-4	Comprehend on genetic and the immune system	-	2	1
CO-5	Illustrate the application of biology system in relative industries.	1,2	3	

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.4	2.25	2	-	-	-	-	-	-	2.6	-	-

Prerequisites: A course on Biology Preferred

Contents:

Unit-I

Introduction to Cell Biology: Need to study biology, Cell, structure types, function of prokaryote and eukaryote, cell organization cell differentiation, cell theory etc. Microbiological fundamentals (yeast, bacteria and virus) **06 Hrs.**

Unit-II

Biomolecules: Structure, classification and functions of lipid and fats proteins, enzymes, nucleic acids, vitamins, carbohydrates etc. **05 Hrs.**

Unit-III

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Physiology and Human Diseases: Excretory, circulatory, respiratory, digestive and nervous system, immunology. Jaundice, cancer, diabetes, COVID-19. **05 Hrs.**

Unit-IV

Cell and Tissue Engineering: Recombinant DNA technology, stem cells genetically modified organisms, biosensors, applications. **05 Hrs.**

Unit-V

Environmental and Industrial Biology: Cycles of life: Nitrogen, oxygen, carbon etc. Culture media, sterilization etc. microbes in food products, treatment of sewage bioremediation etc. **05 Hrs.**

Question Paper Pattern:

1. Each question will carry 10 marks with maximum of three sub divisions
2. Each unit will consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Reference Books:

1. S. Thyaga Rajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, "*Biology for Engineers*," Tata McGraw-Hill, New Delhi, 2012.
2. Wiley, "Biology for Engineers" Wiley India Ltd.
3. Jeremy M. Berg, John L. Tymoczko and LubertStryer, "*Biochemistry*," W.H. Freeman and Co. Ltd., 6th Ed., 2006.
4. Robert Weaver, "*Molecular Biology*," MCGraw-Hill, 5th Edition, 2012.
5. Jon Cooper, "*Biosensors A Practical Approach*" Bellwether Book**s, 2**004.
6. Martin Alexander, "*Biodegradation and Bioremediation,"* Academic Press, 1994.
7. Kenneth Murphy, "*Janeway's Immunobiology*," Garland Science; 8th edition, 2011.
8. Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, "Principles of Neural Science, McGraw-Hill, 5th Edition, 2012.

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Chemistry Cycle

21UCYC100/200	Engineering Chemistry	(3-0-0) 3

Contact Hours: 39 CIE: 50 Marks SEE: 100 Marks Exam Duration: 3 Hrs.

Course Learning Objectives (CLOs):

In this course, the student is expected to learn principles of electrochemistry, construction and working of advance batteries, new techniques of corrosion control, metal finishing, and alternative energy sources and their significance, determination of various parameters of water, conversion of sea water into potable, sewage management, and synthesis of industrially important polymers. The course intends to provide strong foundation on these topics to engineering students of all disciplines. Delivery of the contents will be made through lectures, demonstration and experiments. The evaluation will be carried-out through quiz, internals and end sem. examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Apply basic knowledge of Chemistry, and fundamental equations in solving electrochemistry numericals and in	2	1	
CO-2	Understand appropriate techniques & modern tools to modify surface properties & analyzing coated material, their properties in controlling the corrosion.	3	1	
CO-3	Analyze the water sample parameters & identify the impurities and its effects. Able to design process for purification of water towards the safety of health and environment.		2	1

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CO-4	To identify & interpret the qualities of Chemical Energy resources using experimental techniques in professional engineering practices.		2	1
CO-5	To understand the properties and applications of polymers in various engineering fields.		1	2

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.6	2.0										

Prerequisites: Basic knowledge of chemistry

Contents:

Unit I

Electrochemistry: Introduction, Nernst equation, numerical problems on E, Ecell,, E0, E0cell, [Mn+]. Reference electrodes, Secondary reference electrodes: construction, working and applications of calomel. Construction and working of glass electrode; determination of pH using glass electrode. Electrolyte concentration cells, numerical problems. 04 Hrs.

Energy storage devices: Introduction, classification-primary, secondary and reserved batteries. Construction, working and applications of, Li-MnO2 and Li-ion batteries. Fuel Cells: Difference between conventional cell and fuel cell, limitations, advantages. Construction & working of solid-oxide fuel cells. 04Hrs.

Self study components: Ag/AgCl electrodes, methanol-oxygen fuel cells.

Unit II

Water resource management: Introduction, hardness and alkalinity of water, determination of hardness of water. Determination of DO and COD; Numerical problems on hardness and COD. Determination of Chloride, Determination of Sulphate (gravimetric method) and Determination of Nitrate by phenol disulfonic acid method. 04 Hrs.

Water Treatment: Conversion of sea water into potable by Desalination: Electro dialysis, Reverse osmosis and flash evaporation methods. Sewage management:

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Primary, secondary (activated sludge method) and tertiary methods. 03Hrs.

Unit III

Corrosion Technology: Introduction, Electrochemical theory of corrosion, Factors affecting the rate of corrosion: Nature of metal, anodic and cathodic areas, nature of corrosion product, nature of medium – pH, conductivity and temperature. Types of corrosion- Differential metal corrosion, Differential aeration corrosion (Pitting and water line corrosion), stress corrosion with examples. Corrosion control: Metal coatings; Galvanization and Tinning. Cathodic protection; Sacrificial anodic method and impressed current method. 05Hrs.

Metal finishing: Introduction, Technological importance, Theory of electroplating, Electroplating of Gold (Cyanide process) and Electro-less plating of Nickel and their applications. 03Hrs.

Unit IV

Energy resources and significance: Introduction, classification, calorific value-gross and net calorific values, determination of calorific value of fuel using Bomb calorimeter, numerical problems. Cracking: fixed bed and fluidized bed catalytic cracking. Octane and cetane numbers, knocking and their mechanism, anti-knocking agents, unleaded petrol and power alcohol. Synthesis of petrol by Bergius process and Fischer-Trops process. 08 Hrs.

Self study component: Renewable energy sources; Solar energy, Technical significance of solar energy, Photovoltaic cell, principle, construction and working.

Unit V

Industrially important Polymers: Introduction, Glass transition temperature (Tg): Factors influencing Tg- Flexibility, inter molecular forces, molecular mass, branching & cross linking, and stereo regularity. Synthesis of polymers: Preparation, properties and applications of polycarbonate. Elastomers: Introduction, synthesis, properties and applications of butyl rubber and silicone rubber. Adhesives: Introduction, synthesis, properties and applications of epoxy resin. 04 Hrs.

Material Science: Composite polymers: Carbon fibers; Introduction, Preparation, properties and application. Conducting Polymers- Introduction, Polyaniline: Mechanism of conduction in polyaniline and applications. 04Hrs.

Question Paper Pattern:

1. Each question will carry 20 marks with maximum of four sub divisions
2. Each unit will consists of two full questions

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3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Reference Books:

1) R. V. Gadag & A. Nityananda Shetty, "Engineering chemistry", 2/e IK International Publishing House Private Ltd. New Delhi, 2010.

2) B.S. Jai Prakash, R.Venugopal, Sivakumaraiah & Pushpa Iyengar., "Chemistry for Engineering Students" Subhash Publications, Bangalore.

3) F. W. Billmeyer, "Text book of Polymer Science", 2/e, John Wiley & Sons, 2007.

4) K. Pushpalatha, "Engineering Chemistry", Revised Edition, Wiley Precise Textbook Series, Wiley, India Pvt. Ltd. 2014.

21UECC100/200 Basic Electronics (3-0-0) 3

Contact Hours: 39 CIE:50 Marks SEE:100 Marks Exam Duration: 3 Hrs.

Course Learning Objectives(CLOs):

The course focuses on characteristics of widely employed electronic devices, their applications and design of simple analog and digital circuits.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Discuss semiconductor diodes and apply the knowledge to build regulated power supply units.	3	1,2	--
CO-2	Describe the operation of BJT and its applications.	--	1	2,3
CO-3	**Explain** the working principle and configuration of operational amplifier and discuss its	--	1,2	3
CO-4	**Apply** the concepts of analog and digital techniques to build simple electronics circuits.	--	2,12	1,3
CO-5	**Explain** various processors and hardware, software units embedded into a system.	--	--	1

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POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.6	1.75	1.5	--	--	--	--	--	--	--	--	2

Prerequisites: Semiconductor theory

Contents:

Unit-I

Semiconductor Diode and Characteristics: P-N junction diode, Diode characteristics, Photo diode, LED and Zener diode.

Applications of Diodes: Rectification-Half wave rectifier, Full wave rectifier, Bridge rectifier, Effect of capacitor filter on rectifiers, Zener diode as a voltage regulator, 78XX fixed IC voltage regulator, Regulated power supply. **07 Hrs.**

Unit-II

Bipolar Junction Transistor: Construction and working, CB,CE,CC configurations, Transistor voltage and currents, DC operating point, Selection of operating point, Fixed biasing, Voltage divider biasing.

Applications of BJT: BJT as a switch, BJT as an amplifier, Feedback Amplifiers – Principle, Properties, Advantages of negative feedback, Voltage series feedback, Oscillators – Barkhausen's criteria for oscillation, RC phase shift oscillator, Hartley oscillator. **09 Hrs.**

Unit-III

Introduction to Operational Amplifier: Introduction to op-amp, Pin Configuration of 741, Op-amp differential amplifier configurations, Ideal characteristics, CMRR, PSRR, Slew Rate, Input offset voltage, Bias current, Frequency response.

Applications of Operational Amplifiers: Inverting amplifier, Adder, Voltage follower, Integrator, Differentiator, Comparator. **07 Hrs.**

Unit-IV

Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal gates, Realization of expression using universal gates, Half adder, Full adder.

Basics of Communication Systems: Block diagram of communication system, Modulation and need for modulation, Amplitude modulation, Frequency modulation. **09 Hrs.**

Unit-V

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Introduction to Embedded Systems: An embedded system, Hardware units, Software embedded into a system, Exemplary embedded systems.
Processors in the System: Introduction, Microprocessor, Microcontroller, Digital signal processor. **07 Hrs.**

Question Paper Pattern:

1. Each question will carry 20 marks with maximum of four sub divisions
2. Each unit will consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Reference Books:

1) D.P.Kothari, I.J.Nagarath, "Basic Electronics", 2/e, McGraw Hill, 2018.
2) Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits",10/e, PHI, 2008.
3) Thomas L. Floyd," Electronic Devices", 9/e, Pearson Education, 2012.
4) David A. Bell, "Electronic Devices and Circuits", 5/e, Oxford University Press, 2008.
5) George Kennedy and Bernard Davis, "Electronic Communication Systems", 5/e, TMH, 2011.
6) Raj Kamal, "Embedded Systems, Architecture, Programming and Design", 1/e, TMH, 2008.

21UCSC100/200	Problem Solving and Programming in C	(3-0-0) 3

Contact Hours:39 CIE:50 Marks SEE:100 Marks Exam Duration:3 Hrs.

Course Learning Objectives(CLOs): The course focuses on the following learning results:

- Developing the problem solving skills that can be applied to problems in different areas which enables students to take-up subsequent course work and professional career.
- Provides a comprehensive study of the features of C programming language.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)		
	Substantial Level (3)	Moderate Level (2)	Slight Level (1)

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CO-1	Design a solution by analyzing the given problem scenario and represent it using algorithm / flowchart.	-	1,2,3	-
CO-2	Explain the C language primitives, language principles and use them in writing simple programs.	-	1,2,3	-
CO-3	Write a C program using proper control structures to solve simple problems.	-	1,2,3	-
CO-4	Write a C program using arrays, and strings to solve simple problems.	-	2,6	-
CO-5	Explain the usage of pointers and the need for writing modular programs and demonstrate its use in writing programs.	-	-	1,2,3

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.7	1.8	1.7	-	-	2.0	-	-	-	-	-	-

Prerequisites: NIL

Contents:

Unit I

Flow-Chart and Algorithm: Solving various scientific, engineering and business related problems of varying complexity.

Fundamentals of C Programming Language: Program structure and execution. Character set, data types, operators, type conversion, expression evaluation. Input and output statements. **8 Hrs**

Unit II

Decision making and Branching: if statement and its different forms, switch statement. **8 Hrs**

Unit III

Decision making and Looping:loops and their behavior – entry and exit controlled loops, conditional and unconditional jump statements, Nested loops.

8 Hrs

Unit IV

Arrays: Single and multidimensional arrays, advantages and disadvantages of arrays, searching and sorting

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Strings: Definition, Different ways of reading and printing strings, string handling functions, applications. **8 Hrs**

Unit V

Modular Programming: Declaration, definition and use of functions, passing parameters to function. **7 Hrs**

Question Paper Pattern:

1. Each question will carry 20 marks with maximum of four sub divisions
2. Each unit will consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Reference Books:

1) E Balagurusamy, "Programming in ANSI C", 6th Edition, Tata McGraw Hill, 2012.
2) Brian W Kernighan & Dennis M Ritchie, "The C programming language", 2nd Edition, Prentice-Hall India, 2004.
3) R.G.Dromey., "How to solve it by Computer", Prentice-Hall India, 2008
4) B A Forouzan and R F Gilberg, "Computer Program: A structured programming approach using C", 3rd Edition, Thomson Learning, 2005
5) Brain W. Kernighan and Rob Pike, "The Practice of Programming", Pearson Education Inc. 2008.

21UMGC100 /200	Engineering Graphics	(2-0-0) 2

Contact Hours:26 CIE:50 Marks SEE:50 Marks Exam Duration:02 Hrs.

Course Learning Objectives(CLOs): The objectives of this course are to make the student to learn:

1. General projection theory, with emphasis on orthographic projection to represent in two-dimensional views.
2. Dimensioning and annotation of two-dimensional engineering drawings.
3. Application to industry standards and best practices applied in engineering graphics.
4. Freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.

Course Outcomes (COs):

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Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Draw projections of points and lines.	1	6	2
CO-2	Draw the projections of regular planes.	1	6	2
CO-3	Draw the projections of regular solids.	1	6	2
CO-4	Develop the lateral surfaces of regular truncated / frustums of solids.	1	6	2
CO-5	Draw isometric projections of combination of regular solids.	1	6	2

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	1	-	-	-	2	-	-	-	-	-	-	-	-

Prerequisites:

Contents:

Unit I

Introduction to Engineering Graphics: Geometrical constructions-point, line, regular planes (triangle, square, rectangle, pentagon, hexagon and circle), BIS conventions: Dimensioning, Lines, Scale- full scale, enlarged and reduced scale, Standard sheet sizes.

Orthographic projection: XY line, Reference Planes- Horizontal, Vertical and Profile planes, quadrants, object, projectors, projections, observer, representation of projected points in front, top and side view. Relative positions of object, observer, planes in various quadrants and corresponding principal views.

Projection of Points and Lines: Projection of points in all quadrants.

Projection oflines: First quadrant only- line parallel to both reference planes, line inclined to one reference plane and parallel to another, line inclined to both reference planes. 05 Hrs.

Unit II

Projection of Planes: Projections of square, pentagonal, hexagonal and circular lamina with surface inclined to both HP and VP. 05 Hrs.

Unit III

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Projections of Solids: Projections of regular solids - prism, pyramid (Square, pentagon based), cone and cylinder with axis inclined to both HP and VP

05 Hrs.

Unit IV

Development of Lateral surfaces of truncated / frustums ofsolids: Development of prism, pyramid (Square, pentagon based), cone and cylinder.

05 Hrs.

Unit V

Isometric Projection of Solids: Isometric projection of regular solids, combination of solids (cone on cube, prism on square block and sphere on cube)

Introduction to Solid Edge software: Use of commands for 2D environment. Exercises using software. 06 Hrs.

Question Paper Pattern:

1) Each question will carry 10 marks with maximum of two sub divisions
2) Each unit will consists of two full questions
3) Students have to answer one full question from each unit and total five questions to be answered.
4) The question paper will have built in choice in the unit.

Text Book:

1) K. R. Gopalakrishna “Engineering Graphics”, 32nd Edition, Subash Publishers, Bangalore, 2018.

Reference Books:

1) N.D. Bhatt & V.M. Panchal, “Engineering Drawing”, 50th edition, Charotar Publishing House, Gujarat, 2010.
2) A Primer on “Computer Aided Engineering Drawing”, Published by VTU, Belgaum, 2006
3) S. Trymbaka Murthy, “Computer Aided Engineering Drawing”, 3rd revised edition, I.K. International Publishing House Pvt. Ltd., New Delhi, 2006.

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21UCYL100/200 Engineering Chemistry Laboratory (0-0-2) 1

Contact Hours: 26 CIE: 50 Marks SEE: 50 Marks Exam Duration: 3 Hrs.

Course Learning Objectives (CLOs):
To study and acquire experimental skills for qualitative and quantitative analysis of given material such as ore, hard water, cement etc.

Course Outcomes (Cos)):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Demonstrate experimental skills, interpret the data for quantitative estimation of Iron, Copper and Acid mixture in the given solution.	3		
CO-2	Demonstrate experimental skills, interpret the data for quantitative estimation of hardness, calcium in cement and Iron in Haematite ore solution.		4	
CO-3	Estimate dissociation constant and viscosity, Interpret the data		3	
CO-4	Determination of COD and copper in Brass, interpret the data for quantitative estimation.	4		
CO-5	Prepare and write the experimental results.		3,4	

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.6	2.0										

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Contents:

PART – A

1) Estimation of FAS potentiometrically using standard $K_2Cr_2O_7$ solution.
2) Estimation of copper by colorimetrically.
3) Estimation of given acid using standard sodium hydroxide by conductometric method.
4) Determination of pKa of weak acid using pH meter.
5) Determination of Viscosity co-efficient of a liquid using Ostwald's viscometer.
6) Construction of Daniel cell and measurement of potential.

PART – B

1) Estimation of Total hardness of water by EDTA complexometric method.
2) Estimation of Ca present in cement by EDTA method.
3) Determination of percentage of Copper in brass solution using standard sodium thiosulphate solution.
4) Estimation of Iron in hematite ore solution using $K_2Cr_2O_7$ solution by external indicator method.
5) Determination of Chemical Oxygen Demand of waste water.

Reference Books:

1. G.H. Jeffery, J. Bassett, J. Mendham and R.C Denney, "Vogel's Text Book of Quantitative Chemical Analysis" 3/e, 2005.
2. Sudha Rani & S. K. Bashin, "Laboratory manual on Engineering Chemistry", Dhanpat Rai Publishing Co.New Delhi, 2014.
3. O.P.Vermani & Narula, "Theory and Practice in Applied Chemisrty" New Age International Publisers.
4. Sunita Rathan, "Experiments in Applied Chemistry" S.K.Kataria & Sons Publisher.

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21UCSL100/200	Computer Programming Lab	(0-0-2) 1

Contact Hours:26 CIE:50 Marks SEE:50 Marks Exam Duration:3 Hrs.

Course Learning Objectives(CLOs): The course focuses on the following learning results through practice:

- Conceptualization of the solutions for the given simple problems.
- Representation of the solutions using algorithm and flow chart.
- Writing modular C program to solve simple problems.
- Practicing coding and debugging standards to understand maintainability, testability and other quality parameters.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Design a solution by analyzing the given problem scenario and represent it using algorithm / flowchart.	-	1,2,3	-
CO-2	Explain the C language primitives, language principles and use them in writing simple programs.	-	1,2,3	-
CO-3	Write a C program using proper control structures to solve simple problems.	-	1,2,3	-
CO-4	Write a C program using arrays, and strings to solve simple problems	-	1,2,3	-
CO-5	Explain the usage of pointers and the need for writing modular programs and demonstrate its use in writing programs.	-	-	1,2,3

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.7	1.7	1.7	-	-	-	-	-	-	-	-	-

Prerequisites: NIL

Working Platform: Linux Operating System

Expected Coding Practices:

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1. Use of Good Programming practices: Declaration of variables, Indentation, Documentation, Simplicity of logic, Efficiency of logic, uniformity etc.
2. Generic and Reusable code.
3. Inclusions of exceptional cases.
4. Better usability

Course Contents:

Programming exercises of varying complexity, to meet the learning results stated in course outcomes for this course.

Reference Books:

1) E Balagurusamy, "Programming in ANSI C", 6th Edition, Tata McGraw Hill, 2012.
2) Brian W Kernighan & Dennis M Ritchie, "The C programming language", 2nd Edition, Prentice-Hall India, 2004.
3) R.G.Dromey., "How to solve it by Computer", Prentice-Hall India, 2008
4) B A Forouzan and R F Gilberg, "Computer Program: A structured programming approach using C", 3rd Edition, Thomson Learning, 2005
5) Brain W. Kernighan and Rob Pike, "The Practice of Programming", Pearson Education Inc. 2008.

21UAEE200	**Numerical Techniques for Engineers**	**(2-0-0) 2**

Contact Hours: 26 CIE: 50 Mark SEE: 50 Marks Exam Duration: 2Hrs.

Course Learning Objectives(CLOs): The student is expected to learn the concepts of Errors in Computations, able to learn to solve Linear System of Equations through Matrix Inversion methods, Approximate the functions by using various schemes and describe the Co-ordinate Systems in Finite Element Method.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Locate** various types of errors in computations			1,2

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CO-2	**Apply** the knowledge of interpolation for solving Algebraic and Transcendental Equations using various methods.			1,2
CO-3	solve Linear System of Equations through Matrix Inversion methods.			1,2
CO-4	Approximate the functions by using various schemes.			1,2
CO-5	**Apply** the knowledge of calculus to describe the Co-ordinate Systems in Finite Element Method.		1,2	

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.2	1.2										

Prerequisites: Basic Knowledge in Number Theory and Calculus.

Contents:

Unit I

Introduction to Errors in Computation

Introduction, Floating point representation, Errors in computations: Inherent errors, Local Round-off Errors, Local Truncation Error. **5 Hrs.**

Self study: Numerical computations using software packages

Unit II

Solution of Algebraic and Transcendental Equations

Introduction, Bisection method, Muller's method, Bairstow method, System of Non-linear equations **5 Hrs.**

Self study: Solving various problems using C-Program.

Unit III

Solution of Linear System of Equations and Matrix Inversion

Introduction, The relaxation method, Matrix inversion: Gauss-elimination method, Gauss-Jordon method. **5 Hrs.**

Self study: Finding trace, norm and inverse of a matrix using c-program.

Unit IV

Approximation of Functions

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Introduction, Least-Squares approximations, Chebyshev polynomial approximation, Economized power series, Pade approximation. **5 Hrs.**
Self study: Problems on Approximations of functions.

Unit V

Co-ordinate Systems in Finite Element Method

Introduction, One-dimensional linear finite element, Galerkin Finite element method (Element Matrices) method, Local Coordinate systems, Natural Coordinate systems. **6 Hrs.**
Self study: Natural Coordinates for rectangular element

Question Paper Pattern:

1) Each question will carry 10 marks with maximum of two sub divisions
2) Each unit will consists of two full questions
3) Students have to answer one full question from each unit and total five questions to be answered.
4) The question paper will have built in choice in the unit.

Reference Books:

1) **K. SankaraRao**, Numerical Methods for Scientists and Engineers, Fourth edition, PHI Learning Private Limited, 2018.
2) **Dr. B.S. Grewal**, Numerical Methods in Engineering & Science with programs in C, C++ and Matlab, Khanna Publishers, 2013.
3)**Dr. B.S. Grewal**, Higher Engineering Mathematics,44th edition,Khanna Publishers, 2020.
4) **Richard Hamming**,Numerical Methods for Scientists and Engineers, Second edition, McGraw Publication, 1973.

21UHUC101/201	**Society, Environment and Engineering**	**(2-0-0) 2**

Contact Hours:26 CIE: 50 Mark SEE: 50 Marks Exam Duration: 02 Hrs.

Course Learning Objectives (CLOs):

The student is expected to learn the societal structure, development processes, concern towards environment, appropriate technology and role of Engineers in providing engineering solutions for societal comfort.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Analyse the social structure and development needs	6,7		8

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CO-2	Create awareness about the need of balanced ecosystems and identify the reasons for environment degradation.	6,7		8
CO-3	Apply mitigation techniques for conservation of environment	6,7		8
CO-4	Evaluate the need and impact of technology on social system and climate	6,7		8
CO-5	Recite his/her role as a facilitator for sustainable development	6,7		8

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level						3	3	1				

Prerequisites: Nil

Contents:

Unit-I

Societal Structures and Dynamics: An analysis of basic sociology concepts and their applications to contemporary society; cultural heritage, occupation mobility and income distribution, social tensions and their causes; societal responsibility and social institutions.

Transformation of industrial society into information society, Development processes: parameters for development of interrelationship between social economic and scientific factors. Role of science and technology in development planning; its objectives and assessment.

06 Hrs.

Unit-II

Ecosystems: Natural ecosystems, Principles of eco-balance, Biosphere cycle, carbon dioxide cycle, causes of eco-imbalance - its effects and remedies.

Environmental Degradation: Causes of degradation– its effects, Control of air, water, soil, and pollutions, Solid waste management, Protection of ozone layer.

05 Hrs.

Unit-III

Conservation of environment: Optimum utilization of natural resources, Renew able and non renewable resources, Conflict of resources, Global environmental issues, Climate change as a threat to human civilization and Mitigation measures. 05 Hrs

Unit-IV

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Technology: Definition, Impact of technology on environment & society, Benefits of technology due to new inventions, Conflict of technology, technology creation for societal change, Appropriate technology, Intermediate technology, labor based and labor intensive technology, Shifts in employment due to technological advancement, Role of technology to unmask social problems, Impact of technology on culture, tradition and social values. 05 Hrs

Unit-V

Technology for Sustainable development: Definition and concept, Technology for sustainable energy and materials. Agricultural age, industrial age and information age, Characteristics of information society, Information as power and wealth. Community management, Engineers role as facilitator. 05 Hrs

Question Paper Pattern:

1) Each question will carry 10 marks with maximum of two sub divisions
2) Each unit will consists of two full questions
3) Students have to answer one full question from each unit and total five questions to be answered.
4) The question paper will have built in choice in the unit.

Reference Books:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Environmental Engineering", 16th Edition, Laxmi Publications (P) Ltd., New Delhi, 2016
2. H.G. Wells, "Brief History of Civilization",
3. J. Neharu, "Glimps of World History", 2004

21UMAC200	Engineering Mathematics-II	(2-2-0) 3

Contact Hours:39 CIE:50 Marks SEE:100 Marks Exam Duration:3 Hrs.

Course Learning Objectives(CLOs):

The purpose of the course is to facilitate the students with concrete foundation of ordinary and partial differential equations, Laplace transforms, enabling them to acquire the knowledge of these mathematical tools.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)		
	Substantial Level (3)	Moderate Level (2)	Slight Level (1)

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CO-1	**Explain** various physical models through higher order differential equations and solve such linear ordinary differential equations.		1,2	
CO-2	**Solve** problems on partial differential equations by method of separation of variables.		1,2	
CO-3	**Transform** the given function using Laplace transforms depending on the nature of engineering applications.			1
CO-4	Apply Laplace transforms to solve differential equations.		1,2	
CO-5	Compute gradiant, divergence, curl vector valued functions and Illustrate the Engineering applications through vector Calculus.		1,2	

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	2	2										

Prerequisites:1.Differentiation and integration of functions.
2.Differential Equations of first Order.

Contents:

Unit I

Differential Equations of Higher Order:

Second order linear ODE's with constant coefficients-Inverse differential operators, Method of Variation of Parameters, Legendre's homogeneous equations. Applications to oscillations of a spring and L-C-R circuits.

Self Study: Cauchy's homogeneous equations. **7L+ 1T**

Unit II

Partial Differential Equations (PDE's):

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Formation of PDE's by elimination of arbitrary constants /functions. Solution of PDE by variable separable method. Derivation of one dimensional wave equations and solution of wave equation by the method of separation of variables and problems. Derivation of one dimensional heat equations and problems.

Self Study: Solution of heat equation by the method of separation of variables. **7L+ 1T**

Unit-III

Laplace Transforms:

Definition of Laplace transform, Laplace transform of elementary functions, properties of Laplace transforms. Laplace transform of $t^n f(t)$, Laplace transform of $\frac{f(t)}{t}$,Laplace transform of derivative of order *n*, Laplace transform of $\int f(t)dt$ .Laplace transforms of Periodic functions and unit-step function– problems.

7L+ 1T

Unit-IV

Inverse Laplace Transforms

Inverse Laplace transform-problems with standard formulae, computation of the inverse Laplace transform of $e^{-as}\bar{f}(s)$,Inverse transform by completing the square, Inverse transform by the method of partial functions, Inverse transform of logarithmic and inverse functions. Convolution theorem(without proof) to find the inverse Laplace transform and problems. **6L+1T**

Self study: Solution of linear differential equations using Laplace transform.

Unit V

Vector Calculus:-

Vector Differentiation: Scalar point function and vector point functions. Gradient, Directional Derivative, Curl and Divergence-physical interpretation. Solenoidal and irrotational vectors. Illustrative problems.

Vector Integration: Line integrals, Surface integrals and volume integrals. Green's theorem, Gauss divergence theorem (only statements).Illustrative example. **7L+ 1T**

Self study: Stoke's theorem.

Question Paper Pattern:

1) Each question will carry 20 marks with maximum of four sub divisions
2) Each unit will consists of two full questions
3) Students have to answer one full question from each unit and total five questions to be answered.
4) The question paper will have built in choice in the unit.

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Reference Books:

1. **B.S. Grewal**: Higher Engineering Mathematics, KhannaPublishers,44th Ed., 2017.
2. **E. Kreyszig**: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.
3. **Srimanta Pal, Subodh Chandra Bhunia:** Engineering Mathematics ,Oxford university Press,2015.
4. **B.V.Ramana**:"HigherEngineeringMathematics"11th Edition, Tata McGraw-Hill, 2010.

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Academic Program: UG

Academic Year 2021-22 Syllabus

III & IV 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 III & IV 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

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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

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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.

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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 the 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 and 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.

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III Semester (E & E)

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.
18UMAC300	BS	Engineering Mathematics-III	3-0-0	3	50	100	3	-	-
18UEEC300	PC	Network Analysis	4-0-0	4	50	100	3	-	-
18UEEC301	PC	Analog Electronics	3-0-0	3	50	100	3	-	-
18UEEC302	PC	Electrical and Electronics Measurements	3-0-0	3	50	100	3	--	-
18UEEC303	PC	Digital Electronics and Verilog	4-0-0	4	50	100	3	--	-
18UEEC304	PC	Electrical Power Generation, Transmission and Distribution	4-0-0	4	50	100	3	--	-
18UEEL305	PC	Digital Electronics and Verilog Lab	0-0-3	1.5	50	--	--	50	3
18UEEL306	PC	Analog Electronics Lab	0-0-3	1.5	50	--	--	50	3
		Total	**21 - 0- 6**	**24**	**400**	**600**		**100**	

BS- Basic Science, PC- Program Core

*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

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IV Semester (E & E)

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.
18UMAC400	BS	Engineering Mathematics -IV	3-0-0	3	50	100	3	-	
18UEEC400	PC	Signals and Systems	3-0-0	3	50	100	3	-	
18UEEC401	PC	Microcontrollers	4-0-0	4	50	100	3	-	
18UEEC402	PC	Electrical Machines- I (DC Machines & Transformers)	4-0-0	4	50	100	3		
18UEEC403	PC	Control Systems	4-0-0	4	50	100	3		
18UEEC404	PC	Linear ICs and Applications	3-0-0	3	50	100	3		
18UEEL405	PC	Measurement and Circuit Simulation lab	0-0-3	1.5	50	--	--	50	3
18UEEL406	PC	Microcontroller Lab	0-0-3	1.5	50	--	--	50	3
18UEEL407	PC	Introductory Project	0-0-2	1	50				
		Total	**21-0-8**	**25**	**450**	**600**		**100**	

BS- Basic Science, PC- Program Core
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

Total number of credits offered for the Second year: 49

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III Semester

18UMAC300	Engineering Mathematics-III	(3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

To have an insight into Laplace transforms, Fourier series, Fourier transforms, Difference equations and Z-transforms. To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

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)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Transform the given function using Laplace/Fourier transforms depending on the nature of engineering applications.			1
CO-2	Express periodic function as a Fourier series and obtain the various harmonics of the Fourier series expansion for the given numerical data.			1,2
CO-3	Solve difference equations using Z-transform.			1
CO-4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.		1,2	
CO-5	Determine the extremals of functional using calculus of variations and solve problems arising in engineering.			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	POS-1	POS-2	POS-3
Mapping Level	1.2	1.3													

Pre-requisites: A basic course on differentiation and integration.

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Contents:

Unit-I

Laplace Transforms: Definition and Properties. Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function problems. **Laplace Transforms**: Inverse Laplace transform - problems, Convolution theorem(without proof) to find the inverse Laplace transform and problems, solution of linear differential equations using Laplace transform. **08 Hrs.**

Unit-II

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions of period 2π and arbitrary period. Half- range Fourier series. Practical harmonic analysis, examples from engineering field. **08 Hrs.**

Unit-III

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Simple problems.

Z-Transforms and Difference Equations: Z-transform- definition, Standard Z-transforms, Damping and shifting rules, Initial value and Final value theorems (without proof) with problems. Inverse Z-transform. Simple problems. Difference equations-basic definition. Application of Z-transform to solve Difference equation. **08 Hrs.**

Unit-IV

Numerical Solutions of Ordinary Differential Equations (ODE's): Numerical solution of ODE's of first order and first degree-Taylor's series method, Modified Euler's method. Runge–Kutta method of fourth order, Milne's predictor and corrector method (No derivations of formulae).Problems. **07 Hrs.**

Unit-V

Numerical Solution of Second Order ODE's: Runge-Kutta method and Milne's predictor and Corrector method. (No derivations of formulae).

Calculus of Variations: Variation of function and functional, variational problems, Euler's equation (without proof), Geodesics (plane), hanging chain problems. **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 (Reprint),2016.
3) Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

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18UEEC300 Network Analysis (4-0-0)4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn fundamentals of energy sources and different methods like network reduction, loop current and node voltage methods to solve AC and DC Circuits. They will learn different network theorems and their application to AC and DC circuits, concepts of resonance and transient response of RL, RC and RLC series circuits. Further, they will be able to calculate rms and average values of non-sinusoidal signals and calculate power consumed by the network. They will apply Laplace Transforms to find out response of the network to different inputs. They will be introduced to coupled circuits and to two port network parameters.

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 to3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Apply network reduction techniques, KVL, KCL and superposition, Thevenin's and Norton's theorems for the solution of electrical networks.	1	2	
CO-2	Use Maximum Power Transform& Reciprocity theorem for ac & dc circuits, and analyses resonance phenomena in electric circuits.	1	2	
CO-3	Determine initial and final values of currents/ voltages and their derivatives, carry out transient analysis of circuits excited by dc voltages.	1	2	
CO-4	Obtain the solutions for electrical network using Laplace transform technique, and also to calculate the different specifications of non-sinusoidal signals.	1	2	
CO-5	Analyze the series and parallel magnetically coupled circuits and two port networks.	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**	**POS-1**	**POS-2**	**POS-3**
Mapping Level	3.0	2.0													

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Prerequisites: 1. Basic Electrical Engineering, 2. Engineering Mathematics

Contents:

Unit-I

Basic Concepts: Source transformation techniques. Mesh and Nodal analysis of DC and AC networks. Star-Delta and Delta-Star conversions**.**

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem for dc and ac networks. **11 Hrs.**

Unit-II

Maximum power transfer theorem and Reciprocity. Theorems for dc and ac networks**.**

Resonance in Electric circuits: Variation of impedance with frequency in series circuits and of admittance with frequency in parallel circuits. Calculation of resonant frequency, half power frequencies, band width and quality factor in series and parallel resonant circuits. **10 Hrs.**

Unit-III

Initial conditions: Initial conditions in R, L, C and RLC networks. Procedure for evaluating initial conditions. Calculation of initial values of current/ voltage and theirderivatives.

Transients in DC circuits: Growth and decay of current in RL circuit, charging and discharging of capacitor in RC circuits, transient response of RLC circuits. **10 Hrs.**

Unit-IV

Application of Laplace Transformation Techniques: Laplace transforms of standard signals, Laplace Transform of periodic signals, solution of differential and integro-differential equations, solution of electrical networks excited by step, pulse and other standard signals using Laplace Transformation techniques.

Non sinusoidal signals: calculation of average and rms values of non-sinusoidal signals, power calculation in networks excited by non-sinusoidal inputs**.** **11 Hrs.**

Unit-V

Coupled Circuits: Magnetic coupling, coefficient of coupling, Dot convention, Analysis of series and parallel coupled circuits.

Two Port Networks: Impedance, admittance, hybrid and ABCD parameters. Relation between parameter sets, interconnection of two port networks. Symmetrical and reciprocal networks, input and output impedances, image impedance. **10 Hrs**.

Reference Books:

1) Hayt, Kemmerley, Durbin, "Engineering Circuit Analysis", 6thEdition, TMH, 2002.
2) M. V. Vanvalkenburg, "Network Analysis", 3rd Edition, PHI/ Pearson Education, 1997.
3) A. Chakrabarti, "Circuit Theory (Analysis and Synthesis)", 5thEdition, DhanpatRai&Co.2007.
4) RoyChoudhary, "Networks and Systems", 2ndEdition, New Age International

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18UEEC301	Analog Electronics	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

To develop strong basics in design concepts of wave shaping, rectifiers, amplifiers circuits. Orient the students to develop ability in problem solving, mathematical reasoning, and analyzing Electronic circuits. To train the students in designing Analog systems using transistor /ICs which have immediate end application to Engineering problems.

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 to3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Demonstrate basic knowledge in analysis and design of rectifiers, clipping, clamping circuits using diode.	1, 2	3	
CO-2	Comprehend FET and MOSFET construction, operation and demonstrate basic knowledge in FET biasing.	1, 2		
CO-3	Analyze and design common source and common drain FET amplifiers.	1, 2,3		
CO-4	Demonstrate basic knowledge & analysis of feed-back amplifiers, Oscillators and 555 timer.	1, 2		3
CO-5	Analyze Power amplifiers.	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	2.0												

Prerequisites: Diode and Transistor fundamentals viz.forward & reverse bias, CE,CB, CC configuration of Transistor.

Contents:

Unit-I

Diode circuits: Diode as circuit element, piece-wise linear model, full wave rectifier circuit andcapacitor filters working analysis and numerical problems.

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Diode wave shaping circuits: Clipping and clamping circuits (brief analysis), Introduction of Schottkey diode. **07Hrs.**

Unit-II

FET fundamentals: JFET, MOSFET constructions & their characteristics; operating point, Fixed bias, Self-bias circuits and numerical problems.

FETbiasing: Voltage divider biasing of FET and MOSFETs and numerical problems. **08 Hrs.**

Unit-III

Field Effect Transistor Circuits: FET small signal model, FET CS and CD Amplifier analysis. i.e. voltage gain and input-output impedance derivation. Lowfrequency and High frequency response FET amplifier. **10Hrs.**

Unit-IV

Feed Back Amplifiers: Feed-back Concepts, Characteristics of Feed Back amplifiers, advantages of negative feed-back, feedback amplifier, derivation of sensitivity factor, input-output impedance, Band-width of feedback amplifier.

Oscillator and timers: Principle, Phase shift Oscillators, derivation of frequency of Oscillations of Colpit's oscillator, FET oscillator; 555 timer block diagram, astableOperation and derivation of frequency of oscillations, mono-stable multi vibratoroperation, pulse width derivation. **08 Hrs.**

Unit-V

Large signal amplifiers: Classifications of amplifiers, Power amplifiers**:** Class Apower amplifier analysis viz. efficiency, Second harmonic distortion, power dissipation, numerical problems.

Power amplifiers: Class B Push-Pull operation and analysis, power dissipationderivation,numerical problems, transformer-less class B operation, Class A operation. **07Hrs.**

Reference Books:

1) Electronic Devices and Circuit theory by Boylstead and Neshlsky. 11th edition, Pearson publication.
2) Millman&Halkias, Satybritjha – Electronic Devices and Circuits, Tata McGraw Hill, 2005.
3) Electronic Circuit Analysis and Design Sudhakar Samuel - Electronics circuits,Sanguine Technical Publishers, 2005.
4) Integrated Electronics by Millman and Halkias McGraw Hill.

18UEEC302	Electrical and Electronics Measurements	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives(CLOs):

The students are expected to learn the basic measuring units of various physical parameters, bridges to measure R, L & C, and the extension of range of the instruments. They are exposed to power and energy measurements, electronic

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instruments, display devices, signal generators and their applications. Further, they learn about different electrical transducers, the concept of data acquisition, construction & working of signal generators and display 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 to3)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	Understand the basics of units and dimensions and analyze the different measurement methods of resistance, inductance, and capacitance.	1	2	
CO-2	Understand the importance of extension of meter ranges and Illustrate the measurements of power, energy.	1	2	
CO-3	Explain the electronic instruments and measurement of non-electrical quantities.	1		2
CO-4	Describe the signal conditioning and data acquisition systems, filters and modulation techniques.	1		
CO-5	Describe the working of signal generators, recorders and display devices.	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	3.0	1.6													

Prerequisites: 1.Basic Electrical Engineering.

Contents:

Unit-I

Introduction: Units, dimensions, sensitivity, errors, accuracy in measuring instruments, Calibration and its importance.

Measurement of resistance, inductance and capacitance : Wheatstone bridge, sensitivity analysis, limitations; Kelvin's double bridge; earth resistance measurement

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using Megger; Anderson bridge, Schering bridge; sources of errors, Examples.

08 Hrs.

Unit-II

Extension of instrument range: Necessity**,** Shunts and multipliers, construction and application of instrument transformers, Definitions of ratio and phase angle errors of CT and PT.

Measurement of power and energy: Dynamometer type wattmeter, construction and operation of induction type energy meter, principle of electronic energy meter and Trivector meter. **08 Hrs.**

Unit-III

Electronic Instruments: Introduction, true RMS voltmeter, electronic multi-meters, digital voltmeters, Qmeter, phase Measuring Unit.

Transducers: Classification and selection of Transducers, strain gauges, LVDT, selsyn,photovoltaic cells, and thermo-couple. **09 Hrs.**

Unit-IV

Signal conditioning and Data Acquisition: Introduction, block diagram of electronic aided measurement, dc signal conditioning system, ac signal conditioning system, generalized data acquisition system. Filters-Passive filters and active filters, Amplitude and Frequency modulation. **07 Hrs.**

Unit-V

Signal generators and display devices:AF oscillators, basic standard signal generator-sine wave, strip chart recorder, X-Y recorders, LCD and LED display, CRO– block diagram, working, dual beam and dual trace. **07 Hrs.**

Reference Books:

1) A K Sawhney, ”Electrical & Electronic Measurements & Instrumentation”,10/e, Dhanpat Rai & Sons, 2002
2) Cooper D & A D Heifrick, “Modern Electronic Instrumentation and Measuring Techniques”, PHI, 1998.David A Bell ”Electronic Instrumentation and Measurements” Oxford University press Second Edition 2014
3) H. S. Kalsi, “Electronic Instrumentation”, 2/e, TMH, 2004.
4) Golding and Widdies, “Electrical Measurements and Measuring Instruments”, 4/e, Wheelers Edition, 1999.

18UEEC303	Digital Electronics and Verilog	(4-0-0) 4

Contact Hours: 52

Course Learning Objective (CLOs):

The students are expected to learn about Boolean algebra, logic problem formulation, K-map, tabular and VEM methods for logic simplification. They learn to explain the concept and design of combinational logic circuits and analyze & synthesize the

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clocked synchronous sequential circuits. Further, they are required to know programmable logic devices and features of different logic families. They are required to learn modeling of digital circuits using Verilog.

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)/PSO(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the concepts of Boolean algebra, logic expressions, gates and use various tools to minimize logic functions.	1		
CO-2	Describe and design MSI logic circuits, (analysis & synthesis) both at gate and IC levels and recite HDL basics &Write Verilog code for simple combinational circuits.	1	3	5
CO-3	Explain the working of latches, flip flop circuits, characteristic equations along with applications and Write Verilog code for simple sequential elements.	1		5
CO-4	Describe the types of register, design asynchronous & synchronous mod-n counters, non-binary counters and write Verilog code for simple sequential circuits.	1, 3		5,12
CO-5	Demonstrate the knowledge about PLDs, Logic families and Analyze& Synthesize finite state Moore and Mealy machines.	1,3	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	2.0	2.7		1.0							1.0			

Prerequisites: Basic Electronics

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Contents:

Unit-I

Boolean algebra and logic gates: Postulates, theorems and properties of Boolean Algebra, Boolean functions, normal and standard forms. Basic, Universal (derived) and special gates.

Simplification of expressions:POS and SOP simplification, Minimal sums and minimal products, Use of Boolean algebra, Karnaugh map (up to five variables), Quine McCluskey method, Prime implicant chart, Petrick's method and table reduction to determine irredundant expressions and Variable entered Karnaugh map.**12 Hrs.**

Unit-II

Combinational logic design with MSI components: Combinational circuits, analysis & synthesis procedure, binary adder, carry look ahead adder, subtractor, decimal adder, comparator, code converters, decoder, logic design using decoder and demultiplexer, encoder, priority encoder, multiplexers, logic design using MUX.Self-study: Study of ICs: 7483, 74153 & 74139. 7446/7447.

Circuit model using Verilog: Need, evolution of Verilog HDL, data types, operators, code structure, styles of modeling and code for simple combinational circuits.

12 Hrs.

Unit-III

Sequential circuits: Basic bi-stable element, latches, SR latch, switch debouncer, Gated SR and D latch, Timing considerations, JK flip-flop, Master slave JK flip-flop, Race around condition, Direct inputs, characteristic equations, Flip-Flop conversions.Verilog code for simple sequential basic elements. **08 Hrs.**

Unit-IV

Registers and counters: Bidirectional shift registers & universal registersCounters: Binary ripple counters.Synchronous counters: Design of modulo-Ncounters using JK, T, D & SR flip-flops.Register based counters: Ring counter, switch tail counter with decoding logic. Self-study: Study of IC 7493 & IC 7490.

Verilog code for simple sequential circuits. **09 Hrs.**

Unit-V

Programmable Logic Devices: Introduction, PROM, PLA, PAL and function realization using PLDs.

Logic families: Definition of Logic level, scale of Integration, propagation delay, fan-in and fan-out. TTL with totem pole output and wired logic. MOS families, CMOS inverters, NOR and NAND gates.

Introduction to synchronous sequential networks: Structure, analysis and synthesis of clocked synchronous sequential circuits, Mealy Model and Moore Model.

11 Hrs.

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Reference books:

1) Donald D. Givone, "Digital Principles and Design" 1/e, TMH, 2004.
2) Morris Mano, "Digital Circuits & Logic Design", 4/e, Pearson Education 2007.
3) Malvino Leech, "Digital Circuits & Applications", 2/e, TMH, 2008.
4) Yarbrough, "Digital Logic Applications and Design", 2/e, Thomas publishing company, 1997.
5) Nazeih M.Botros, " HDL Programming VHDL and Verilog" Dreamtech Press New Delhi, Reprint 2009.

18UEEC304 Electrical Power Generation, Transmission & Distribution (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn different energy sources for generation of electric power, the concept of load curve & plant capacity factor etc. Further, they learn about the different supports of over-head transmission line, corona effect, insulators of O.H. lines and line parameters & performance of O.H. lines. And also the students are expected to learn the importance of underground cables in distribution systems, the distribution system types and calculation of electrical quantities for concentrated 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	Explain Energy sources, Electric Energy generation and Economics of generation.	1, PSO-2		
CO-2	Explain Standard voltages for transmission; describe AC & DC transmission, Corona, string efficiency of insulators and testing of insulators.	2	1, PSO-2	
CO-3	Explain Estimation of the inductance & capacitance O.H. lines and assess performance of O.H. lines.	2		PSO-2
CO-4	Explain Cable types, materials used, grading, testing and evaluation of inter sheath	1,2		PSO-2

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	potentials.			
CO-5	Explain Types of distribution systems, volume of copper used, designing of the feeder by applying Kelvin's law, Substations & Neutral Grounding.	1,2		PSO-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	2.75	3.0												1.25	

Prerequisites: 1.Basic Electrical Engineering.

Contents:

Unit-I

Generation : Sources of conventional energy sources, selection of site, classification – Hydroelectric, Thermal, Nuclear power plants - components & working, comparative study.

Factors influencing cost of energy - Demand factor, diversity factor, load factor, plant capacity factor, plant use factor, loss factor, energy load curve, load duration curve; Introduction to Load forecasting. **10 Hrs.**

Unit-II

Transmission lines: Typical transmission scheme, Standard voltages for transmission, Sag calculation in conductors, (a) Suspended on level supports (b) supports at different levels. Effect of wind, ice, tension and sag at erection. Stringing chart.

Corona: Phenomena, expression for disruptive and visual critical voltages and corona power loss.

Insulators: Types, potential distribution over a string of suspension insulators. String efficiency and methods of increasing string efficiency and testing of insulators.

12 Hrs.

Unit-III

Line parameters and Performance : Calculation of inductance of single phase and three phase lines with equilateral and unsymmetrical spacing. Inductance of composite conductor lines. Capacitance – Calculation for single phase systems and for 3 phase lines with equilateral and unsymmetrical spacing. Bundled conductors.Transposition of conductors. Performance calculation of Short, medium and long transmission lines: equivalent T and π network representation of long

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transmission lines. Line regulation and efficiency, ABCD constants. Line regulation. **12 Hrs.**

Unit-IV

Underground Cables: Types, material used. Insulation resistance, thermal rating of cables, charging current. Grading of cables, capacitance grading and inter sheath grading, testing of cable, problems**.** **09 Hrs.**

Unit-V

Distribution: Introduction: Radial and ring main systems, AC & DC distribution:calculation for concentrated loads, problems. Design of feeders-Kelvin's law.

Substations and neutral grounding: Classification of substations, substation equipments, earthing in substations, power system earthing, neutral groundingtypes. **09 Hrs.**

Reference Books:

1) Soni Gupta & Bhatnagar, "A Course of Electrical Power", 4/e,Dhanpatrai and Sons, 1981.
2) C. L. Wadhwa, "Electrical Power Systems", 2/e,Wiley Eastern, 1991.
3) S. M. Singh, "Electric Power Generation Transmission and Distribution",1/e, Prentice Hall of India Ltd.
4) J. B. Gupta, "A Course in Electrical Power", 12/e, S. K. Kataria, 2002.
5) H. Partab. "Utilization of Electrical Power".

18UEEL305 Digital Electronics and Verilog Lab (0-0-3)1.5

Contact Hours: 36

Course Learning Objectives(CLOs):

The students are expected to learn tosimplify, realize and verify logic circuits using basic, universal and special gates by conducting experiments. They learn to demonstrate the skills of implementation and verification of combinational MSI circuits both at gate level and IC level, sequential circuits for data storage, movement and conversion.To learn implementation and verification of synchronous and asynchronous sequential circuits for pattern generation/counting etc. and clock generation using timer ICs. They are required to use software tools to validate the design of circuits (Verilog).

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 knowledge of Simplifying the given expression	4		1

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	and implement minimal circuits.			
CO-2	Comprehend and Realize MSI circuits like arithmetic circuits, encoders, decoders with driver/display, multiplexers, DE multiplexers, priority encoders etc.	4	2	
CO-3	Apply the techniques for data manipulation and realize latches, flip flops, shift registers both at gate and IC level and validate by using Verilog	4, 5		2
CO-4	Design and test counter circuits,generate clock of desired frequency, pulse stretcher circuits, frequency division employing timer IC 555.	4, 5		

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	1.0	1.5		3.0	3.0										

Prerequisites:1.Basic electronics(preferred). 2. Digital fundamentals.

Contents:Prescribed Experiments:

Note: Minimum of 10 experiments to be conducted.

1. Simplification & realization of Boolean expressions using different gates. Simulation using Verilog.
2. Implementation of arithmetic circuits using basic/universal gates. Use 4-bit binary parallel adder IC 7483. Simulation using Verilog.
3. Implementation of Code converters: Binary to excess-3 using IC 7483, Excess-3 to Binary, Binary to Gray and Gray to Binary.
4. Realization of 2 to 4 line decoder and 4 to 2 encoder, priority encoder.
5. Realize BCD to 7-segment decoder/driver using IC 7446/7447.
6. Logic design using multiplexers and de-multiplexers using IC 74153 and IC 74139 respectively. Simulation using Verilog.
7. Implementation of flip flops using gates and study of IC 7446 and IC 7474. Simulation using Verilog.
8. Realization of 3-bit asynchronous up/down counter using IC 7476.
9. Design and implementation of mod-n (mod-6) counter using IC 7476 or IC 7474.

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10. Realization of shift registers using IC 7474: SISO, SIPO, PISO and PIPO.Bidirectional shift register and universal register. Shift register based counters i.e. ring counter and twisted ring counter with decoding logic.

11. Design and Implementation of astable and monostable multi-vibrators using timer IC 555.

12. Design of two bit magnitude comparator and study of IC 7485 4-bit magnitude comparator.

Reference Books/materials:

1) Laboratory Manual
2) Donald D. Givone,"Digital Principles and design" 1/e, TMH, 2004.
3) Morris Mano,"Digital Circuits & Logic Design", 4/e, Pearson Education 2007.
4) Malvino Leech, "Digital Circuits & Applications", 2/e, TMH, 2008.
5) Yarbrough, "Digital Logic Applications and Design", 2/e, Thomas publishing company, 1997.

18UEEL306 Analog Electronics Lab (0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The students are expected to realize Diode circuits and do analysis viz. rectifiers, wave shaping circuits**;** Design & implement CE amplifier using BJT/MOSFET, also learn to conduct experiments by designing Oscillator circuit using BJT and analyze Power amplifier.

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	Design and demonstrate the working of Diode rectifiers, clipping and clamping circuits, FET biasing circuits.	9,2	5, 6, PSO-3	
CO-2	Demonstrate the design fundamentals of Transistor and analyze MOSFET amplifiers.	9, 2	5, 3, 6	PSO-3

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CO-3	Perform and analyze fundamentals of oscillator circuits and feed-back amplifier.	9	5, 1, 2	PSO-3
CO-4	Preform and analyze class-B power amplifier		9	1, 2, 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	1.5	2.25	2.0		2.0	2.0			2.75						1.25

Prerequisites: 1. Basic Electronics
2. Course on Analog Electronics (Preferred)

Contents:

Prescribed Experiments: (**Note: Minimum of 10 experiments to be conducted.)**

1. Design of Rectifier (full wave) with filter
2. Stability analysis of BJT/FET
3. Clipping circuits using diodes
4. Clamping circuits using diodes.
5. Amplifier design using BJT/FET
6. R C Coupled Amp. Freq. response input & output impedance
7. Colpitt's Oscillator
8. Class B Power Amplifier.
9. RC phase-shift Oscillator
10. Summing amplifier using Op-amp.
11. Simulation of Voltage series feed-back
12. Simulation of Sub-tractor.

Reference Books/Materials:

1) Analog Electronics Laboratory manual.
2) Millman&Halkias, "Integrated Electronics", 5/e, McGraw Hill, 2005.
3) Sudhakar Samuel, "Electronics circuits", Sanguine Technical Publishers, 2005.
4) RamakantGayakwad, "Op-amp & LICs", 4th Edition, Eastern economy edition, 2004.

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IV Semester

18UMAC400	Engineering Mathematics-IV	(3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

To provide an insight into applications of conformal mapping, integration of complex functions and application of probability distributions in Engineering.

Course Outcomes (COs):

Description of the Course Outcomes: 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	Construct and use the concepts of analytic function to solve the problems arising in Engineering field.			1
CO-2	Utilize conformal transformation and complex integral to transform irregular domain onto a relatively simple domain.		1	
CO-3	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.		1	
CO-4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.		1,2	
CO-5	Estimate the correlation, covariance using joint probability distributions. Also use student's t-distribution,Chi-square distribution as a test of goodness of it.		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	1.8	2.0													

Pre-requisites: 1. A basic course on Differentiation and integration.
2. A basic course on probability and statistical averages.

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Contents:

Unit-I

Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms. Construction of analytic functions: Milne-Thomson method-Problems. **07 Hrs**.

Unit-II

Conformal transformations: Introduction. Discussion of transformations $w = e^z; w = z^2, w = z + \frac{1}{z}, z \neq 0$).Bilinear transformations- Problems.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's Integral theorem. **08 Hrs.**

Unit-III

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression–problems.

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form $= ax + b; y = ax^2 + bx + c; y = ax^b$. **08 Hrs**.

Unit-IV

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions-problems (No derivation for mean and standard deviation)-Illustrative examples. **08 Hrs**.

Unit-V

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness off it. **08 Hrs**.

Reference Books:

1) E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons 10th edition (Reprint) 2016.
2) 2.B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
3) 3.Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

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18UEEC400	Signals and Systems	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

Thestudents are expected to Learn and understand various types of signals and systems and their properties. They are also be aware of carrying out analysis and synthesis of signals using various transforms and to find system output using system impulse response and system equations.

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	Define signals and systems with its properties. Classify signals and check the periodicity, even and odd nature of the signal.	1, 2,		
CO-2	Represent LTI systems in time-domain using impulse response, differential/difference and block diagram approach.	1, 2		
CO-3	Represent periodic signal using Fourier series representation in both continuous and discrete time domain.	1, 2		5
CO-4	Represent non periodic signal using Fourier transform representation and illustrate applications	1, 2		5
CO-5	Solve Z-transform and IZT using different 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			1.0										

Prerequisites: 1. Engg. Mathematics.
2. Network Analysis.

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Contents:

Unit-I

Introduction: Definition of a signal and a system, classification of signals, basic operations on signals, elementary signals and systems viewed as interconnections of operations, properties of systems. **08 Hrs.**

Unit-II

Time-domain representation for LTI systems: Convolution, impulse response representation, properties of impulse response representation, differential and difference equation representations. Block diagram representations. **08Hrs.**

Unit-III

Fourier Series Representation of signal: Introduction, Fourier representations of periodic signal, Properties of Fourier series, Applications of Fourier series representation. **07 Hrs**.

Unit-IV

Fourier Transform Representation of signal: Introduction,Fourierpresentations of non-periodic signal, Properties of Fourier transform, Applications of Fourier transform representation. **07 Hrs.**

Unit-V

Z-Transforms: Introduction, Z-transforms, properties of ROC, properties of Z-transforms, inversion of Z-transforms, transforms analysis of LTI systems, transfer function, stability and causality, unilateral Z-transform and its application to solve difference equations. **09 Hrs.**

Reference Books:

1) Simon Haykin and Barry Van Veen, “Signals and Systems”, 2nd edition, John Wiley & sons, 2005.
2) Michel J Roberts, “Signals and systems: Analysis of signals through linear systems”, 2/e, Tata McGraw Hill, 2003.
3) Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”, 2nd edition, Pearson Education Asia, 1997.
4) Ganeshrao&Tunga, ”Signals & Systems”, 2004.
5) Uday Kumar S. “Signals & Systems” 6th Edition, Prism Publication, 2017.

18UEEC401	Microcontrollers	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

To understand the basic differences between microcontrollers and microprocessors and microcontroller architecture. To understand the different addressing modes and instruction set Assembly. Programs associated with 8051 Microcontroller. To write and test assembly and C language programs with a tradeoff between size and

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complexity using development tools. To understand the concepts of timers, interrupts, serial communication and memory interfacing to design an embedded system and to implement real time applications.

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 microprocessor & microcontrollers and write assembly programs for 8051.	1, 2		
CO-2	Write Assembly and C programs for 8051.	1, 2	5	
CO-3	Apply programming techniques for timers and serial communication.	1,2	3,5	
CO-4	Apply concepts of interfacing to implement controllers for applications using interrupts, memoryand data converters.	1,2,3	5	PSO 3
CO-5	Apply concepts of interfacing to implement controllers for applications using keyboard, display device, motors; Learn basic architecture of Advance microcontroller MSP 830.	3	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	2.6	2.8	2.5		2.0										1.0

Prerequisites: 1. Logic design.2. C programming language

Contents:

Unit-I

Microprocessors and Microcontrollers: Microcontrollers and Embedded Processors. RISC & CISC Architectures, Harvard & Von-Neumann CPU architecture.
The 8051 Architecture and Instruction set of 8051: Instruction set, Addressing modes, I/Oport programming, **10Hrs.**

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Unit-II

Assembly Language Programming: Assembly programming examples:addition subtraction, smallest and biggest no finding, palindrome, data serialization, code conversion, checksum byte program.

8051 programming in C: Data types and time delays in 8051, I/O programming, logic operation, data conversion programs, accessing code ROM space, data serialization. **12Hrs.**

Unit-III

Timer and Counter Programming of 8051 in Assembly and C: Programming 8051 Timers and counters in mode 1 and mode 2

Serial Communication and Programming of 8051 in Assembly and C: Basics of Serial Communication, 8051 connections to RS 232, DB 9 Pin Connector, 8051 Serial Communication Programming. **11Hrs.**

Unit-IV

8051 Interrupts, Programing in Assembly and C: Response of 8051 to interrupts, Interrupt types, Programing Timers, serial, external Hardware interruptsand Interrupt priority.

8051 Interfacing and Applications: Memory interfacing, 8255 interfacing, ADC and LM34/35 interfacing, DAC. **11Hrs.**

Unit-V

Display, Keyboard and Motor Interfacing to 8051: Interfacing 8051 to LCD,Keyboard, Stepper motor and DC motor Interfacing.

Introduction to Advanced Micro-controller: Architecture of MSP 430 Micro-controller, outline of its features. **08Hrs.**

Reference Books:

1) Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rolling D. Mekinlay - The 8051 Microcontroller and Embedded Systems-using assembly and C, Pearson, 2006.
2) Kenneth J. Ayala - The 8051 Microcontroller Architecture, Programming &Applications, 2nd edition, Thomson Learning, 2005.
3) Microcontroller and Applications by Dr. RamaniKalpathi and Ganesh Raja SanguinePublication
4) Raj Kamal - Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson, 2005.

18UEEC402 Electrical Machines-I (DC Machines & Transformers) (4-0-0)4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn the basic principle, construction, characteristics and operating modes of dc machines, the performance analysis and applications of

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dc machines. They also learn the basic principle, construction, characteristics and operating modes, the performance analysis and applications of single and three phase transformers. They are also exposed to the basic concepts, construction and characteristics of special electrical 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	ExplainElectromechanical Energy Conversion, the construction and working, e.m.f equation, armature reaction, draw the characteristics, numerical related to DC Generator	1, 2		
CO-2	Explain Principle, types, characteristics, necessity of Starter, speed control, testing &applications of DC motors.	1, 2		
CO-3	Explain Construction, operation, e.m.f equation, phasor diagram, determination of voltage regulation, all day efficiency & equivalent circuit of single phase transformer, Parallel operation,	1, 2		
CO-4	Comprehend the Single phase auto transformers:Principle,construction, determination of saving in copper, Construction, Types of connections, Magnetization characteristics and harmonics in three phase transformers and applications in transmission section.	1, 2		
CO-5	Explain the Construction, working, Drawing the characteristics ofdc servomotor, PMDC motor and universal motor	1		

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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: Basic Electrical Engineering

Contents:

Unit-I

Principle of Electromechanical Energy Conversion: Energy in magnetic system, field energy and mechanical force, mechanical energy. Doubly excited magnetic field systems. Forces/ Torques in systems with permanent magnets. Dynamical equations of electro mechanical systems.

DC Generators: Construction, emf equation, armature reaction, calculation of demagnetizing and cross magnetizing AT/pole. Compensating winding, commutation and inter poles, Characteristics and applications of different types of dc generators. **12Hrs.**

Unit-II

DC Motors:Principle, types, characteristics and applications of dc motors. Starters for dc shunt motors, speed control and braking of dc motors. Losses, efficiency and testing of dc machines (Swinburne's test, Hopkinson's test and retardation tests). Field test on dc series machines. **11Hrs.**

Unit-III

Single Phase Transformers: Construction of core and shell type transformers. Operation on no load and on load. Phasor diagrams. O.C., S.C and Sumpner's tests. Losses, efficiency and voltage regulation. Equivalent circuit and predetermination of performance. All day efficiency. Parallel operation and load sharing. **11Hrs.**

Unit-IV

Three Phase Transformer: Construction, star-star, star-delta, delta-star and delta-delta transformers, Scott connection and open delta connections. Magnetization characteristics and harmonics. Parallel operation, three winding transformers.

Auto Transformer: Single phase auto transformers: Principle, construction, saving in copper. Threephase auto transformers and applications. **09Hrs.**

Unit-V

Miscellaneous topics: Pulse transformer, Welding Transformer, Servo motors, PMDC motor, BLDC Motor, Stepper Motor, Universal motor. **09Hrs.**

Reference Books:

1) D.P.Kothari and I.J.Nagrath,"Electric Machines", TMH 4th Edition 2011
2) M.G.Say, "Performance and design of AC machines", 3/e, CBS Publications, 2002.
3) AshfaqHussain, "Electric Machines", 2/e, DhanpatRai& Co, 2005.
4) Mulukutla S. Sarma&Mukesh K. Pathak, "Electric Machines", 4th Indian Reprint 2011, Cengage Learning India Pvt. Ltd.

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18UEEC403 Control Systems (4-0-0) 4

Contact Hours: 52

Course Learning Objectives(CLOs):

The students are expected to learn the definition of control system, open loop and closed loop system, electromechanical systems, differential equations of physical systems and mathematical modeling. They will learn to formulate, solve and analyze control engineering problems. Further, they learn to check the stability of control systems using different techniques and also write simple MATLAB programs for 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	Distingush between open loop and closed loop systems, write the mathematical representation of electromechanical systems and reduction of block diagrams, demonstrate the transfer function of ac and dc servomotors	1,2	PSO 2	
CO-2	Develop the knowledge of signal flow graphs,Mason's gain formula and illustrate the time domain specifications.	1,2		4, PSO 2
CO-3	Examine the stability using Routh Hurwitz's criterion and introduction to types of controllers.	1,2		4
CO-4	Illustrate the stability analysis using root locus and get introduced to MATLABprogramming	1,2		4, 5 PSO 2
CO-5	Predict the stability analysis of frequency domain using Bode and Nyquist plots	1,2		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**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	3.0	3.0		1.0	1.0									1.25	

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Prerequisites: 1. Basic Electrical engineering.
2. Engineering Mathematics.

Contents:

Unit-I

Introduction: Definition of control systems, open loop and closed loop system comparison with examples. Electromechanical systems.Differential equations of physical systems.

Block diagram and reduction of block diagrams: Transfer function, Block diagram representation and reduction, Transfer functions of control components dc servomotor, two- phase AC servomotor. **11 Hrs**.

Unit-II

Signal flow graphs and reduction of signal flow graphs: signal flow graph representation and reduction using Mason's Gain formula.

Time response: feedback control system, standard test signals, unit step response of first and second order systems, examples, static error analysis, examples. **11 Hrs.**

Unit-III

Stability: Concept of stability, Relative stability analysis, stability for a second order system, Routh-Hurwitz stability criterion, examples, Introduction to P, PI and PID controllers. **09 Hrs.**

Unit-IV

Root locus: Concept, steps to solve the problems with root locus, advantages of root locus, examples on determination of gain constant and damping ratio.

Introduction to MATLAB: Obtaining transient response, Root locus, Bode plot using MATLAB, Exercises. Introduction to SIMULINK, P, PI & PID controllers using SIMULINK **11 Hrs.**

Unit-V

Frequency domain Analysis: Stability analysis, Bode plot and to obtain phase margin and gain margin of third order system, examples. **10 Hrs.**

Reference Books:

1) I. J. Nagrath and M. Gopal, "Control Systems Engineering", 3/e, Wiley Eastern Ltd, 2003.
2) K. Ogata, "Modern Control Engineering", 4/e, PHI, 2004.
3) B. C. Kuo, "Automatic control systems", 7/e, PHI.2000.
4) Gopal M., "Control System - Principles & Design", 4/e,TMH, 1984.
5) http://www.nptelvideos.in/2012/11/control-engineeringprof-gopal.html

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18UEEC404 Linear ICs and Applications (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn the basic working of Linear IC, design concepts of Linear ICs based circuits and solve relevant problems. They also learn to analyze electronic circuits even with the help of relevant software and fundamental design skills of analog systems using linear ICs which have immediate end application to Engineering problems.

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	Recall the basics and understand the stability issues of Opamp circuits.	1		
CO-2	Comprehend the fundamentals of MOS based Opamp circuits.	1		
CO-3	Apply the knowledge of basic Opamps in the linear circuit design.	2,3	PSO 3	
CO-4	Apply the knowledge of basic Opamps in the non-linear circuit design.	2,3		
CO-5	Analyze the performance of different Opamp circuits from the point of view of their applications.	2	5, PSO 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	3.0		2.0										2.0

Prerequisites: Basic/Analog Electronics

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Contents:

Unit-I

Review of basics: Ideal and practical Opamps, Performance parameters of Opamps. **Frequency response:** Requirement of circuit stability, Barrack Hussein's

criteria,Frequency compensation methods, Circuit bandwidth, Effects of slew rate andstray capacitance, Circuit stability precautions. **08 Hrs.**

Unit-II

CMOS Opamps: Comparison of BJT and MOS based Opamps. Basic CMOS Opamps. MOS differential amplifier, Single ended and differential amplifier, Quantitative and qualitative analysis (Only elementary treatment), Basic current mirrorcircuits,Cascode current mirror circuits. **07 Hrs.**

Unit-III

Opamp circuit design: Voltage follower, High input impedance Inverting and non-inverting amplifiers, Differentiator, Integrator, Precision rectifiers (half wave and full wave), Clippers, Clampers, Sample and hold circuits. **08 Hrs.**

Unit-IV

Design & Applications of Opamp Nonlinear Circuits: Comparators, Schmitt trigger, Square wave generators, Monostable multivibrators, Oscillators-Triangular wave generator, RC phase shift oscillator, Wein bridge oscillator, and Active filters-2nd order Butterworth low pass, high pass, band pass and band elimination filters.

07 Hrs.

Unit-V

Special ICs and applications: Phase locked loops (NE565), Analog to Digital Converters- Successive approximation, Dual slope and Flash type, Digital to Analog Converters- Binary weighted and R-2R type Regulated power supply, IC 723 Voltage regulator.

Self-learning component: Usage of modern tool for the simulation of Opamp based circuits. **09 Hrs.**

Reference Books:

1) Roy &Choudary, “Operational amplifiers and Linear Integrated circuits”, 2/e, New Age International 01-Jan-2003
2) Ramakanth A. Gayakwad, “Operational Amplifiers and Linear IC’s”3/e, Prentice Hall,2000.
3) David A. Bell,” Operation Amplifiers and Linear IC’s”,2/e, PHI, 2005.
4) BehzadRazavi, “Design of analog CMOS Integrated circuit “, Tata McGraw-Hill Education, 01-Oct-2002

18UEEL405	Measurement and Circuit Simulation lab	(0-0-3) 1.5

Contact Hours: 36

Course learning Objectives (CLOs):

The students are expected to learn conducting experiments to determine the resistance, inductance and capacitance of given specimen by using suitable bridges. The students learn to measure power in three phase circuit and to draw calibration

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curve of energy meter. They will also study to obtain transfer functions of ac, dc motors and learn to write simple MATLAB programs to solve control system problems.

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 skills of determining the values of circuit elements using bridges.		2, PSO 2	
CO-2	To measure power in three phase circuit and to draw the calibration curve of energy meter.		2, PSO 2	
CO-3	Demonstrate the knowledge of obtaining the transfer function of servomotors and write MATLAB program to steady state response		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**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level		2.0												2.0	

Prerequisites: 1. Basic Electrical Engineering.
2. Electrical and Electronics Measurements.

Contents:

Prescribed Experiments:

(**Note:** Minimum of 10 experiments is to be conducted.)

1. Measurement of resistance using Wheatstone Bridge
2. Measurement of resistance using Kelvin's Double Bridge.
3. Measurement of inductance using Anderson Bridge.
4. Measurement of capacitance by Schering Bridge.
5. Measurement of three phase power using two-wattmeter method.
6. To draw the calibration curve of single phase energy meter.
7. Transient response of second order system and determination of transient response specifications analytically and obtaining from experiment.
8. Verification of network theorems i) Maximum power transfer theorem ii) Superposition theorem
9. Verification of network theorems i) Thevinin's theorem ii) Reciprocity theorem

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10. Transient response of RL,RC and RLC circuits.
11. Study of series resonance
12. Study of digital energy meter.

Reference Books:

1) Measurements and control systems Laboratory Manual.
2) A. K.Sawhney, "Electrical & Electronic Measurements & Instrumentation", 10th edition, DhanpatRai& Sons, 2002.
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.

18UEEL406	Microcontroller Lab	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives(CLOs):

The students are expected to learn fundamentals of Assembly Language Programming, acquire logical skills for developing / implementing given problem, acquire Programming skills in embedded 'C' andunderstand and get the knowledge, about interfacing I / O s, mixed signal circuits and actuators.

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 fundamentals of assembly language and C programming skills.	9, 5	1, PSO 3	2
CO-2	Demonstrate on chip timer counters for counting, serial communication and generating waveforms.	9, 5	1, 2	3
CO-3	Demonstrate the interfacing of DAC and external ADC.	9, 5, PSO 3	1	3, 6
CO-4	Demonstrate the interfacing stepper motor and. LCD	9, 5, PSO 3	1	3, 6

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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	1.5	1.0		3.0	1.0			3.0						2.67

Prerequisites: Course on microcontrollers.

Contents:

Prescribed Experiments:**(Note: Minimum of 10 experiments to be conducted)**

I. PROGRAMMING:

1. Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array.
2. Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube – (16 bits Arithmetic operations – bit addressable).
3. Counters.
4. Boolean & Logical Instructions (Bit manipulations)
5. Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal - HEX
6. Programs using serial port and on-chip timer /counter.
   i. Program on serial communication.
   ii. Program on timer (on chip). Waveform generation using on chip timer of 8051on the ports of 8051.

II. INTERFACING:

C programs to interface 8051 chip to Interfacing modules to develop single chip solutions.

1. Alphanumeric LCD panel and Hex keypad input interface.
2. External ADC and Temperature control interface.
3. Generate different waveforms Sine, Square, Triangular, Ramp etc. using DAC interface; change the frequency and amplitude.
4. Stepper and DC motor control interface.Generate waveform of a particular frequency using on-chip timer.

Reference Books / Materials:

1) 1.Microcontroller Laboratory Manual**.**

2) 2. Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rolling D. Mekinlay, "The 8051 Microcontroller and Embedded Systems-using assembly and C:1/e, Pearson,2006.

3) 3.Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming & Applications", 2/e, Thomson Learning, 2005.

4) Predko, "Programming and Customizing the 8051 Microcontroller", 1/e, TMH,2004.

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18UEEL407	Introductory Project	(0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs):

The course is to provide an exposure to the students to identify simple societal problems and propose a technical solution. 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 Outcome: Upon completion 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 a socially/ technically relevant problem and formulate a problem statement		6	1
CO-2	Propose thetechnical approach towards the solution.		6	
CO-3	Implementthe solution.		6	3
CO-4	Prepare the report in a specified format.		10	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	1.0		1.0		3.0	2.0				2.0	1.0				

Contents:

Introductory project is introduced with an objective of understanding and identifying the community expectation in terms of possible Engineering solutions by applying the fundamental knowledge of basic sciences and basic engineering courses. The project shall be engineering oriented in terms of problem definition, related literature survey and existing solutions.

Evaluation:

The team consisting of 10-12 students shall be asked to identify the problems related to community and try to propose a 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 introductory project.

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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)**)**

Ph: **0836-2447465 Fax: 0836-2464638 Web:** www.sdmcet.ac.in

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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

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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

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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.

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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.

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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.

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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)

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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.

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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	---	

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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)

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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.**

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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		

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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.

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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		

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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

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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		

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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.

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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.

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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.**

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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

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	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.

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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.

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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

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	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

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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	

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	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.

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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

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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.

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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									

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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.**

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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		

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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

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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		

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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.

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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.

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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.

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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

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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.

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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

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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.

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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		

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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.**

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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

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	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.

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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	

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	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.**

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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	

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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.**

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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	

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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.

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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.

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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.**

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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.

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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

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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

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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.

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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.

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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.

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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)**

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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

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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.

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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		

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	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

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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		

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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

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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

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	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

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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	

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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.**

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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

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	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

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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	

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	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

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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	

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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.**

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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.

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Academic Program: UG

Academic Year 2021-22 Syllabus

VII & VIII 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)**)**

Ph: **0836-2447465 Fax: 0836-2464638 Web:** www.sdmcet.ac.in

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for VII & VIII 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

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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

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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.

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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.

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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.

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SDM College of Engineering and Technology, Dharwad
Dept. of Electrical & Electronics Engineering
VII 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.
18UEEC700	PC	Computer Applications to Power Systems	3-0-0	3	50	100	3	-	-
18UEEC701	PC	Electrical Machine Design	3-0-0	3	50	100	3	-	-
18UEEE74X	PE	Elective –IV	4-0-0	4	50	100	3	-	-
18UEEO703	OE	Open Elective-II	3-0-0	3	50	100	3	-	-
18UEEL704	PC	Relay, High Voltage & Power System Simulation Lab	0-0-3	2	50	-	-	50	3
18UEEL705	PC	Major Project-Phase I	0-0-6	2	50	-	-	50	3
18UEEL706	PC	Internship	0-0-6	2	50	-	-	-	-
		Total	**13-0-15**	**19**	**350**	**400**		**100**	

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

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Electric Vehicles (**Open Elective-II)**	18UEEO703
Elective-IV	
AI Applications to Power System	18UEEE741
Modern Trends in Transmission System	18UEEE742
Modern Power System Protection	18UEEE743
Modern Power System Operation and Control	18UEEE744
Digital Image Processing	18UEEE745
Arm Processors	18UEEE746
Embedded Systems	18UEEE747

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SDM College of Engineering and Technology, Dharwad
Department of Electrical & Electronics Engineering
VIII 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.
18UEEC800	PC	Industrial Utilization of Electric Power	4-0-0	4	50	100	3	-	-
18UEEE85X	PE	Elective-V	3-0-0	3	50	100	3	-	-
18UEEO802	OE	Open Elective–III	3-0-0	3	50	100	3	-	-
18UEEL803	PC	Technical Seminar	0-0-3	1	50	-	-	-	-
18UEEL804	PC	Major Project-Phase-II	0-0-14	7	50	-	-	50	3
		Total	**10-0-17**	**18**	**250**	**300**		**50**	

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

Micro Electro Mechanical Systems **(Open Elective-III)**	18UEEO802
Elective-V	
Modern Trends in Grid Integration	18UEEE851
Power System Dynamics and Stability	18UEEE852
Power System Restructuring and Power Quality	18UEEE853
Reliability Engineering	18UEEE854
Analog and Digital Communication	18UEEE855

Total credits offered during 2nd, 3rd and 4th year = 135

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VII Semester

18UEEC700	Computer Techniques in Power systems	(3 - 0 - 0) 3

Contact Hours: 39

Course learning objectives (CLOs):

The students are expected to learn about the formation of different matrices to represent the power system network and load frequency control techniques. It is required to understand the load flow studies and use of various numerical techniques for the same. The student should get exposure to optimal distribution of load and economic operation. Further, must know to carry out steady and transient states analysis using different 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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe importance of computer techniques in power system, form bus impedance and admittances matrices.	1, 2		
CO-2	Model single area and two area systems and analyse steady state and dynamic response of load frequency control,	1, 2		
CO-3	Analyse load flow using different techniques	1, 2		
CO-4	Determine Optimal distribution of load between the units with and without transmission line loss	1, 2		
CO-5	Analyse Transient stability studies using different 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. Electrical Power generation 2. Electrical Power Distribution and

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Utilization 3. Power System Analysis and Stability 4. Switchgear and Protection

Contents:

Unit-I

Bus incidence matrix: Primitive admittance matrix, Y-Bus by singular transformation. Algorithm for formation bus impedance matrix of single-phase system and numerical examples. **08 Hrs.**

Unit-II

Power System Control: Load frequency control, turbine speed governing system modelling. Block diagram representation of single area, steady state and dynamic response and Two-area load frequency control. **07 Hrs.**

Unit-III

Load flow studies: static load flow equations, types of buses, Gauss – Siedel iterative method using Y bus including PV bus, acceleration of convergence. Newton Raphson method in polar co-ordinates. Fast Decoupled load flow method. Representation of transformer fixed tap setting transformer, tap changing under load transformer. **08 Hrs.**

Unit-IV

Economic operation of power system: Optimal distribution of loads between units within a plant, Transmission loss as a function of plant generation, determination of loss coefficient and economic load dispatch with and without transmission line loss and numerical problems. **08 Hrs.**

Unit-V

Transient stability studies: Swing equation, Numerical solutions of differential equations: modified Euler's method, Runge Kutta IV order method Representation of synchronous machine for transient stability studies, load representation, Network performance equation and. Solution techniques with flowcharts. **08 Hrs.**

Reference Books:

1) Stag and El-Abiad, "Computer Methods in Power System Analysis", 1/e, McGraw Hill International, 1965
2) Uma Rao, "Computer Techniques and Models in Power Systems", I.K. International Publishing House Pvt. Ltd, 2007
3) Nagrath & Kothari, "Modern Power system Analysis", Tata McGraw Hill, 3/e, 2003
4) M. A. Pai, "Computer Techniques in Power System', Tata McGraw Hill, 2/e, 2014.

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18UEEC701	Electrical Machine Design	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn the Principles of Electrical Machine Design including magnetic and insulating materials, magnetic circuit calculations, heating and cooling aspects. Further, they are expected to independently design single phase and three phase transformers, DC machines, three phase induction motors and 3 phase synchronous 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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss the fundamentals of Electrical machine design and analyse the thermal aspects.	1, 2		
CO-2	Discuss design aspects of electromagnet and determine magnetic circuit parameters of electric machines.	2, 3		
CO-3	Design single phase and three phase transformers.	2, 3		
CO-4	Design DC machines and discuss basics of three phase Induction motor design	2,3		
CO-5	Design three phase induction motor and three phase synchronous machine.	2,3		

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	3	3												

Prerequisites: Electrical machines.

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Contents:

Unit-I

Principles of Electrical Machine Design: Introduction, specifications of different machines, Limitations, Conducting, magnetic and insulating materials used. Classification of solid insulating materials.

Heating and Cooling: Modes of heat dissipation in electric machines. Expression for temperature rise.Heating and cooling curves, related problems. **07 Hrs.**

Unit-II

Design of Electromagnets: Expression for magnetic pull, calculation flux density in the air gap, AT for airgap and iron parts calculation of coil current.

Magnetic circuit calculations: Magnetic circuit of rotating machines and transformers, Calculation of total mmf in case of dc machines. **08 Hrs.**

Unit-III

Design of single phase and three phase transformers: Output equations, expression for volt/turn, determination of main dimensions of the core, yoke and window, design of windings and arrangement of turns, estimation of no-load current, expression for leakage reactance, determination of no. of cooling tubes. **08 Hrs.**

Unit-IV

Design of DC machines: Output equation, selection of specific loadings, choice of no. of poles, design of main dimensions, slot design of poles, design of shunt and series field windings.

Design of three phase induction motors: Output equation, choice of specific loadings, design of main dimensions, stator winding design. **08 Hrs.**

Unit-V

Design of three phase induction motors: calculation of air gap length, selection of no. of slots of cage rotors, design of rotor bars and end rings, estimation of no-load current, design of slip ring induction motors.

Design of 3 phase synchronous machines: Output equation, choice of specific loadings, short circuit ratio, design of main dimensions, design of stator slots and windings, design of rotor of salient pole and cylindrical rotor machines. **08 Hrs.**

Reference Books:

1) A.K.Sawhney, “A course in Electrical Machine Design”, 6/e edition, Dhanpatrai & Co, 2006.
2) V. N. Mittle, “Design of Electrical Machines”, 4/e edition, standard publishers, and distributors, 2002.
3) R. K. Aggarwal, “Principles of Electrical Machine Design”, S. K.Kataria & Sons, 4/e, 2000.

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4) Shanmugasundaram, Gangadharan and Palani, “Electrical Machine Design data book”1/e, Willey Eastern Ltd.1979.

18UEEO703 Electric Vehicles (3 – 0 – 0) 3

Contact Hours:39

Course Learning Objectives (CLOs):

The students are expected to learn the working of Electric Vehicles and recent trends. To analyse different power converter topology used for electric vehicle application. To develop the electric propulsion unit and its control for application of electric vehicles. To design converters for battery charging and explain transformer less topology.

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 to12)/ PSO’s (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.	1,2		
CO-2	Explain the working of electric vehicles and hybrid electric vehicles in recent trends.	1,2		
CO-3	Energy storage for EV and charging from renewable and grid sources.	1,2		
CO-4	Develop the electric propulsion unit and its control for application of electric vehicles and	1,2		
CO-5	Basic Design of Electric Vehicles	1,2	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	3.0	3.0	2.0												

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Prerequisites: Power Electronics

Contents:

Unit-I

Vehicle Mechanics: Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power, Force-Velocity Characteristics, Maximum Gradability, Velocity and Acceleration, Constant FTR, Level Road, Velocity Profile, Distance Traversed, Tractive Power, Energy Required, Non-constant FTR, General Acceleration, Propulsion System Design. **07 Hrs**.

Unit-II

Electric and Hybrid Electric Vehicles: Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains. **08 Hrs.**

Unit-III

Energy storage for EV: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Super capacitors. Power Electronic Converter for Battery Charging: Charging methods for battery, Termination methods, charging from grid, charging from Renewable Energy Sources. **08 Hrs.**

Unit-IV

Electric Propulsion: EV consideration, DC motor drives, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration, and control of Drives. **08 Hrs.**

Unit-V

Design of Electric and Hybrid Electric Vehicles: Series Hybrid Electric Drive Train Design: Operating patterns, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of Parallel Hybrid Electric Drive Train Design: design of engine power capacity, design of electric motor drive capacity, transmission design. **08 Hrs.**

Reference Books:

1) Iqbal Husain - Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2) M. Ehsani, Y. Gao, S.Gay and Ali Emadi- Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2003.
3) Sheldon S. Williamson - Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.

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4) C.C. Chan and K.T. Chau - Modern Electric Vehicle Technology, OXFORD University, 2001.
5) Chris Mi, M. AbulMasrur, David WenzhongGao - Hybrid Electric VehiclesPrinciples and Applications with Practical Perspectives, Wiley Publication, 2011.

18UEEE741 AI Applications to Power System (4 - 0 - 0) 4

Contact Hrs: 52

Course Learning Objectives (CLOs):

The students are expected to learn basic concepts of AI, soft and hard computing. They study about artificial intelligence and relevance of fuzzy logic, fuzzification and defuzzification. Further, they are expected to learn genetic algorithms and apply AI techniques to power system applications.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss soft, hard computing techniques, expert systems, fuzzy systems, and genetic algorithm	1		2
CO-2	Illustrate the concepts of feed forward neural networks, learning and understanding of feedback neural networks.	3	1	2
CO-3	Design and develop fuzzy logic for simple systems.	3	1	2
CO-4	Design and develop genetic algorithms for simple systems.	3	1	2
CO-5	Assess Fuzzy logic, Expert System and Genetic Algorithm application in power systems operation and control.	3,5		

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	2.0	1.33	2.33		3.0										

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Prerequisites: 1. A course higher level language 2. Mathematics

Contents:

Unit-I

Introduction: Introduction, definition of AI, difference between soft computing techniques and hard computing systems, Expert Systems, brief history of ANN, Fuzzy Logic and Genetic Algorithm. **09 Hrs.**

Unit-II

Artificial neural networks: Introduction, human brain, model of artificial neuron, neural network architectures, characteristics of neural network, learning methods, architecture of back propagation network, back propagation learning. **11 Hrs.**

Unit-III

Fuzzy logic: Introduction, Fuzzy versus crisp, fuzzy sets - membership function – basic fuzzy set operations – properties of fuzzy sets, crisp relations- fuzzy Cartesian product, operations on fuzzy relations, fuzzy logic - fuzzy quantifiers-fuzzy inference, fuzzy rule-basedsystem, defuzzification methods. **12 Hrs.**

Unit-IV

Genetic algorithms: Working principles, difference between genetic algorithm and traditional methods, different types of coding methods, fitness function, reproduction, different types of cross over methods in genetic algorithm, mutation. **11 Hrs**.

Unit-V

Applications of AI techniques in electrical systems: Applications of ANN, Fuzzy logic, Expert System and Genetic Algorithm in power systems operation and control. **09 Hrs.**

Reference Books:

1) S.Rajasekaran,G.A.V.Pai, “Neural Networks, Fuzzy Logic & Genetic Algorithms” PHI,1/e,New Delhi, 2003.
2) Abe Springer, “Neural Networks and Fuzzy Systems Theory and Applications”, Science&Business Media, 2012.
3) D.E.Goldberg,” Genetic Algorithms” Pearson Education India,1/e, Dec -2006.
4**)** Weerakorn Ongsakul, “Artificial Intelligence in Power System Optimization” CRC Press, May-2013

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18UEEE742 Modern Trends in Transmission System (4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn FACTS concept, transmission interconnection, FACTs controllers, shunt, series, combined shunt and series connected controllers. The students are required to get exposure to power semiconductor devices like MOSFET, MOS turn OFF thyristor, emitter turn OFF thyristor, integrated gate commuted thyristor (GCT & IGCT). They are also required to learn Static shunt compensator SVC and STATCOM, general aspects of DC transmission and comparison of it with AC transmission and control of HVDC converters and 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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss the basic concepts of FACTS.	1, 2		
CO-2	Select power semiconductor devices and converter configuration for FACTS application.	1, 2		
CO-3	Analyse performance of shunt FACTS devices.	1, 2	3, 5	
CO-4	Analyse performance of series FACTS devices.	1, 2	3, 5	
CO-5	Discuss the configuration and performance of HVDC power transmission.	1, 2	5	
CO-6	Carry out a self-study in FACTS and HVDC in the form of Case study.	12		

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	2.0		2.0							3.0			

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Prerequisites: 1. Electrical Power Generation and Transmission 2. Electrical Power Distribution and Utilization 3. Power System Analysis and Stability 4. Switchgear and Protection 5. Power Electronics

Contents:

Unit-I

FACTS: Concepts and general system configuration: Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration, relative importance of controllable parameters, basic types of FACTS controllers, shunt, series, combined shunt, and series connected controllers. Significance of power semiconductor devices in FACTS application. **10 Hrs.**

Unit-II

Power semiconductor devices and converters for FACTS: Types of high-power devices, principle of high-power device characteristics and requirements, power device material, diode, MOSFET, MOS turn OFF thyristor, emitter turn OFF thyristor, integrated gate commuted thyristor (GCT & IGCT). Voltage sourced converters: basic concepts, single phase full wave bridge converter operation, square wave voltage harmonics for a single-phase bridge 3 phase full wave bridge converter. Self and line commutated current source converter: basic concepts, 3 phase full wave diode rectifier, thyristor-based converter, current sourced converter with turnoff devices, current sourced versus voltage source converter. **10 Hrs.**

Unit-III

Static shunt compensator SVC and STATCOM: Objective of shunt compensation, methods of controllable Var generation, static Var compensator, SVC and STATCOM, comparison between, SVC and STATCOM. **10 Hrs.**

Unit-IV

Static series compensators: Objectives of series compensation GCSC, TSSC, TCSC and SSSC, variable impedance type of series compensation, switching converter type series compensation, external control for series reactive compensators. **09 Hrs.**

Unit-V

HVDC transmission: Historical sketch, Comparison of HVAC and HVDC Transmission. Earlier practices, Present Trends-Thyristor valves, Self commutated valves, Active filters, Tunable ac filters, ac-dc measurements, DSP controllers, Compact station design.

Case study: Students have to carry out a self-study in FACTS or HVDC**.** **13 Hrs.**

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Reference Books:

1) Narian Hingorani, L Gyugyi," Understanding FACTS: concepts and technology offlexible AC transmission systems" IEEE Press ISBN 0-7803- 3455-8
2) K.R.Padiyar," HVDC Power Transmission Systems" 2/e, New Academic Science, 2011.
3) E.W. Kimbark, "Direct current Transmission"1/e, Wiley-Interscience,1971.
4) PrabhaKundur, "Power system stability and control" 9th reprint, TMH, 2007.
5) S. Rao, "EHV AC, HVDC Transmission & Distribution Engineering" 3/e, Khanna publishers, 2003.
6) HVDC and FACTS Controller- Application of static converters in Power System; Vijay K Sood Kluwer Academic Publishers 2004.

18UEEE743 Modern Power System Protection (4 – 0 – 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn Basic construction, classification, basic circuits, smoothing circuits, and output devices used in static relays. Further, the students must have exposure to digital/ numerical relays &numerical protection system, relaying algorithms.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Illustrate the knowledge of microprocessor based static relay and Microprocessor based digital protection	1,2		
CO-2	Apply the knowledge of Over current protection schemes for transmission lines	1,2	3	
CO-3	Illustrate DSP based relay algorithms.	1,2		
CO-4	Apply the knowledge of distance protection schemes	1,2		

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	for transmission lines and			
CO-5	Understand protection of Induction motor.	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	2.0												

Prerequisites: 1.Digital Signal Processing 2.Switchgear and Protection

Contents:

Unit-I

Solid State Relays: Introduction, Microprocessor-based static relay, types of electronic circuits in a static protection system, Advantages and limitations of static relays, Comparators, Instantaneous over current relay, definite time over current relay, inverse-time over current relay, directional over current relay, Basic radial feeder, methods of discrimination, Rules for setting the IDMT relays. **12 Hrs**.

Unit-II

Microprocessor-Based Digital Protection: Advantages of numerical relaying, Numerical relay hardware, Data Acquisition system, Sample and Hold Circuit, Sampling theorem, Anti-Aliasing Filter, Estimation of Phasors. **10 Hrs.**

Unit-III

Relaying Algorithms: Mann and Morrison Algorithm, Three Sample technique, First and second derivative algorithm, Two sample technique, differential equation algorithm, Application of Differential Equation algorithm to three-phase line, LSQ Algorithm by Sachdev**.** **12 Hrs.**

Unit-IV

Protection of Transmission Lines by Distance Relay: Types of Distance relays, Stepped distance characteristics of a distance relay, Problems in distance measurement, Limitations of distance protection for transmission lines. **09 Hrs.**

Unit-V

Induction Motor Protection: Starting of Induction motor, Faults in induction motors, Abnormalities of induction motors, Protection of small induction motors, Protection of large induction motors. **09 Hrs.**

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Reference Books:

1) Badriram & Vishwa Karma – "Power System Protection & Switch Gear"1/e, TMH, 1995.
2) Bhuvanesh A Oza, Nirmal Kumar C Nair, Rashesh P Mehta &Vijay H Makwana – "Power System Protection and Switchgear", 1/e, McGraw Hill Education India, 2016.
3) Ravindranath & Chander - Power System Protection & Switch Gear, New Age Publications, 2005.
4) S. R. Bhide – "Digital Power System Protection", 1/e, PHI Learning, 2014.

18UEEE744 Modern Power System Operation and Control (4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn SCADA, control canter, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, generation control loops, Load frequency control (LFC) modelling, steady state frequency deviation, AGC in single area system and multi area system and tie line bias control. Further, they are required to get exposure to reactive power & voltage control, optimal dispatch of generation and Unit Commitment.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the concepts of SCADA, AGC, Tie-lines and analyse the process of frequency deviation in power system.	1,2		
CO-2	Develop LFC block diagram and analyse it using MATLAB.	1,2		5
CO-3	Develop AVR block diagram and analyse it using MATLAB and describe the	1,2		5

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	secondary voltage control methods.			
CO-4	Exhibit the knowledge of economic dispatch of thermal units using optimization techniques.	1,2		PSO-1
CO-5	Exhibit the knowledge of Unit commitment and explore its 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	3			1								1		

Prerequisites: 1. Power System Analysis and Stability 2. Control Systems

Contents:

Unit-I

Control center operation of power systems: Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model. **10 Hrs.**

Unit-II

Power system Control: Basic generation control loops, Load frequency control (LFC) modeling, steady state frequency deviation, AGC in single area system and multi area system, tie line bias control. examples to be solved with MATLAB & Simulink. **10 Hrs.**

Unit-III

Reactive Power and voltage control: Automatic voltage control (AVR)modeling, steady state voltage response, excitation system stabilizer-rate feedback, and PID controller, power flow through transmission line, relation between voltage, real power and reactive power, supplementary methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse. Examples to be solved using MATLAB and Simulink. **10 Hrs.**

Unit-IV

Optimal dispatch of generation: Introduction, equality and inequality constraints, operating cost of thermal plant, economic dispatch neglecting losses and no generator limits, economic dispatch neglecting losses and including generator limits, economic dispatch including losses. Examples. **10 Hrs.**

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Unit-V

Unit Commitment: Statement of the problem, need and importance of unit commitment, example with shut down rule, constraints, Spinning reserve, thermal unit constraints and other constraints, Unit commitment solution methods-priority lists method, dynamic programming method.

Power system security: Introduction, factors affecting security, contingency analysis, detection of network problems, calculation of network sensitivity factors. **12 Hrs.**

Reference Books:

1) G. L. Kusic, “Computer Aided Power System Analysis”, 2/e, Taylor & Francis, 2008.
2) Hadi Saadat, “Power System Engineering”, 2/e TMH, 2002.
3) Kotrhari, Nagrath “Power System Analysis”, 2/e, TMH, 2008.
4) A. J. Wood & B. F. Woolemberg, “Power Generation, Operation and Control”, 1/e, JohnWiley, and Sons,1984.

18UEEE745	Digital Image Processing	(4 – 0 – 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are required to learn fundamentals of image processing such as image sampling, quantization, various image enhancement techniques in spatial and frequency domain, colour image processing, and concepts of detection of discontinuities, edge linking and boundary detection.

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 to12)/ PSO’s (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite fundamentals of image processing	1		
CO-2	Describe image enhancement in spatial and frequency domains and use suitable image enhancement technique based on application.	1		
CO-3	Explain and compare various image restoration techniques	1	5	PSO-2

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CO-4	Explain and Compare various image segmentation techniques	1	5	
CO-5	Explain the fundamentals of colour image processing	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	3.0				2.0									1	

Prerequisites: 1. A course on Analog Electronic circuits
2. A course on Digital Electronics

Contents:

Unit-I

Introduction: Fundamental steps in digital image processing, Components of digital image processing systems.

Digital Image Fundamentals: Elements of visual perception, Image sensing and acquisition, Image sampling and quantization, Basic relationship between pixels, Linear and nonlinear operations. **10 Hrs.**

Unit –II

Image Enhancement in Spatial Domain: Basic Gray level transformation, Histogram processing, Enhancement using arithmetic and logic operations, Spatial filtering, Smoothing, and sharpening spatial filters.

Image Enhancement in Frequency Domain: Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering. **11 Hrs.**

Unit - III

Image Restoration: Noise models, Restoration in the presence of noise, Spatial filtering, Periodic noise reduction by frequency domain filtering, Linear position invariant degradation, estimating degradation function, Inverse filtering, Minimum mean square error filtering, Constrained least squares filtering, Geometric mean filter, Geometric transformations. **11 Hrs.**

Unit -IV

Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region-based segmentation. **10 Hrs.**

Unit -V

Colour Image Processing: Colour fundamentals, Colour models, Pseudo colour image processing, Basics of full colour image processing, Colour transformations, Smoothing and sharpening concept. **10 Hrs.**

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Reference Book:

1) C Gonzalez and Richard E Woods, Rafael, "Digital Image Processing", 2/e,Pearson Education, 2005.
2) Anil K Jain, "Fundamentals of Digital Image Processing", Pearson Education,PHI,2001
3) B Chanda and D DuttaMajumdar, "Digital Image Processing and Analysis", PHI, 2003.
4) Milan Sonka, Vaclav Hlavac&Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomoson Learning, 2001.

18UEEE746 ARM Processor (4- 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

To learn fundamentals of ARM architecture and ARM embedded systems. To acquire and develop logical and Assembly Programming skills. To understand about the interrupt structure in ARM and Embedded Operating 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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the fundamentals of ARM architecture and embedded system.	1		
CO-2	Illustrate ARM instruction set.	1, 2	5	
CO-3	Demonstrate ARM and Thumb instructions usage and synthesize simple programs using Arm/Thumb instructions.	5	1, 2	
CO-4	Describe interrupt structure & handling, and discuss fundamentals of embedded operating system	1, 2		
CO-5	Analyse C programs to compile on ARM architecture.	3, 5		

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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	2.75	2.67	3.0		2.67										

Prerequisites: Microcontrollers

Contents:

Unit-I

ARM Embedded System: The RISC Design Philosophy, ARM Design Philosophy, Embedded System Hardware and Software.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Assembler directives viz AREA, DCB, DCW, DCD. EQU, ENTRY, ALIGN, END. **11 Hrs.**

Unit-II

Introduction to the ARM Instruction Set: Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software Interrupt Instruction, Program Status Register Instructions,Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions Loading constant, Conditional Execution. **10 Hrs.**

Unit-III

Introduction to the Thumb Instruction Set: Thumb programmer's model**,** Thumb Register Usage, ARM-Thumb Interworking, Thumb other Branch Instructions and SWI instruction, Data Processing Instructions, Single-Register Load-Store Instructions, Multiple-Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction.

Programming using ARM and Thumb Instructions: Programming examples using ARM and Thumb, SWI, Arithmetic and logical examples. **11 Hrs.**

Unit-IV

Exception and Interrupt Handling: Exception Handling Interrupts, Interrupt Handling Schemes Viz. Non-nested, Nested

Embedded Operating Systems: Fundamental Components, Example: Simple Little Operating System. **11 Hrs.**

Unit-V

Efficient C programming: Basic C data types, C looping structures, allocation, C function calls, Pointer aliasing, structure arrangement, Inline functions and assembly, Bit fields Portability issues. **10 Hrs.**

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Reference Books:

1) Andrew Sloss, Dominic Symes, Chris Wright, “ARM System Developer’s Guide: Designing Optimizing System Software”,2/e, Morgan Kaufmann, 2004.
2) Steve Furber, “ARM System-on-Chip Architecture”, 2/e, Pearson Education,2000.
3) ARM Assembly Language fundamentals and Techniques, Fourth Impression2013,by William Hohl, (CRC press).

18UEEE747 Embedded Systems (4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn about Embedded Systems**.** Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. They also know Sensors and Actuators, Communication Interface, Development Languages, RTOS Based Embedded System Design, Operating System Task Scheduling, memory management. Further they are exposed to Device Drivers, Integration and Testing of Embedded Hardware, Firmware and Advanced Microcontrollers.

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 to12)/ PSO’s (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Outline the difference between embedded and desktop system.		1	
CO-2	Recognize the best technology suitable for embedded systems		1, 3	
CO-3	Explain real-time operating systems & basic kernel services of an OS and concept of task, processes & threads, basic of Multi-tasking and different scheduling algorithms,	1		
CO-4	Comprehend different types of message passing techniques &analyse inter process communication & the need for task synchronization in Multi-tasking environment	1	3	

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CO-5	Demonstrate the knowledge of integration and testing of embedded systems including advanced microcontrollers.	4		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		2.0	3.0											

Prerequisites: 1. Microcontrollers 2. C-programming language

Contents:

Unit-I

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. **09 Hrs.**

Unit-II

Typical Embedded System: Core of the Embedded System, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System components, Embedded Firmware Design Approaches and Development Languages. **11 Hrs**.

Unit-III

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling. **10 Hrs**.

Unit-IV

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS. **10 Hrs.**

Unit-V

Integration and Testing of Embedded Hardware and Firmware & Advanced: Microcontrollers, Out of Circuit Programming, in system Programming, in application Programming, Use of Factory Programmed Chip, Overview of PIC and ATMEL Family of Microcontrollers. **12 Hrs**.

Reference Books:

1) Shibu K.V, "Introduction to Embedded Systems" 1/e,Tata McGraw Hill, 2013.
2) Jonathan W. Valvano, "Embedded Microcomputer Systems", 3/e, Cengage Learning, 2011.

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3) Lyla B. Das, “Embedded Systems an Integrated Approach”, First Impression, Pearson, 2013.
4) Raj Kamal, “Introduction to Embedded Systems”, Tata McGraw Hill, 2/e, 2008.
5) Tammy Noergaard, “Embedded Systems Architecture: A Comprehensive Guidefor Engineers and Programmers”,Newnes,2/e, 2012.

18UEEL704 Relay, High Voltage & Power System Simulation Lab (0 - 0 - 3) 2

Contact Hours: 36

Course Learning Objectives (CLOs):

The students are expected to learn to independently handle the engineering practices in power systems, High voltage Engineering, Protection by conducting various experiments. They are to learn to formulate the circuit/system/experimental set up/work set up, operate the circuit, record the observations, tabulate the results indicating one specimen calculation, plot the curves if any and finally present the results/inference with justification and prepare laboratory report. Further they get exposure to the contemporary technological happenings and accordingly make use of software packages, tolls to find the solution for power system related problems.

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 to12)/ PSO’s (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Form Y bus and calculate solution for swing equation	9, POS-3	5	4
CO-2	Carry out load flow analysis, fault studies	9, POS-2	5	4
CO-3	Determine the characteristics of different relays	9, POS-2	5	4
CO-4	Determine breakdown strength of air and oil	9, POS-2	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				1.0	2.0				3.0					3	3

Prerequisites: 1. Power system Analysis and Stability
2. High Voltage Engineering

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3. Switchgear and Protection

Contents:

Minimum of 10 experiments to be conducted from the list given below.
Expt.1. Y Bus formation by inspection/ singular transformation method.
Expt.2. Swing equation by RK method.
Expt.3. Load flow analysis by GS/NR method.
Expt.4. Fault studies using power system toolbox.
Expt.5. Operating characteristics of electromechanical relay.
Expt.6. Operating characteristics of static relay.
Expt.7. Operating characteristics of Negative sequence relay.
Expt.8. Characteristics of % differential relay.
Expt.9. Operating characteristics of microprocessor based over-current relay.
Expt.10 . Induction motor protection using numerical relay.
Expt.11. Break down strength of air by sphere gap method-demonstration.
Expt.12. Break down strength of transformer oil- demonstration.

Reference Books/Material:

1. Laboratory manuals.
2. Relevant books prescribed for the prerequisite subjects.

18UEEL705	Major Project - Phase I	(0 - 0 - 6) 2

Contact Hours: 72

Course Learning Objectives (CLOs):

The students are expected to learn carrying out literature survey to locate the state-of-the-art technology while formulating/defining the project problem in engineering domain of their interest. The students are expected Select a topic from an emerging area relevant to electrical sciences and/or other relevant branches and define the problem for the project work. The material collection, survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The same work will be continued in the next phase in VIII semester.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Carry out the literature survey to locate the state-of-the-art	2		4, 5, PSO-2, PSO-3

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	technology in his Engineering field of interest			
CO-2	Define/formulate the problem for the project work	2, 3	1, 4, 5	PSO-2, PSO-3
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code etc. relevant to his project work	3	5	7, 8, 9, 12, PSO-2, PSO-3
CO-4	Summarize the work into a project report and in all can carry out the technical work assigned		10	6, 8, 11, PSO-2, PSO-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	2.0	3.0	3.0	1.5	1.6	1.0	1.0	1.0	1.0	2.0	1.0	1.0		1.0	1.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous semesters and relevant value-added information.

Contents:

Major project phase-1 in which the students are expected to locate the state of the art technology in his 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. The material collection, survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The project shall consist of a team of students not more than 4. Each batch shall be assigned with a guide. A committee consisting of minimum 3 faculty members of which guide is a member shall evaluate at the end for CIE. 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.

General Instructions to Students:

1. Students are expected to perform extensive literature survey, identify problem statements and prepare synopsis in consultation with project guide/supervisor. Students are expected to submit synopsis- Initial (Registration Phase-1) approved by project guide, to the project coordinator as per the schedule notified. A copy is to be maintained with students and the guide. This registration/ Initial synopsis

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contains the description of the project concept created and acts as a base line for design and Implementation of the system.

2. Notification/schedules and evaluation procedures will be sent to all students in the Google groups created in the department.
3. Evaluation of problem statement/synopsis-Initial (registration phase-1), Literature Survey and SRS (Requirement Analysis Phase-1) are done in the 7th semester.

Sl No	Parameters for Assessment	% of weightage for CIE and SEE
P1	Project Synopsis/ Proposal Evaluation	15
P2	Literature survey/Technology used / Architectural design	15
P3	Requirement Analysis (SRS)	15
P4	Design methodology/Demonstration of tool used for designing	10
P5	Implementation modules	15
P6	Discussion of test cases /Project demonstration	15
P7	Project Report(phase-1 and Phase-2)	10
P8	Paper Publication / Presentation	05

Reference materials/books:

1. Engineering books.
2. Journals.
3. Manuals and data sheets.
4. Software packages.
5. Previous project reports.
6. Product information brochures.
7. Interaction with academia and industrial experts.
8. Internet.

18UEEL706 Internship (0 - 0 - 6) 2

Duration: 4 Weeks.

The students are to undergo internship in Private industries/R&D organizations/Centers of Excellence/Laboratories of Reputed Institutions/Govt. & Semi Govt. organizations, PSUs, construction companies, entrepreneurial organizations, inter departments within the college etc. to get an exposure to the external world for a

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period of **4 weeks** in the summer vacation after VI sem and before start of VII semester. The students are to prepare a report on the internship work carried out. The internal faculty shall monitor the student and award CIE marks. The student shall present his/her work before a panel of examiners consisting of HoD, Guide and one faculty member during VII semester as final exam. The performance shall be communicated to the CoE office and the same shall reflect in the VII semester grade card.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	Know the industrial environment.	1,10	7,9,11	6,12
CO-2	Acquire knowledge and skill to use in professional career.	1	2,4,5	3
CO-3	Acquire the ability of report preparation and presentation skills.	8,10		
CO-4	Follow the code of practice in Electrical & Electronics Engineering related activities.	1		6,8

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	3.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	2.0	3.0	2.0	1.0			

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value added information.

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VIII Semester

18UEEC800	Industrial Utilization of Electric Power	(4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn the different electric drives, their selection, and dynamics. Further, they are required to evaluate their performance under transient and study state conditions. They are required to know the performance of specific drives like DC motors, Induction motors and Synchronous motors, their suitability and applications in various industries. It is expected that they are to be aware of new control mechanisms of industrial drives.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Understand the concepts of electrical drives system and dynamics (both transient and steady state) and apply this knowledge to solve numerical.	2		
CO-2	Determine the motor rating selection based on the duty and thermal model for heating and cooling.	2		
CO-3	Analyze the DC Motor Drive characteristics and their control through power electronic systems and apply this knowledge to solve numerical.	2		
CO-4	Analyze the Induction Motor Drive characteristics and their control through power electronic systems and hence be able to solve numerical.	2		
CO-5	Analyze the Synchronous Motor Drive characteristics and their control through power electronic	2		

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	systems.			
CO-6	Understand the process involved in important industries and develop reasoning for the application of specific electric therein.	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													

Prerequisites: 1. AC and DC Machines.2. Power Electronics.

Contents:

Unit-I

Introduction to Electrical drives & its dynamics: Parts of electrical drives; Merits & Demerits; choice of electrical drives; status of dc and ac drives. Dynamics of electrical drives; Fundamental torque equation; speed torque conventions; four quadrant operation. Equivalent values of drive parameters. Components of load torques; nature and classification of load torques. Calculation of time and energy loss in transient operations; Steady state stability. **10 Hrs.**

Unit-II

Selection of motor power rating: Thermal model of motor for heating and cooling, Classes of motor duty, determination of motor rating for Continuous duty, fluctuating duty, short time duty and periodic duty. **10 Hrs.**

Unit-III

D C Motor Drives: Starting; Braking; Transient analysis. Single phase fully controlled rectifier control of dc separately excited motor. Three phase fully controlled rectifier control of dc separately excited motor. Multi quadrant operation of dc separately excited motor fed form fully controlled rectifier. Rectifier control of dc series motor. Chopper control of separately excited dc motor. Chopper control of series motor.

10 Hrs.

Unit-IV

Induction motor Drives: Operation with unbalanced source voltage and single phasing; Starting; Braking; Transient analysis. Stator voltage control; Variable voltage, frequency control from voltage sources; Voltage source inverter control; Current source inverter control, Rotor resistance control, Slip power recovery, Speed control of single-phase induction motors. **10 Hrs.**

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Unit-V

Synchronous motor Drives: Synchronous motor Drive Basics; Operation form fixed frequency supply; Synchronous motor variable speed drives; Variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thyristor inverter. **08 Hrs.**

Industrial Drives: Rolling mill drives; Cement mill drives; Paper mill dries; Textile mill drives. **04 Hrs.**

Reference Books:

1) G.K. Dubey, "Fundamentals of Electrical Drives", 2 Edition, 5/e reprint Narosa publishing house Chennai, 2002.
2) N.K. De and P.K. Sen, "Electrical Drives", PHI, 2007.
3) S.K. Pillai, "A first course on electric drives" 1/eWiley Eastern Ltd 1990.
4) V.R.Moorthi,"Power Electronics, Devices, Circuits and industrial applications",2/e Oxford University Press, 2005.

18UEEO802 Micro Electro Mechanical Systems (MEMS) (3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn the history of MEMS, motivation, scaling in micro-domain, Mechanical and other properties of materials used in MEMS and Micro-fabrication/Micromachining. They also learn about transduction principles, MEMS modeling, radio frequency (RF) MEMS and optical MEMS. They are required to get exposure to nanotechnology.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the basics of MEMS technology and apply scaling laws.	1, 2		3
CO-2	Describe materials required and discuss fabrication processes.	1, 2	3	
CO-3	Explain transduction principles and carry out modeling.	1, 2		

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CO-4	Discuss the construction and working of RF and Optical MEMS.	1, 2	5	
CO-5	Discuss the issues in handling nano products with the help of MEMS.	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	1.5		2.0										

Prerequisites: Measurements and Instrumentation, Basic Communication (preferred)

Contents:

Unit-I

Introduction to MEMS technology: Introduction to MEMS and motivation, definitions, history of MEMS. How small is different- some natural examples, Scaling laws in electrostatic, electromagnetic, rigidity of structures, heating & cooling, Fluid viscosity and fluid interfaces, etc. Scaling in overall system performance considering multiple physical domains **08 Hrs.**

Unit-II

Mechanical and other properties of materials used in MEMS. Overview of micro-fabrication, Review of microelectronics fabrication processes like photolithography, deposition, doping, etching, structural and surface materials, and other lithography methods, MEMS fabrication methods like surface, bulk, LIGA and wafer bonding methods. **08 Hrs.**

Unit-III

Transduction principles in micro-domain. Basic modeling elements in electrical-mechanical, thermal, and fluid systems, analogy between 2^{nd} order mechanical and electrical systems. Modeling elastic, electrostatic, electromagnetic systems. **08 Hrs.**

Unit-IV

RF-based communication systems, RF – MEMS like MEMS inductors, varactors, tuners, filters, resonators, phase shifters, switches. Optical MEMS: Preview, passive optical components like lenses and mirrors, actuators for active optical MEMS. **08 Hrs.**

Unit-V

Nanotechnology and MEMS: Relation between micro and nanotechnologies. Need and issues in handling nano products with the help of MEMS. **07 Hrs.**

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Reference Books:

1) Tai, Ran Hsu," MEMS and Microsystems Design and Manufacture", TMH, 2002, Chang Liu, "Foundations of MEMS" Pearson International Edition, 2006, ISBN 0-13-199204.
2) Nitaigour Premchand Mahalik, "MEMS", 2/e, TMH, 2007.
3) Madou, "Fundamentals of Micro fabrication", CRC Press, 1997, ISBN 0-8493-9451- (Micro fabrication for MEMS + some information on materials and devices.)
4) Nadim Maluf, Kirt Williams, "An Introduction to Micro electromechanical Systems Engineering",2/e, Artech House, 2004.

18UEEE851	Modern Trends in Grid Integration	(3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn and explain power generation by alternate energy source like wind power and solar power. They learn to explain selection of size of units and location for wind and solar systems. They will learn the effects of integration of distributed generation on the performance the system. Further, they will be able to provide practical and useful information about grid integration of distributed generation.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the concepts and Explain energy generation by wind power and solar power. Discuss the variation in production capacity at different time scales, the size of individual units, and the flexibility in choosing locations with respect to wind and solar systems.	2,3	1	
CO-2	Explain the performance of the system when distributed generation is integrated to the system.	2,3	1	

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CO-3	Discuss effects of the integration of DG: the increased risk of overload, increased losses, increased risk of overvoltage and increased levels of power quality disturbances.	2,3	1	
CO-4	Discuss effects of the integration of DG: incorrect operation of the protection.	2,3	1	
CO-5	Discuss the impact the integration of DG on power system stability and operation.	2,3	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	2.0	3.0	3.0												

Prerequisites: 1.Electrical Power Generation and Transmission and Distribution.
2. Renewable Energy Sources.

Contents:

Unit-I

Distributed Generation: Introduction, status, Properties of wind power, Power Distribution as a function of wind speed, Solar Power: Status, Properties, Space requirements, Photovoltaic's, Seasonal variation in production capacity, Combined Heat-and-Power: Status, Options for space Heating, Hydropower: Properties of Large Hydro, Properties of small Hydro, Variation with time, Tidal Power, Wave Power, Geothermal Power, Thermal Power Plant. **08 Hrs.**

Unit-II

Distributed Generation (continued): Interface with the Grid. Power System Performance: Impact of Distributed Generation on the Power System, Aims of the Power System, Hosting Capacity Approach, Power Quality, Voltage Quality and Design of Distributed Generation, Hosting Capacity Approach for Events, Increasing the Hosting Capacity. Overloading and Losses: Impact of Distributed Generation, Overloading: Radial Distribution Networks, Active Power Flow Only, Active and Reactive Power Flow Overloading: Redundancy and Meshed Operation, Redundancy in Distribution Networks, Meshed Operation, Losses. **08 Hrs.**

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Unit-III

Over loading and Losses (continued): Increasing the Hosting Capacity: Increasing the Load ability Building New Connections, Inter trip Schemes, Advanced protection Schemes, Energy Management Systems. Power Electronics approach, Demand Control, Prioritizing Renewable Energy, Dynamic Load ability.

Voltage Magnitude Variations: Impact of Distributed Generation, Voltage Margin and Hosting Capacity: Voltage Control in Distribution Systems, Voltage Rise Owing to Distributed Generation, Hosting Capacity, estimating hosting capacity without Measurements, Sharing hosting capacity. Design of Distribution Feeders: Basic Design Rules, Terminology, An Individual Generator Along a Medium-Voltage Feeder, Low voltage feeders, Series and Shunt Compensation, A Numerical Approach to Voltage Variations: Example for Two-stage Boosting, General Expressions for Two-Stage Boosting Tap Changers with Line- Drop Compensation: Transformer with One Single Feeder, Adding a Generator. Probabilistic Methods for Design of Distribution Feeders: Need for Probabilistic Methods, The System Studied, Generation with Constant Production, Adding Wind Power. **08 Hrs.**

Unit-IV

Voltage Magnitude Variations (continued): Statistical Approach to Hosting Capacity, Increasing the Hosting Capacity: New or Stronger Feeders, Alternative Methods for Voltage Control Accurate Measurement of the Voltage Magnitude Variations, Allowing Higher Overvoltage's Overvoltage Protection, Over Voltage Curtailment Compensating the generators voltage variations, Distributed generation with voltage control, Coordinated voltage control.

Power Quality Disturbances: Impact of Distributed Generation, Fast Voltage Fluctuations: Fast Fluctuations in Wind Power, Fast Fluctuations in Solar Power, Rapid Voltage Changes, Very Short Variations. Voltage Unbalance: Weaker Transmission System, Stronger Distribution System, Large Single- Phase Generators, Stronger Distribution Grid Voltage Unbalance. **08 Hrs.**

Unit-V

Power Quality Disturbances(continued): Low-Frequency Harmonics: Wind Power: Induction Generators, Generators with Power Electronics Interfaces, Synchronous Generators, Measurement Example, Harmonic Resonances, Weaker Transmission Grid, Stronger Distribution Grid. High-Frequency Distortion: Emission by Individual Generators, Grouping Below and Above 2 kHz, Limits Below and Above 2 kHz, Voltage Dips: Synchronous Machines Balanced Dips and Unbalanced Dips, Induction generators and unbalanced dips. Increasing the Hosting Capacity: Strengthening the Grid, Emission Limits for Generator Units, Emission Limits for Other Customers, Higher Disturbance Levels, Passive Harmonic Filters, Power Electronics Converters, Reducing the Number of Dips, Broadband and High-Frequency Distortion. **07 Hrs.**

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Textbook:

1) Integration of Distributed Generation in the Power System, Math Bollen, Wiley, 2011

18UEEE852 Power System Dynamics and Stability (3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn power system stability concepts, states of operation and system security &system dynamic problems. They learn to carry out mathematical analysis of steady state stability, analysis of transient stability and simplified representation of excitation control. They will learn the modeling of synchronous machine and about excitation & prime mover controllers. Further, they will get exposed to static VAR compensators, dynamics of a synchronous generator synchronous machine model, calculation of initial conditions, analysis of a single machine system and application of power system stabilizers.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the concepts and definitions of power system stability. Review the classical methods of modeling power system.	2,3	1	
CO-2	Model and analyze synchronous machines	2,3	1	
CO-3	Model excitation system and prime mover controls. Model Transmission line SVC and loads.	2,3	1	
CO-4	Analyze the dynamics of single machine system connected to infinite bus.	2,3	1	
CO-5	Decide on choosing the necessary stabilizers	2,3	1	

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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	3.0												

Prerequisites: 1. Power System Analysis and Stability
2. Computer Techniques in Power Systems
3. Electrical Power Generation and Transmission
4.Electrical Power Distribution and Utilization

Contents:

Unit-I

Review of Classical methods: Basic concepts and definitions: Rotor angle stability, voltage stability and voltage collapse, Mid-term and long-term stability Classification of stability, states of operation and system security &system dynamic problem. System model, some mathematical analysis of steady state stability, analysis of transient stability and simplified representation of excitation control. **08 Hrs.**

Unit-II

Modeling of synchronous machine: Introduction, synchronous machine, park's transformation, analysis of steady state performance per unit equivalent circuits of synchronous machine, determination of parameters of equivalent circuits, measurements for obtaining data, saturation models, transient analysis of a synchronous machine. **08 Hrs.**

Unit-III

Excitation and prime mover controllers: Excitation system Modelling, prime mover control systems. Modeling of Transmission line, SVC and loads. **08 Hrs.**

Unit-IV

Analysis of a single machine system: System model, synchronous machine model, calculation of initial conditions, inclusion of SVC Model. Small signal analysis with block diagram representation, synchronizing and damping torque analysis, small signal model, nonlinear oscillators. **09 Hrs.**

Unit-V

Application of power system stabilizers: Basic concepts, control signals, structure and tuning of PSS, field implementation and operating experience. **06 Hrs.**

Reference Books:

1) P. W. Sauer & M.A.Pai," Power system dynamics and stability",2/e, Pearson education, Asia Inc., 2003.
2) K. R. Padiyar, "Power system dynamics, stability and control" 2/e, BS Publications, Hyderabad, 2002.

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3) P. Kundur, “Power system stability and control”, 1/e, Tata Mcgraw-Hill, Inc. 1994.

18UEEE853 Power System Restructuring and Power Quality (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

Restructure of power systems is gaining importance in the competitive environment and current situation around the world. This subject gives the students a focused insight of operating power systems in restructured scenario and its benefits and its effects. Moreover, the different types of transmission open access and pricing issues of various countries shall be studied in this subject. The students also learn the power quality issues in the restructured environment.

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 to12)/ PSO’s (1 to 3)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Recite the concept of Deregulation of the Electricity Supply Industry.		3	5
CO-2	Explain role of independent system operator (ISO) & GENCOs in operational planning activities and ancillary service.		1	5
CO-3	Describe transmission open access, pricing of power transactions and congestion management in restructured scenario.	3		5
CO-4	Explain the basic concept of power quality phenomenon occurring in a power system.		1	5

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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		2.5		1.0										

Prerequisites: [1] Power system Analysis [2] Power Transmission & Distribution
[3] Power system Operation and Control
[4] Power system planning.

Contents:

Unit – I

Restructure of the Electricity Supply Industry

Introduction, meaning of deregulation, background to deregulation and the current situation around the world, benefits from a competitive electricity market, after effects of deregulation. **08 Hrs**.

Unit - II

Power systems Operation in restructured Environment

Introduction, role of independent system operator (ISO), operational planning activities of ISO, Operational planning activities of Gencos. Ancillary services in restructured scenario. **07 Hrs.**

Unit –III

Transmission Open Access and Pricing Issues

Introduction, power wheeling, transmission open access, cost components in transmission, pricing of power transactions, transmission open access and pricing mechanisms in various countries, developments in international transmission pricing in Europe, security management in deregulated environment, congestion management in deregulation. **08 Hrs.**

Unit – IV

Introduction to Power Quality: Power Quality, Voltage Quality, concerned about Power Quality, The Power Quality Evaluation Procedure, and General Classes of Power Quality Problems Transients, Long-Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage Fluctuation, Power Frequency Variations, Power Quality Terms, Ambiguous Terms, CBEMA and ITI Curves. **08 Hrs**.

Unit – V

Voltage Sags and Interruptions: Sources of Sags and Interruptions, Transient Over voltages Sources of Transient Over voltages,

Harmonic Distortion: Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads, Locating Harmonic Sources, Effects of Harmonic Distortion. **08 Hrs**.

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Reference Books:

1) Kankar Bhattacharya, Math H J Bollan, Jaap E Daalder, "Operation of Restructured Power systems", Kluwer Academic Publishers, 2001.
2) Loi Lei Lai, "Power systems Restructuring and Deregulation; Trading, Performance and Information Technology", John Wiley and Sons, Ltd, 2002
3) Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H. Wayne Beaty, "Electrical Power Systems Quality" McGraw Hill, 2003.
4) Math H J Bollen, "Understanding Power Quality Problems; Voltage Sags and Interruptions", Wiley India, 2011

18UEEE854	Reliability Engineering	(3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn Concept of reliability, reliability indices, component reliability, and system reliability failure models for non-repairable components fault tree analysis and Monte- Carlo simulation. They are required to know the basic probability theory, probability concepts, permutation and combination, practical engineering concepts, Venn diagram rules for combining probabilities, probability distribution, random variables density distribution, system reliability evaluation using probability distribution, series system, parallel system, partially redundant system, and mean time to failure stand by 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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the concept reliability, significance of reliability and system reliability		2,3	1, PSO2
CO-2	Carry out analysis of state enumeration techniques		2,3	1
CO-3	Select components fault tree analysis and Monte- Carlo simulation		2,3	1

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CO-4	Design electromagnets for lifting objects and design cooling system for transformers.		2,3	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	1	2	2											1	

Prerequisites: 1. Mathematics

Contents:

Unit-I

Introduction: Concept of reliability, reliability indices, component reliability – Introduction, non-repairable component, hazard models, components with preventive maintenance, repairable components. **08 Hrs.**

Unit-II

System Reliability: Network methods, Introduction; series configuration parallel configuration, mixed configuration, the r out of n configuration d composition method minimal – tie and minimal – cut methods logic diagrams. **07 Hrs.**

Unit-III

System reliability state space method system representation basic concepts state probability state frequency and duration system of two independent component two components with dependent failures combining state failure effect analysis state enumeration methods. **07 Hrs.**

Unit-IV

System reliability other methods dependent failure models for non-repairable components fault tree analysis Monte- Carlo simulation. **08 Hrs.**

Unit-V

Basic probability theory probability concepts permutation and combination practical engineering concepts Venn diagram rules for combining probabilities, probability distribution random variables density and distribution. **09 Hrs.**

Reference Books:

1) L. S. Srinath, "Concepts in reliability engineering",2/e,East West Press Ltd,.1985.
2) J. Endrenyi, "Reliability modeling in electrical power system", 1/e, John Wiley & Sons, 1978.

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3) Roy Billintan& Ronald. N. Allar, “Reliability Evaluation of Engineering System”,2/e, 1992

18UEEE855 Analog and Digital Communication (3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about basics of analog and digital communications, modulation techniques, data & pulse communication. Further, they come to know source and error coding schemes and advanced mobile communication phone system, GSM, CDMA 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 to12)/ PSO’s (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain basics of analog communication and compare analog communication systems	1		
CO-2	Describe modulation techniques and compare ASK, FSK, MSK, PSK etc.	1		
CO-3	Describe basics of Data Communication, Circuits, Codes, error detection, error correction Techniques and Data communication Hardware serial & parallel interfaces	1	5	PSO-2
CO-4	Explain Source encoding theorems, and Error Control Coding.	1	5	
CO-5	Describe AMPS, GSM, CDMA, Channel Assignment, Multiple Access Schemes - Satellite Communication – Bluetooth technology	1		

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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	

Prerequisites: 1. A course on Analog Electronic circuits
2. A course on Digital Electronics

Contents:

Unit-I

Analog Communication

Noise: Source of Noise - External Noise- Internal Noise- Noise Calculation. Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM). **08 Hrs.**

Unit –II

Digital Communication

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) –Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK - Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM). **08 Hrs.**

Unit - III

Data and Pulse Communication:

History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Error Detection and Correction Techniques - Data communication Hardware - serial and parallel interfaces. Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM). **08 Hrs.**

Unit -IV

Source and Error Control Coding: Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, viterbi decoding algorithm. **07 Hrs.**

Unit -V

Multi-User Radio Communication

Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Hand off - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth. **08 Hrs.**

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Reference Books:

1) Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.
2) Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004 35
3) Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007.
4) H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.
5) B.P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press, 2007.
6) Blake, "Electronic Communication Systems", Thomson Delmar Publications, 2002.
7) Martin S.Roden, "Analog and Digital Communication System", 3rd Edition, Prentice Hall of India, 2002.
8) B.Sklar, "Digital Communication Fundamentals and Applications" 2nd Edition Pearson Education 2007.

18UEEL803	Technical Seminar	(0 - 0 - 3) 1

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn how to carry out literature survey to locate the state-of-the-art technology in engineering domain of their interest. They are required to carry out selection of an emerging topic beyond the syllabus relevant to Electrical, Electronics and Computer related areas, study the same in detail, understand the concept, analyze, and present effectively before the target audience. Further, they are expected to know how to write a paper in the required format. They are also required to learn the effective communication and modalities of technical interactions.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Select a technical topic in emerging area by referring to renowned journals		2	6, PSO-3
CO-2	To study and understand the concept given in the paper		2	6, 8, PSO-2, PSO-3

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	/literature			
CO-3	Compile the information and prepare a write up/report/paper			1, 2, 6, 8, 9, 11, PSO-2, PSO-3
CO-4	Make presentation with effective communication and in all will come to know the state-of-the-art technology in E&E Engg. and allied branches		5, 9,10	8, PSO-2, PSO-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	1.0	1.6			2.0	1.0		1.0	1.5	1.0	1.0			1.0	1.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters.

Contents:

1. Select a topic from an emerging area relevant to electrical sciences beyond curriculum and understand, analyze, and present it for 15 minutes followed by 5 minutes for questions and answers. Further, they are to submit the seminar material in the form of a paper in IEEE format. All the students are required to attend all the 52 slots.
2. Present the technical innovative/novel work carried out in the laboratory.

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18UEEL804	Major Project - Phase II	(0 – 0 –14) 7

Contact Hours: 100

Course Learning Objectives (CLOs):

The students are expected to learn working in a team and on multidisciplinary projects. They are expected to carry out the intensive literature survey to locate the state-of-the-art technology in his engineering field of interest. They must learn to formulate/define the problem for the project work. They will learn to design, develop, analyze, test, interpret the results, fabricate, simulate, write code etc. relevant to their project work. They are also expected to acquire the skills of summarizing the work into a project report and in all, can carry out the technical work assigned to them independently.

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 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Carry out the literature survey to locate the state-of-the-art technology in his Engineering field of interest	2		4, 5, PSO-2, PSO-3
CO-2	Define/formulate the problem for the project work	2,3	1,4,5	PSO-2, PSO-3
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code etc. relevant to his project work	3	5	7,8,9,12, PSO-2, PSO-3
CO-4	Summarize the work into a project report and in all can carry out the technical work assigned		10	6,8,11, PSO-2, PSO-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	1.5	1.66	1.0	1.0	1.0	1.0	2.0	1.0	1.0		1.0	1.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value-added information.

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Major project phase-2 is the continuation from **Major project phase – I** in which the students are expected to go for material collection, survey, visits, data collection, preliminary design, analysis, model development, code writing, field work etc. The same project team formed for phase –I will continue the work under the guidance of the same faculty member. For all the projects, problems may be domain specific or interdisciplinary also in nature. A committee consisting of minimum 3 faculty members of which guide is a member shall evaluate at the end for CIE. There is a viva voce examination which shall be examined by two examiners one internal and one external to the college appointed by COE based on the suggestions by the respective HoD.

Reference materials/books:

1. Engineering books.
2. Journals.
3. Manuals and data sheets.
4. Software packages.
5. Previous project reports.
6. Product information brochures.
7. Interaction with academia and industrial experts.
8. Internet etc.

General Instructions to Students:

1. Students are expected to Design the problem modules in consultation with project guide/supervisor. Students are expected to submit Design Phase (Design Aspects in Phase-2) approved by project guide, to the project coordinator as per the schedule notified. A copy is to be maintained with students and the guide. Designs will be the base line for the implementation module.
2. Notification/schedules and evaluation procedures will be sent to all students in the Google groups created in the department.
3. Evaluation of Design Phase, implementation of each module Exploring different test cases with respect to each module is done in 8^{th} semester.
4. Final Project Report will be prepared includes the content of Phase-1 and Phase-2.

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Academic Program: PG

Academic Year 2021-22

Department of Electrical & Electronics Engineering

Power Systems Engineering

I & II Semester M. Tech. Syllabus

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002
(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)

Ph: **0836-2447465 Fax: 0836-2464638** **Web: www.sdmcet.ac.in**

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for I & II semester M. Tech in Power Systems 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	Digitally signed by KURAKUNDI RAGHAVENDRARAO GOPINATH Date: 2023-02-09 10:31+05:30	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:

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

SDMCET- Quality Policy

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

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Teamwork and
- Trust

Department Vision and Mission

Vision:

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

Mission:

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

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The Program Educational Objectives (PEOs):

I. To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit, and consulting firms.

II. To prepare graduates who will contribute to society as broadly educated, expressive, ethical, and responsible citizens with proven expertise.

III. To prepare graduates who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, research, design, and implementation skills.

IV. To prepare graduates who will thrive to pursue life-long reflective learning to fulfill their goals.

Program Outcomes (POs):

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: Student should be able to demonstrate a degree of mastery over the area ofPower SystemEngineering.

PO4: Exposure to the state-of-the-art practices in the domain of power systems engineering

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Scheme of Teaching and Examination
I-Semester M. Tech. (Power Systems Engineering)

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PRMIC100	Research Methodology and IPR	2-0-0	2	50	50	2		
20PMEEC100	Applied Mathematics	4-0-0	4	50	100	3		
20PEPSC100	Advanced Power System Analysis	4-0-0	4	50	100	3		
20PEPSC101	Power System Modeling & Dynamics	4-0-0	4	50	100	3		
20PEPSEXXX	Elective 1	4-0-0	4	50	100	3		
20PEPSL102	Power System Laboratory-I	0-0-3	2	50			50	3
20PEPSL103	** Seminar	0-0-2	1	50				
Total		**18-0-5**	**21**	**350**	**450**		**50**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

***SEE** for theory courses is conducted for 100 marks and reduced to 50 marks.

****** Seminar is to be conducted every week and 2-3 students/week will present a topic from emerging areas in power systems preferably the contents not studied in their regular courses. The seminar shall be evaluated by 3 faculty members having specialization in power system and allied areas.

Course Code	Elective – 1	Credits
20PEPSE151	Advanced Power System Protection	4
20PEPSE152	EHV AC Transmission	4
20PEPSE153	Linear and Nonlinear Optimization	4

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Scheme of Teaching and Examination
II-Semester M. Tech. (Power Systems Engineering)

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PEPSC200	Artificial Intelligence Techniques to Power System	4-0-0	4	50	100	3		
20PEPSC201	FACTS Controllers	4-0-0	4	50	100	3		
20PEPSEXXX	Elective 2	4-0-0	4	50	100	3		
20PEPSEXXX	Elective 3	4-0-0	4	50	100	3		
20PEPSEXXX	Elective 4	4-0-0	4	50	100	3		
20PEPSL202	Power System Laboratory-II	0-0-3	2	50			50	3
20PEPSL203	**Seminar	0-0-2	1	50				
	Total	**20-0-5**	**23**	**350**	**500**		**50**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

***SEE** for theory courses is conducted for 100 marks and reduced to 50 marks.

****** Seminar is to be conducted every week and 2-3 students/week will present a topic from emerging areas in power systems preferably the contents not studied in their regular courses. The seminar shall be evaluated by 3 faculty members having specialization in power system and allied areas.

Course Code	Elective (2, 3, 4)	Credits
20PEPSE231	Reactive Power Management in Power System	4
20PEPSE232	Economic Operation &Control of Power System	4
20PEPSE233	Power System SCADA	4
20PEPSE234	HVDC Power Transmission	4
20PEPSE235	Fundamentals of Smart Grid Technology	4
20PEPSE236	Distributed Generation and Micro Grids	4

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I - Semester M.Tech.(Power Systems Engineering)

20PRMIC100	Research Methodology and IPR	(2-0-0) 2

Contact Hours: 26

Course Learning Objectives (CLOs):

The students are expected to learn about the need and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing. Further, the students shall know about the intellectual property rights, copy rights, trademarks, patents, patents filing procedure, infringement &remedies and information technology act etc.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Formulate theresearch problem, carryout literature survey and decide the methodology.		1	
CO2	Use measurement and scaling and carryout data collection.		1	
CO3	Test the hypothesis, interpret & analyze the results, and write the report.	2	3	
CO4	Explain the need of IPR, copy right, patents, trademarks, & the filing procedure and know about infringement, remedies and regulatory framework.		2	

PO's	PO-1	PO-2	PO-3
Mapping Level	2.0	2.5	2.0

Prerequisites: Branch specific course on problem analysis.

Contents:

1) **Research Methodology:** Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, importance of knowing how research is done, research process, criteria of good research and problems encountered by researchers in India. **2 Hrs.**

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Defining the Research Problem: Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration. **1 Hr.**

2) **Reviewing the literature:** Importance of the literature review in research, how to review the literature, searching the existing literature, reviewing the selected literature, and writing about the literature reviewed. **2 Hrs.**

Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design, different research designs, basic principles of experimental designs, importantexperimentaldesigns. **3 Hrs.**

3) **Measurement and Scaling:** Measurement in research, measurement scales, sources of error in measurement, scaling, meaning of scaling and important scaling techniques **2 Hrs.**

Data Collection: Collection of primary data, observation method, interview method, collection of data through questionnaires, collection of data through schedules, difference between questionnaires and schedules, collection of secondary data. **2 Hrs.**

4) **Testing of Hypotheses:** What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses. **2 Hrs.**

5) **Interpretation and Report Writing:** Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation, and mechanics of writing a research report, precautions for writing research reports, plagiarism and its significance. **3 Hrs.**

6) **Introduction to Intellectual Property Rights:** Meaning and conception of IPR, competing, rationale for protection, international conventions, world court. **1 Hr.**

Copy right: Historical evolution of the law on copy right, meaning, content, substance, ownership, primary, special rights, obligations, period, assignment, and relinquishment of copy rights. License and application for registration of copy right.

Patents: Meaning of Patent, purpose and policy object of patent law, gains to inventor, application of patents, joint application, discovery and invention, patentable and non-patentable inventions, publications and public use, priority date and its purpose, procedure for obtaining patent. Stages of procedure, refusal to grant patent - consequence, protection period, drafting if claims, grant of patent and significance of date of patent and date of ceiling. Services available with patent office, jurisdiction, appellate authorities, powers and obligations of central government, patent agent and controller – not a civil

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court. **4 Hrs.**

Industrial design: Concepts & Significance **1 Hr.**

Trademarks: Definitions and conceptions of Trademark, advantages of registration, marks which are not registrable, known, and well-known trademarks, application for registration and procedure for registration, procedure and certification of Trademarks. **1 Hr.**

Infringement and Remedies: Meaning of infringement, acts of infringements, suit against infringement and defence against infringement, reliefs, and certificate of validity. **1 Hr.**

The information Technology Act: Definitions, certifying authority, meaning of compromise of digital signature, offences and penalties, applicability of IPRs, cybercrimes, adjudicating officer, violation, damages and penalties, Cyber regulation appellate tribunal, World Wide Web and domain names and cyber flying. Self-Study. **1 Hr.**

Reference Books:

1) C.R. Kothari, GauravGarg, Research Methodology: Methods and Techniques, New Age International, 4th Edition, 2018.
2) Ranjit Kumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3rdEdition, 2011.
3) Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.
4) N. K. Acharya, Textbook on Intellectual Property Rights, 4th Edition, Asia Law House, Hyderabad.

20PMEEC100	Applied Mathematics	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

Learn the idea of random variable and probability distribution. To prepare the students to formulate and solve linear programming problem. Study Numerical methods to solve algebraic, transcendental equations. Learn to solve system of linear equations. Introducing students to the fundamental concepts of Graph theory and linear *algebra.*

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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 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO1	Learn the idea of random Variables (discrete/continuous) and probability distributions in analyzing the probability models arising in power system engineering.		1,2	
CO2	Apply the concept of optimization to Solve system of linear and non-linear programming problems.		1,2	
CO3	Learn the Concept of graph theory in engineering problems.		1,2	
CO4	Employ numerical techniques in order to achieve more accurate values in the computation of roots of algebraic and non-linear equations		1,2	
CO5	Apply standard iterative methods to compute Eigen values		1,2	

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	2.0		

Prerequisites: [1] Differentiation Matrices [2] Vectors [3] Basic Probability Theory

Contents:

1) Probability Theory

Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions-illustrations. Binomial, Poisson, Exponential, Gaussian and Rayleigh distributions example. **10 Hrs.**

2) Linear and Nonlinear Programming

Formulation of LPP problem. Simplex Algorithm-Two Phase and Big M techniques– Duality theory-Dual Simplex method. Nonlinear Programming Constrained extremal problems-Lagranges multiplier method- Kuhn-Tucker conditions and solutions. **12 Hrs.**

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3) Graph Theory

Basic terminologies, types of graphs, sub graphs, graphs isomorphism, connected graphs-walks, paths, circuits, connected and disconnected graphs, operations on graphs, Eulerian paths and circuits, Hamiltonian paths and circuits, shortest path algorithms, applications of graphs. **10 Hrs.**

4) Numerical Methods

Solution of algebraic and transcendental equations- iterative methods based on second degree equation – Muller method (no derivation), Chebyshev method. Fixed point iteration method (first order), acceleration of convergence, Δ - Aitken's method. Bairstow's method, Graeffe's root squaring method. **10 Hrs.**

5) Linear Algebra

Computation of Eigen values and Eigen vectors of real symmetric matrices- Given's method. Orthogonal vectors and orthogonal bases. Gram-Schmidt orthogonalization process. QR decomposition, singular value decomposition, least square approximations**.** **10 Hrs.**

Reference Books:

1) M K Jain, S R K Iyengar and R K Jain, "Numerical Methods for Scientific and Engineering Computations", New Age International, 2004.
2) Dr. B.S. Grewal, "Higher Engineering Mathematics", 41stEdition, Khanna Publishers, 2011.
3) Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", PHI, 2012.
4) Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 2011.
5) Richard Bronson, "Schaum's Outlines of Theory and Problems of Matrix Operations", McGraw-Hill, 1988.

20PEPSC100	Advanced Power System Analysis	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) Study various methods of load flow and their advantages and disadvantages.
2) Understand how to analyze various types of faults in power system.
3) Understand and analyze various stability aspects of power system.
4) Study voltage instability phenomenon.
5) Understand need of state estimation and study simple algorithms for state estimation.

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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 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO1	Perform load flow studies for a multi-machine system	1	3	2
CO2	Analyze for various faults in power system	1	3	2
CO3	Explain stability aspects of power system and voltage stability phenomenon	1	3	2
CO4	Locate the state of power system using algorithms	1	3,4	2

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	3.0	1.0	2.0	2.0

Prerequisites: Power System Analysis

Contents:

1) **Load Flow:** Overview of Newton-Raphson, Gauss-Siedel, Fast De-coupled methods, convergence properties, sparsity techniques, handling Q_{max}violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variable in load flow. **10Hrs.**
2) **Fault Analysis:** Simultaneous faults, open conductor faults, generalized method offaultanalysis. **10 Hrs.**
3) **Stability Aspects of Power System:** Steady state stability of a multi-machine power system, Transient Stability Studies- Swing equation, RungeKutta Method, Long term transient stability studies. Dynamic Stability Studies-Concept, effect of saliency and saturation on stability, Demello-Concordia model, dynamic stability assessment using torque angle loop analysis, effect of excitation on stability. **14 Hrs.**
4) **Voltage Stability:** Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiples load flow, voltage collapse proximity indices. **09 Hrs.**
5) **State Estimation:** Sources of errors in measurement, virtual and Pseduo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction. **09 Hrs.**

Reference Books:

1) J.J. Grainger &W. D. Stevenson, "Power System Analysis", McGraw Hill, 2003

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2) A. R. Bergen & Vijay Vittal, “Power System Analysis”, Pearson, 2000.
3) L.P. Singh, “Advanced Power System Analysis and Dynamics”, New Age International, 2006.
4) G.L.Kusic, “Computer Aided Power System Analysis”, Prentice Hall India, 1986.
5) A.J. Wood, “Power generation, operation and control”, John Wiley, 1994
6) P.M. Anderson, “Faulted power system analysis”, IEEE Press, 1995
7) PrabhaKundur, “Power System Stability and control, 1st Edition, 1994
8) Nagarath & Kothari, Modern Power System Analysis”, 4th Edition, TMH, 2011.

20PEPSC101 Power System Modeling and Dynamics (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) To impart knowledge on dynamic modeling of a synchronous machine excitation and prime mover controllers.
2) To describe the modeling of transmission lines, SVC and loads.
3) To explain the dynamics of single machine connected to infinite bus.
4) To describe the analysis of single systems and evaluation of transient stability.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Model and analyze synchronous machines and transients respectively	1	3	2
CO2	Develop appropriate models of individual power system elements for power system dynamics studies.	1, 3	4	2
CO3	Model and analyze single machine connected to infinite bus for transient stability.	1, 3	4	2
CO4	Use compensation technique for smooth operation of power system and decide on choosing necessary power system stabilizers	1	3, 4	2

PO’s	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	1.0	2.5	2.0

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Prerequisites: [1] Computer Techniques in Power System [2] Electric machines
[3] Electric Power generation and transmission

Contents:

1) **Modeling of Synchronous Machine:** Review of classical methods, modeling of Synchronous machine, Park's Transformation, Transformation of flux linkages, Transformation of stator voltage equations and rotor equations, Analysis of steady state performance, per unit quantities, Equivalent circuits of synchronous machine - determination of parameters of equivalent circuits. **10 Hrs.**
2) **Excitation System and prime mover controllers:** Excitation system modeling, excitation systems block Diagram system representation by state equations, Prime mover control system. **06 Hrs.**
3) **Transmission lines and loads:** Modeling of transmission lines, D-Q transformation, modeling of SVC and loads, modeling of Induction motors. **06 Hrs.**
4) **Dynamics of a Synchronous Generator Connected to Infinite Bus:** System model, Synchronous machine model, stator equations, rotor equations, Synchronous machine model x x, calculation of Initial conditions. **10 Hrs.**
5) **Analysis of Single Machine System:** Small signal analysis with block diagram, Representation characteristic equation and application of Routh Hurwitz criterion, Synchronizing and damping torque analysis, small signal model State equations. **09 Hrs.**
6) **Application of Power System Stabilizers:** Basic concepts in applying PSS, Control signals, structure and tuning of PSS, washout circuit, dynamic compensator analysis of single machine infinite bus system with and without PSS. **07 Hrs.**

Reference Books:

1) K.R. Padiyar, "Power System Dynamics", B.S. Publications, Hyderabad
2) P.M. Anderson and A.A. Fouad, "Power System Control and Stability", 2nd Edition, B.S. Publications Hyderabad
3) Peter W. Sauer & M. A. Pai, "Power System Dynamics and Stability" Prentice Hall.

20PEPSE151 Advanced Power System Protection (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) To introduce the components of the Power System to be protected.
2) To discuss hardware resource required to develop the digital relay.

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3) To introduce basics of DSP hardware, algorithms,and relaying schemes to protect power system.
4) To introduce to the concept of existing digital relays for motor protection, transformer protection and other components in power system.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Apply the knowledge of hardware to develop the digital relay for different components of Power System	4	3	2
CO2	Develop DSP based relay algorithms	4	3	2
CO3	Apply concepts of programming to simulate and study the behavior of developed hardware resource to protect components of power system.	1,4	3	2
CO4	Apply concepts of Digital Protection to protect transformers, Motors, and Busbar.	4	3	2

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	1.0	2.0	3.0

Prerequisites: Power system protection

Contents:

1) **Introduction toComputer Relaying:**
Development of computer relaying, Historical background, Expected benefits of computer relaying, Computer relay architecture, Protection Generations, Analog to digital converters, Anti-aliasing filters, Digital Signal Processing, Hierarchical Structure of Protection and Control. **10 Hrs.**
2) **Relaying practices:**
Introduction to protection systems, Functions of a protection system, Protection transmission lines, Performance of current and voltage transformers. **10Hrs.**

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3) **Relaying Algorithm**

Algorithms Based on Undistorted single frequency sine wave: Mann and Morrison Algorithm, Three Sample technique, First and second derivative algorithm, two sample technique.

Algorithms Based on Solution of Differential Equation: Differential Equation Algorithm, Solution of Differential Equation Algorithm using NumericalIntegration, Application of Differential Equation Algorithm to Three-Phase Line.

Algorithms Based on Least Squared Error: LSQ Technique, LSQ and Pseudo inverse, LSQ Algorithm By Sachdev. **15 Hrs.**

4) **Digital Protection of transformers and machines:** Introduction, Power transformer algorithms, Generator protection, Motor protection. **06 Hrs.**
5) **Digital Bus Differential Protection:** Introduction, Busbar Protection Techniques, New Differential Bus Protection Algorithm, Differential Principle, CT Saturation Detection. **06 Hrs.**
6) **Hardware organization in integrated systems:** The nature of hardware issues, Computers for relaying, The substation environment, Industry environmental standards, Countermeasures against EMI, Supplementary Equipment. **05 Hrs.**

ReferenceBooks:

1) Arun G. Phadke, James S. Thorp, "Computer Relaying for Power Systems", John Wiley and Sons Inc, 2nd Edition, 2009
2) A. T. Johns and S. K. Salman, "Digital Protection for Power Systems" Peter Peregrinus Ltd,
3) S. R. Bhide, "Digital Power System Protection" PHI Learning Private Limited, 1st Edition,2013
4) Waldemar Rebizant, Janusz Szafran, Andrzej Wiszniewski, "Digital Signal Processing in Power System Protection and Control, Springer, 1st Edition,2011
5) GER-3984 Reference Manual, General Electric, Digital Low-Impedance Bus DifferentialProtection: Principles and Approaches

20PEPSE152	EHV AC Transmission	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

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

1) Select the transmission voltage level.
2) Calculate Line parameters for bundled conductors and analyze the performance.
3) Calculate voltage gradient of bundled conductors.

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4) Evaluate the corona effects, interference on radio waves and suggest remedies to overcome the same.
5) Calculate electrostatic field of EHV AC lines
6) Analyze travelling waves.
7) Analyze compensated devices for voltage control.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level(1)**
CO1	Describe recent trends in power transmission at extra high voltages	1,2	3,4	
CO2	Estimate the voltage gradients on conductor and corona loss, analyze the propagation of travelling waves and standing waves on transmission lines.	1,2	3,4	
CO3	Distinguish the various protection methods for lightning and switching surges on transmission lines.	1,2	3,4	
CO4	Design EHV line based on steady state limits and assess the effect of electrostatic and magnetic fields of EHV lines on the human beings and the surrounding.		1,2	3,4

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	2.75	2.75	1.75	1.75

Prerequisites: High Voltage Engineering

Contents:

1) **Transmission Line Trends and Preliminaries:** Role of EHV/UHVAC Transmission, Standard Transmission Voltages, Average Values of Line Parameters, Power-Handling Capacity and Line Loss, Examples of Giant Power Pools and Number of Lines, Costs of Transmission Lines and Equipment, Mechanical Considerations in Line Performance. **04 Hrs**.
2) **Calculation of Line and Ground Parameters:** Resistance of Conductors, Temperature Rise of Conductors and Current-Carrying Capacity, Properties of Bundled Conductors, Inductance of EHV Line Configurations, Line Capacitance

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Calculation, Sequence Inductances and Capacitances, Line Parameters for Modes of Propagation, Resistance, and Inductance of Ground Return.

08 Hrs.

Voltage Gradients of Conductors: Electrostatics, Field of Line Charges and Their Properties, Charge-Potential Relations for Multi-Conductor lines, Surface Voltage Gradient on Conductors, Gradient Factors and Their Use. **04 Hrs.**

3) **Corona:** I2R Loss and Corona Loss, Corona-Loss formulae, Attenuation of Travelling Waves due to Corona Loss, Audible Noise: Generation and Characteristics, Limits for Audible Noise. Generation of Corona Pulses and their Properties, Properties of Pulse Trains and Filter Response, Limits for Radio Interference Fields. **04 Hrs.**
4) **Theory of Travelling Waves and Standing Waves:** Travelling Waves and Standing Waves at Power Frequency, Differential Equations and Solutions for General Case, Standing Waves and Natural Frequencies, Open-Ended Line: Double-Exponential Response, Open-Ended Line: Response to Sinusoidal Excitation, Line Energization with Trapped-Charge Voltage, Corona Loss and Effective Shunt Conductance, The Method of Fourier Transforms, Reflection and Refraction of Travelling Waves, Transient Response of Systems with Series and Shunt Lumped Parameters and Distributed Lines, Principles of Travelling-Wave Protection of EHV Lines. **08 Hrs.**
5) **Lightning and Lightning Protection:** Lightning Strokes to Lines, Lightning-Stroke Mechanism, General Principles of the Lightning-Protection Problem, Tower-Footing Resistance, Insulator Flashover and Withstand Voltage, Probability of Occurrence of Lightning-Stroke Currents, Lightning Arresters and Protective Characteristics, Dynamic Voltage Rise and Arrester Rating, Operating Characteristics of Lightning Arresters, Insulation Coordination Based on Lightning. **06 Hrs.**
6) **Over voltages in EHV Systems Caused by Switching Operations:** Origin of Over voltages and Their Types, Short-Circuit Current and the Circuit Breaker, Recovery Voltage and the Circuit Breaker, Over voltages Caused by Interruption of Low Inductive Current, Interruption of Capacitive Currents, Ferro-Resonance Over voltages, Calculation of Switching Surges—Single Phase Equivalents, Distributed-Parameter Line Energized by Source, Generalized Equations for Single- Phase Representation, Generalized Equations for Three-Phase Systems, Inverse Fourier Transform for the General Case, Reduction of Switching Surges on EHV Systems, Experimental and Calculated Results of Switching-Surge Studies. **08 Hrs.**
7) **Design of EHV Lines Based upon Steady-State Limits and Transient Over voltages:** Introduction, Design Factors under Steady State, Design Examples: Steady-State Limits, Design Examples I to IV, Line Insulation Design based upon Transient Over voltages. **06 Hrs.**

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8) Electrostatic and Magnetic Fields of EHV Lines: Electric shocks and threshold current, Capacitance of a long object, electrostatic field of ac lines, Effect of high electrostatic fields on humans, animals and plants, Magnetic fields, magnetic field of three phase lines, Effect of power frequency magnetic field on human health. **04 Hrs.**

Reference Books:

1) Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International Publishers. 4th Edition, 2011
2) EHV Transmission line reference book-Edition Electric Institute (GEC) 1986.

20PEPSE153	Linear and Nonlinear Optimization	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) Provide introduction to optimization.
2) Explanation to classification of optimization problems.
3) Explanation for linear programming and solution of LPP problem.
4) Explanation for nonlinear programming and solution of nonlinear programming problem by one dimensional minimization method.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Explain the optimization methods used in engineering studies		1	2
CO2	Identify the suitable techniques to be used for solving a given optimization problem.	1	3	2
CO3	Apply Linear and nonlinear programming techniques for the solution of optimization problem	1,4	3	2

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	2.67	1.0	2.0	3.0

Prerequisites: Linear and Nonlinear Optimization Techniques

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Contents:

1) Optimization:

Introduction, historical development, engineering applications of optimization, statement of an optimization problem, design vector, design constraints, constraint surface, objective function, objective function surfaces, classification of optimization problems based on existence of constraints, nature of the design variables, physical structure of the problem, nature of the equations involved, nonlinear and linear programming problem(NLP and LPP), permissible values of the design variables, deterministic nature of the functions, number of objective functions, optimization techniques. **09 Hrs.**

2) Classification of Optimization Problems:

Introduction, single variable optimization, multivariable optimization with no constraints, semi-definite case, saddle point, multivariable optimization with equality constraints, solution by direct substitution, by the method of constrained variation and by the method of Lagrange multipliers, multivariable optimization with inequality constraints, Kuhn-Tucker conditions, constraint qualification, formation of LLP, graphical method. **09 Hrs.**

3) Linear Programming-I:

Introduction, applications of linear programming, standard form of a LPP, geometry of LPP, definitions and theorems, solution of a system of linear simultaneous equations, pivotal reduction of a general system of equations, motivation of the simplex method, simplex algorithm, identifying an optimal point, improving a non-optimal basic feasible solution, two phases of the simplex method. **09 Hrs.**

4) Linear Programming-II:

Revised simplex method, duality in linear programming; symmetric and primal-dual relations, primal-dual relations when the primal is in standard form, duality theorems, dual simplex method, decomposition principle, sensitivity or post-optimality analysis, changes in right-hand-side constants bi, changes in the cost coefficients Cj, addition of new variables, changes in the constraint coefficients aij, addition of constraints. Transportation problem, Karmarkar's method, statement of the problem, conversion of an LPP into required form, algorithm, quadratic programming **09 Hrs.**

5) Non-Linear Programming - One Dimensional Minimization Methods:

Introduction, Unimodal function, Unrestricted search with fixed step size and accelerated step size, exhaustive search, dichotomous search, interval halving method, Fibonacci method, golden section method, comparison of elimination methods, interpolation methods, quadratic and cubic, direct root methods, Newton, Quasi-Newton and Secant methods, practical considerations. **07 Hrs.**

6) Non-Linear Programming - Unconstrained Minimization Methods:

Introduction, direct search methods: random search methods, grid search, univariate, pattern directions, Hook and Jeeve's method, Powel's methods,

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Rosenbrock's method of rotating coordinates, simplex methods, reflection, expansion, contraction, indirect search methods, gradient of a function, Cauchy method, conjugate gradient methods, Newton's method, Marquadrant method, quasi- Newton methods, Davidon-Fletcher-Powel method, Broydon- Fletcher – Goldfarb – Shanno method, test functions, constrained and unconstrained optimization techniques, direct and indirect methods. **09 Hrs.**

Reference Books:

1) Singiresu S Rao (S. S. Rao), "Engineering Optimization", John Wiley andSons Inc, 1996
2) David Mautner Himmelblau, "Applied Nonlinear Programming", McGraw-Hill, 1972.
3) A. P. Verma, "Operation Research", S. K. Kataria& Sons, 2009

20PEPSL102	**Power System Laboratory – I**	**(0-0-3) 2**

Contact Hours: 36

Course Learning Objectives:

1) Conduct experiment for operator request power flow analysis, contingency analysis and ranking for an interconnected power system.
2) Conduct experiments for fault analysis including different configurations of transformers in power system.
3) Conduct experiment for relay coordination.
4) Conduct experiments to perform stability studies.
5) Conduct experiment for observability analysis, state estimation and bad data detection.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Apply the knowledge of electrical engineering in conducting different experiment in the laboratory.	4	1,3	2
CO2	Use suitable simulation software package for the conduction of experiments and analyze the results.	4	1,3	2

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PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	1.0	2.0	3.0

List of Experiments

1) Operator request load flow using voltage and frequency dependent load modeling and generator droop characteristic.
2) Contingency analysis and Ranking for a given interconnected power system.
3) Frequency and voltage dependency model of the load and under frequency load shedding.
4) Sequence impedance diagram development and distribution of earth fault current computation in a practical power system having auto transformers with tertiary delta winding, star-delta and delta-star configurations.
5) Over current relay co-ordination with and without instantaneous setting for a given network with NI relay characteristic curves.
6) Transient stability studies for a given system having minimum 10 buses, machines, and an infinite grid to determine (i) Critical clearing time (ii) Natural frequency of oscillations of electro-mechanical system considering classical representation of the machine and detailed modeling (sub-transient model) of the machine.
7) The AVR and Governor modeling and their effect on system stability.
8) Obtain PV &QV curve for a given power system with load buses and voltage instability analysis.
9) Eigen value computation and small signal stability studies for a given power system with at least 3 machines and 10 buses using IEEE-Type 1 AVR and turbine-governor models.
10) Observability analysis, state estimation and bad data detection for a given power system using measurement data.

Activity based learning: Relay algorithms.

20PEPSL103	Seminar	(0-0-2)1

Contact Hours: 24

Course Learning Objectives (CLOs):

The objective of the seminar is to inculcate self-learning, enhance communication skill, involve in group discussion, and present the ideas before the audience.

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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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Communicate effectively on a technical topic	1, 3	2	4
CO2	Learn new technical things by self-study	1, 3	2	4
CO3	Involve in technical group discussion actively	1, 3	2	4
CO4	Face and interact with class audience	1, 3	2	4

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	2.0	3.0	1.0

Each student, under the guidance of a Faculty, is required to,

i) Choose a topic of his/her interest relevant to the Course of Specialization

ii) Carryout literature survey, organize the subject topics in a systematic order

iii) Prepare the report with own sentences

iv) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities

v) Present the seminar topic at least for 30 minutes through power point slides

vi) Answer the queries and involve in debate/discussion lasting for about 10 minutes

vii) Submit two copies of the typed report with a list of references

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident. The internal assessment marks shall be awarded by a committee consisting of at least two staff members based on the relevance of the topic, presentation skill, participation in the question & answer session and quality of report.

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II - Semester M. Tech. (Power Systems Engineering)

20PEPSC200 Artificial Intelligence Techniques To Power System (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) To impart knowledge on basic concepts of AI, soft and hard computing.
2) To explain the concepts of artificial intelligence, fuzzy logic, and genetic algorithms.
3) To apply the AI techniques to power system applications.

Course Outcomes:

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO1	Differentiate between Soft Computing and hard Computing techniques	1	3	2
CO2	Study concepts of artificial neural networks, fuzzy logic, and genetic algorithms	4	1,3	2
CO3	Apply appropriate AI framework for solving power system problems	4	3	2

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.5	1.0	2.0	3.0

Contents:

1) Introduction

Introduction, definition of AI, difference between soft computing techniques and hard computing systems, Expert Systems, brief history of ANN, Fuzzy Logic and Genetic Algorithm. **06 Hrs.**

2) Artificial Neural Networks

Introduction Models of Neuron Network, Architectures, Knowledge representation, Neural networks–Learning, Multi – layer perceptron using Back propagation Algorithm (BPA), Self-Organizing Map (SOM), Radial Basis Function Network, Functional Link Network (FLN). **14 Hrs.**

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3) Fuzzy Logic

Introduction, Fuzzy versus crisp, Fuzzy sets, Membership function, BasicFuzzy set operations, Properties of Fuzzy sets, Fuzzy Cartesian Product, operations on Fuzzy relations ,Fuzzy-logic, Fuzzy Quantifiers, Fuzzy Inference Fuzzy Rule based system, De-fuzzification methods. **10 Hrs.**

4) Genetic Algorithms

Introduction, Encoding, Fitness Function, Reproduction operators, Genetic Modeling, Genetic operators, Cross over, Single site cross over, Two-point cross over, Multi point cross over, Uniform cross over, Matrix cross over, Cross over Rate, Inversion &Deletion, Mutation operator, Mutation, Mutation Rate, Bit–wise operators , Generational cycle , convergence of Genetic Algorithm

10 Hrs.

5) Applications of AI Techniques

Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area system and two area system, Small Signal Stability (Dynamic stability) Reactive power control, speed control of DC and AC Motors.

12 Hrs.

Reference Books:

1) S.Rajasekaran and G.A.V.Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi, 2003.
2) Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition, 2011
3) Kevin Warwick, Arthur Ekwue, Raj Aggarwal, Artificial Intelligence Techniques in Power Systems.

20PEPSC201	FACTS Controllers	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The power systems interconnection has led to the complexity of operation and control of transmission system. The advent in the semiconductor and consequent power semiconductor technology and the sophisticated processors have made the Flexible AC Transmission System more relevant in the reliable and secured operation transmission system taking many benefits. This subject gives the students a focused insight of Flexible AC Transmission system. Moreover, the different types of FACTS controllers used in the practical situation and their modeling, design, operation, and applications shall be studied in this subject. The students also learn how to make performance comparison of different FACTS controllers.

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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 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO1	Recite the concept of AC power transmission networks and basic types of FACTS Controllers.	3		2
CO2	Demonstrate the knowledge of power semiconductor devices and their application to the FACTS controllers.	3		1,2
CO3	Analyze the operation of different types of FACTS controllers.	3		2
CO4	Use different types of FACTS controllers in the transmission system applications.		4	2

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	1.0	1.0	3.0	2.0

Prerequisites: [1] Power systems Analysis [2] Power Transmission & Distribution
[3] Power Electronics [4] Control Systems

Contents:

1) Introduction

Basics of power transmission networks - control of power flow in AC - transmission line- flexible AC transmission system controllers – Basic type of FACTS controllers and definitions. Application of FACTS controllers in transmission and distribution system. **06 Hrs.**

2) AC Transmission Line and Reactive Power Compensation

Analysis of uncompensated AC Line - passive reactive power compensation - compensation by a series capacitor connected at the midpoint of the line - shunt compensation connected at the midpoint of the line - comparison between series and shunt capacitor - compensation by STATCOM and SSSC- some representative examples. **08 Hrs**.

3) Static VAR Compensator

Analysis of SVC, Configuration of SVC, SVC Controllers, harmonics, and filtering - protection aspects – modeling of SVC – applications of SVC**. 06 Hrs.**

4) Thyristor and GTO Controlled Series Capacitor

Introduction - Basic concepts of controlled series compensation operation of TCSC - analysis of TCSC- control of TCSC - modeling of TCSC for stability studies - GTO thyristor-controlled series capacitor (GCSC) – Issue sub

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synchronous resonance with TCSC - Applications of TCSC. **06 Hrs.**

5) Static Phase Shifting Transformer

General - basic principle of a PST - configurations of SPST improvement of transient stability using SPST - damping of low frequency power oscillations - applications of SPST. **06 Hrs.**

6) Static Synchronous Compensator (STATCOM)

Introduction - principle of operation of STATCOM - a simplified analysis of a three phase six pulse STATCOM -- multi-pulse converters Control of type I Converters - multilevel voltage source converters, Comparison between SVC and STATCOM Applications of STATCOM. **08 Hrs.**

7) SSSC and UPFC

SSSC-operation of SSSC and the control of power flow –modeling of SSSC in load flow and transient stability. **04 Hrs.**

Unified Power Flow Controller (UPFC) – Principle of operation – modes of operation –applications – modeling of UPFC for power flow studies. **04 Hrs.**

Special Purpose FACTS Controllers: Interline Power Flow Controller - operation and control. **04 Hrs.**

Reference Books:

1) K. R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International, 2007.
2) Narain G Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, Wiley India, 2011.
3) Y. H. Song and A. T. Johns, “Flexible AC Transmission System”, Institution of Engineering and Technology, 2009.
4) Mohan Mathur, R., Rajiv. K. Varma, “Thyristor – Based Facts Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc.

20PEPSE231 Reactive Power Management in Power System (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) To identify the necessity of reactive power compensation
2) To describe load compensation and reactive power control
3) To select various types of reactive power compensation in transmission systems
4) To differentiate the static and dynamic compensation
5) To characterize utility practices and reactive power management.

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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 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO1	Demonstrate knowledge on: Load Compensation and different methods of reactive power control in transmission system	1	3	2
CO2	Observe dynamic performance of transmission system with compensation	1	3	2
CO3	Demonstrate knowledge on static and dynamic compensation, sources of harmonics and reactive power coordination between utility and consumers	1, 4	3	2

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	3.0	1.0	2.0	3.0

Prerequisites: Power system analysis

Contents:

1) Theory of Load Compensation:

Introduction- Requirement for compensation, objectives in load compensation, the idealcompensator specifications of a load compensator, power factor correction and voltage regulations in single phase system, phase balancing and power factor correction of unsymmetrical loads, compensation in terms of symmetrical components expression for the compensating susceptance in terms of phase line currents. **12 Hrs.**

2) Reactive Power Control:

Fundamental requirement in AC power transmission, fundamental transmission line equation,surge impedance and natural loading, voltage and current profiles of uncompensated radial and symmetrical line on open circuit, uncompensated line under load, effect of line length, load power and p. f on voltage and reactive power, passive and active compensators, uniformly distributed fixed compensation, passive shunt compensation, control of open circuit voltage by shunt reactance, required reactance of shunt reactors, multiple shunt reactors along the line, voltage control by means of switch shunt compensation, midpoint shunt reactor or capacitor, expression for mid-point voltage, series

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compensation , objectives and practical limitation , symmetrical line with midpoint series capacitor and shunt reactor, power transfer characteristics and maximum transmissible power for a general case, fundamental concepts of compensation by sectioning. **24 Hrs.**

3) Dynamic Performance of Transmission Systems with Reactive Power Compensation:

The dynamics of electrical power system. Need for adjustable reactive compensation and four characteristics time period. **04 Hrs.**

4) Principles of Static Compensation:

Principle of operation of thyristor-controlled reactor, thyristor switch capacitor, saturated reactor compensator. **03 Hrs.**

5) Series Capacitors:

Introduction, protective gear, reinsertion schemes and varistor protective gear. **03 Hrs**.

6) Synchronous Condenser:

Introduction, power system voltage control, emergency reactive power supply, startingmethods for motor, reduced voltage starting, static starting. **02 Hrs.**

7) Harmonics:

Sources, effects of harmonics on electrical equipment. **02 Hrs.**

8) Reactive Power Co-Ordination:

Reactive power management, utility objectives and utility practices, transmission benefits. **02 Hrs.**

Reference Books:

1) T. J. E Miller, “Reactive Power Control in Electrical Systems”, BSP books PVT Ltd, 2010.
2) D. Tagare, “Reactive Power Management”, TMH, 2011.
3) A**.** Chakrabarti, D. P. Kothari, A. K Mukhopadhyay and D. E Abinandan, “AnIntroduction to Reactive Power Control and Voltage Stability in Power Transmission Systems”, PHI, 2010.
4) George J. Wakileh, “Power Systems Harmonics; Fundamentals, Analysis and Filter Design”, Spinger, 2014.

20PEPSE232 Economic Operation & Control of Power System (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) To provide students the knowledge of optimization techniques used in the power system and Load Frequency Control (LFC).
2) To provide a solid foundation in mathematical and engineering fundamentals required to control the governing system in Turbine models.
3) To provide the knowledge of Hydrothermal scheduling, reactive power control

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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 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO1	Discuss about thermal and hydro power plants operation in meeting the load demand optimally.		2	3
CO2	Demonstrate the importance of reactive power control.	1	2,3	
CO3	Model single area load frequency control and two area load frequency control	2	1	3,4
CO4	Model and design turbine and Automatic controller.	2	1	3,4

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.33	2.5	1.25	1.0

Prerequisites:[1] Power System Analysis

Contents:

1) Introduction:

Different states of power systems, energy control centers, power systems control problems, steady state & transient security of power systems, security monitoring, SCADA systems, Automatic generation, and voltage control. **08 Hrs**.

2) Power System Security:

Introduction, factors affecting system security, power system contingency analysis, and detection of network problems. Network sensitivity methods, calculation of network sensitivity factor, connecting generator dispatch by sensitivity methods, contingency ranking. **08 Hrs**.

3) Control of Voltage and Reactive Power:

Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node-single machine infinity bus system, methods of voltage Control. **08 Hrs**.

4) Power System Optimization:

Optimal system operation with thermal plants, incremental production costs for steam power plants, analytical form of generation costs of thermal power plants, constraints in economic operation flowchart. Transmission loss equation for B

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co-efficient, unit commitment: statement of the problem, constraints, spinning reserve. **08 Hrs**.

5) Loss Co-efficient:

Definitions and Computation of loss co-efficient, incremental transmission of transmission loss, loss co-efficient using Y Bus, sparse matrix techniques, use of load flow Jacobian for economic dispatch- flowchart -AGC -AGL - use of AGE for economic dispatch, block diagram, block- merit order scheduling. **10 Hrs**.

6) Hydrothermal Coordination:

Introduction, Hydroelectric Plant Models, Scheduling Problems, the Short-Term Hydrothermal Scheduling Problem, Short-Term Hydro-Scheduling: A Gradient Approach, Hydro-Units in Series (Hydraulically Coupled), Pumped-Storage Hydro plants, Dynamic-Programming Solution to the Hydrothermal Scheduling Problem, Hydro-Scheduling Using Linear Programming, Hydro-Scheduling with Storage Limitations. **10 Hrs**.

Reference Books:

1) C. L, Wadhwa, “Electrical Power System”, New Age International, 2010

2) Allen Wood and Woolenberg, “Power Generation Operation and Control”, Wiley India 2nd Edition, 2009.

3) Olle. I. Elgerd, “Electrical Energy Systems”, TMH, 2001

4) C. L. Kusic “Computer Aided Power System Analysis”, CRC Press, 2nd Edition Indian reprint, 2014

5) Nagrath& Kothari, “Modern Power System Analysis”, 4thEdition, TMH, 2011

20PEPSE233	Power System SCADA	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The advent in digital technology has led paradigm shift in the control strategies of various engineering systems. The operation of integrated power system is challenge posed to the control engineers. The technology usage happened in incremental fashion and hence, it is necessary to integrate these in phase wise manner. The information and communication technology are useful for real time operation of critical infrastructures. The initiation is with data acquisition and supervisory control in segmented approach. This subject makes the students to understand the methods of data acquisition, transmission in open loop manner & closed loop manner, use of ICT, communication protocols, presentation of data, processing of data and generating control signals etc. Further it provides information regarding the information management system and security measures. The students also learn the codes specified by the standard organizations.

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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 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO1	Recite the concept of power system state estimation techniques, metering, measurements, operation, and control.		1	3
CO2	Comprehend the importance of automation in critical infrastructures and basics of SCADA system as applied to power systems.		1	3
CO3	Use communication protocols for data transmission in closed and open loop environment, vulnerability, security, IDS and security projects adhering to standard & reference documents.	1	2	3
CO4	Explain the requirements for substation, distribution station and feeder automation with protective and alarming schemes.	1	4	3

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.5	2.0	1.0	2.0

Prerequisites:[1]. Power System Analysis [2] Power System Operation & Control

Contents:

1) State Estimation in Energy Control Centers (ECC):

Introduction, power system measurements, states of power systems, overview of different state estimator techniques, bad data handling, pseudo measurements, and observability analysis. **05 Hrs.**

2) SCADA System:

History of Critical Infrastructure Directives, SCADA system evolution, definitions, SCADA system architecture, SCADA applications, SCADA system security issues, overview, SCADA system desirable properties, SCADA systems in the critical infrastructure, employment of SCADA systems. OSI and TCP/IP reference models. Few examples of SCADA controlled systems.

09 Hrs.

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3) Evolution of SCADA Protocols:

Background technologies of the SCADA protocols, SCADA protocols (the MODBUS model, the DNP3 protocols, UCA 2.0 and IE61850 standards, control area network, control and information protocol, device Net, control Net, Ether Net/IP, FFB, profibus, the security implications of the SCADA protocols, demilitarized zone. ` **09 Hrs.**

4) SCADA Vulnerabilities and Attacks:

The myth of SCADA invulnerability, SCADA risk components, risk management components, assessing the risk, mitigating the risk, SCADA threats and attack routes, SCADA Honey net project. **08 Hrs.**

5) SCADA Security Methods & Techniques:

SCADA security mechanisms, SCADA intrusion detection systems, SCADA security standards and reference documents, standards, and reference documents. **05 Hrs.**

6) Power System Automation:

Introduction, overview of power system instrumentation, power system metering, Power plant automation, substation automation, transmission management, distribution management, SCADA distribution management, distribution automation – feeder automation, demand side management, load management. **08 Hrs.**

7) Substation Automation and Protocol Standards for Power Systems:

Need for a automation, definition of integration and automation, substation control panels – with electromechanical devices, with Intelligent Electronic Devices (IED), automatic load restoration – intelligent bus fail to VAr, supply, line sectionalizing, monitoring of equipment condition, alarm processing, power quality, switched feeder capacitor banks, equipment rating. Integrated protection functions – Adaptive relaying. **08 Hrs.**

Reference Books:

1) Krutz, Ronald. L, “Securing SCADA Systems”, 2nd Edition, Wiley, 2005.
2) Michael Wiebe, “A Guide to Utility Automation: A MR, SCADA, and IT Systems for Electric Power”, Penn Well Books, 1999
3) Allen Wood &Woolenberg, “Power generation, operation and control” John Wiley Edition, 2012
4) Prabha K, “Power System Stability and Control” McGraw hill, 2016

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20PEPSE234	HVDC Power Transmission	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) To give an exposure to the new technology domain "HVDC Power Transmission".
2) To impart the basic knowledge regarding the HVDC Power Transmission.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	List the advantages and the relevance of HVDC Power Transmission.	1		
CO2	List the applications and present status of HVDC Power Transmission.	1		
CO3	Demonstrate the knowledge about the role of Power Electronics in HVDC Power Transmission.	1	2	
CO4	Recite the different control aspects of HVDC Power Transmission.	1	2	
CO5	Explain the concepts of filters, measurement, monitoring aspects with reference to HVDC Power Transmission.	1		
CO6	Recite the present technology trends in HVDC Power Transmission.	1	2	

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	2.0		

Pre-Requisites: [1] Basics of Electrical Engineering [2] Power Electronics [3] Power Systems

Contents:

1) HVDC Transmission: Introduction; Comparison of AC-DC Transmission: Evaluation of Transmission Cost, Technical Consideration, Reliability and Availability Costs; Applications of dc Transmission; Types of HVDC Systems: Monopolar Link, Bipolar Link, Homopolar Link. **04 Hrs**.

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2) **Types of Converters:** Introduction; Current Source Converters (CSC): Case with no overlap period, Case with overlap period less than 60 degrees; Voltage Source Converters (VSC): Control of the DC Capacitor Voltage, VSC with AC Current Control, VSC with AC Voltage Control. **08 Hrs.**

3) **Synchronization Techniques for Power Converters:** Introduction; Review of GFUs: Individual Phase Control (IPC) Unit, Equi-Distant Pulse Control (EPC) Unit; GFUs: Conventional GFU, DQO GFU, Comparison. **06 Hrs**.

4) **HVDC Controls:** Historical Background; Functions of HVDC Controls; HVDC and FACTS Controllers; Control Basics for a Two-terminal DC Link; Current Margin Control Method: Rectifier Mode of Operation, Inverter Mode of Operation; Current Control at the Rectifier; Inverter Extinction Angle Control; Hierarchy of Controls. **08 Hrs**.

5) **Forced Commutated HVDC Converters:** Introduction; Commutation Techniques for HVDC Converters; Examples of FC Converters for HVDC Transmission: Circuit Commutated Converters, Self-Commutated Converters. **04 Hrs.**

6) **Capacitor Commutated Converters for HVDC Systems:** Introduction; Reactive Power Management; Thyristor Valve Modules. **04 Hrs.**

7) **HVDC Systems Using Voltage Source Converters**: Introduction; Basic Elements of HVDC using VSCs - Voltage Source Converters; Voltage Source Converter - Operating Principles of a VSC. **06 Hrs.**

8) **Active Filters:** Introduction; DC Filters; AC Filters. **04 Hrs.**

9) **Measurement/Monitoring Aspects**: Introduction; Monitoring of Signals Protection against Over-currents; Protection against Over-voltages. **04 Hrs.**

10) **Modern HVDC - State ofthe Art:** Introduction; Past Decade Version; Present Decade Version. **04 Hrs.**

Reference Books:

1) Vijay K Sood, “HVDC and FACTs Controllers; Applications of Static Converters in Power Systems, BSP Books Pvt. Ltd, First Indian reprint 2013.

2) K. R. Padiyar, “HVDC Power Transmission Systems”, New Age International, 2012.

3) E.W. Kimbark “Direct Current Transmission”, Vol.1, Wiley Inter-Science, London, 2006.

4) Arrilaga, “High Voltage Direct Current Transmission”, The Institute of Engineering and Technology, 2nd Edition, 2007.

5) S Kamakshaiah and V Kamaraju, “HVDC Transmission”, TMH, 2011.

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20PEPSE235	Fundamentals of Smart Grid Technology	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The use of communications and information technologies is likely to cause major shifts in the way energy gets delivered. The smart grid will use these technologies to deliver electricity reliably and efficiently, and it has the potential to radically change the electricity sector in the same way that new technologies changed the telecommunications sector. Students in this course will learn the fundamentals of the smart grid: its purpose and objectives, its technologies, its architectures, and its management. Students will also learn many of the challenges facing the smart grid as part of its evolution.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Recite the various aspects of the smart grid	1	3	2
CO2	Demonstrate how a perfect power system can be realized	1	3	2
CO3	Analyze the power system in real time with enabling technologies	4	3	2
CO4	Use technology alternatives for efficient electricity end use.	4	3	2

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	1.0	2.0	3.0

Prerequisites: [1] Renewable Energy Sources
[2] Transmission and Distribution (AC/DC)

Contents:

1) Introduction

Introduction to smart grid, electricity network, local energy networks, electric transportation, low carbon central generation, attributes of the smart grid, alternate views of a smart grid. **04 Hrs.**

2) Smart Grid to Evolve a Perfect Power System

Introduction, overview of the perfect power system configurations, device level power system, building integrated power systems, distributed power systems, fully integrated power system, nodes of innovation. **06 Hrs.**

3) DC Distribution and Smart Grid

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AC Vs. DC sources, benefits of and drives of dc power delivery systems, powering equipment and appliances with DC, data centers and information technology loads, future neighborhood, potential future work and research. **04 Hrs**.

4) Intelligent grid Architecture for the Smart Grid:

Introduction, launching intelli-grid, intelli-grid today, smart grid vision based on the intelli-grid architecture, barriers and enabling technologies. **06 Hrs.**

5) Dynamic Energy Systems Concept

Smart energy efficient end use devices, smart distributed energy resources, advanced whole building control systems, integrated communications architecture, energy management, role of technology in demand response, current limitations to dynamic energy management, distributed energy resources, overview of a dynamic energy management, key characteristics of smart devices, key characteristics of advanced whole building control systems, key characteristics of dynamic energy management system. **08 Hrs**.

6) Energy Port as Part of the Smart Grid

Concept of energy -port, generic features of the energy port. Policies and Programs to Encourage End – Use Energy Efficiency: Polices and programs in action; multinational, national, state, city and corporate levels. **08 Hrs**.

7) Market Implementation

Framework, factors influencing customer acceptance and response, program. planning, monitoring and evaluation. **06 Hrs.**

8) Efficient Electric End – Use Technology Alternatives

Existing technologies, lighting, space conditioning, indoor air quality, domestic water heating, hyper efficient appliances, ductless residential heat pumps and air conditioners, variable refrigerant flow air conditioning, heat pump water heating, hyper efficient residential appliances, data center energy efficiency, LED street and area lighting, industrial motors and drives, equipment retrofit and replacement, process heating, cogeneration, thermal energy storage, industrial energy management programs, manufacturing process, electro - technologies, residential, commercial and industrial sectors. **10 Hrs.**

Reference Books:

1) Clark W Gellings, “The Smart Grid, Enabling Energy Efficiency and DemandSide Response”, CRC Press, 2009.
2) Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”, Wiley, 2012.
3) James Momoh, “Smart Grid: Fundamentals of Design and Analysis”, Wiley, IEEE Press.

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20PEPSE236	Distributed Generation and Micro Grids	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1) To illustrate the concept of distributed generation
2) To analyze the impact of grid integration.
3) To study concept of Microgrid and its configuration
4) To study protection issues and communication protocols

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Review the conventional power generation	1	3	2
CO2	Analyze the concept of distributed generation and installation	1	3	2
CO3	Design the grid integration system with conventional and non-conventional energy sources	4	3	2
CO4	Design the dc and ac micro grid, Analyze power quality issues, control operation	4	3	2
CO5	Understand protection concepts and communication protocols in Microgrids	4	3	2

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	1.0	2.0	3.0

Prerequisites: AC Generation, Transmission and Distribution

Contents:

1) **Introduction:**
   Conventional power generation: advantages and disadvantages, Energy crises, Non - conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources. **08 Hrs.**
2) **Distributed Generations (DG):**
   Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in

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DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants. **10 Hrs.**

3) Basics of Microgrid:

Concept and definition of microgrid, microgrid drivers and benefits, review ofsources of microgrids, typical structure and configuration of a micro grid, AC and DC microgrids, Power Electronics interfaces in DC and AC micro grids.

08Hrs.

4) Impact of Grid Integration:

Requirements for grid interconnection, limits on operational parameters, voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability, and power quality issues. **08 Hrs.**

5) Control and Operation of Microgrid:

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication-based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids. **10 Hrs.**

6) Protection Issues for Microgrids:

Introduction, Islanding, Different islanding scenarios, Major protection issues of stand-alone Microgrid - Impact of DG integration on electricity market, environment, distribution system, communication standards and protocols.

08 Hrs.

Reference Books:

1) Amirnaser Yezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2009.

2) Dorin Neacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006.

3) Chetan Singh Solanki, “Solar Photo Voltaics”, PHI learning Pvt. Ltd., New Delhi, 2009

4) J. F. Manwell, J.G “Wind Energy Explained, Theory Design and Applications,”. McGowan Wiley publication, 2nd Edition, 2009.

5) D. D. Hall and R. P. Grover, “Biomass Regenerable Energy”, John Wiley, New York, 1987.

6) John Twidell and Tony Weir, “Renewable Energy Resources”, Taylor and Francis Publications, Second Edition, 2006.

7) S. Chowdhury, S.P. Chowdhury, and P. Crossley, Microgrids and Active Distribution Networks, ISBN 978-1-84919-014-5, IET, 2009.

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20PEPSL202	Power System Laboratory-II	(0-0-3)2

Contact Hours: 36

Course Learning Objectives (CLOs):

1) Conduct of experiment for reactive power optimization and loss minimization studies.
2) Conduct of experiment for Dynamic VAR compensation and voltage control using shunt SVC.
3) Conduct of experiments for economic dispatch problem considering network loading constraints and computation of bus incremental cost.
4) Conduct of experiment for ATC computation, open access feasibility study.
5) Conduct of experiment for Harmonic analysis and voltage and current harmonic distortion computation for a given power system. Tuned filter design to eliminate the harmonic currents.
6) Conduct experiments to use AI techniques in power system studies.
7) Conduct experiments involving distributed sources.

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 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO1	Apply the knowledge of electrical engineering in conducting different experiment in the laboratory.	4	1, 3	2
CO2	Use suitable simulation software package for the conduction of experiments and analyze the results.	4	1, 3	2

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	1.0	2.0	3.0

List of Experiments

1) Reactive power optimization and loss minimization studies for a given power system.
2) Dynamic VAR compensation and voltage control using shunt SVC.
3) Economic dispatch problem taking into account the network loading constraints and computation of bus incremental cost.
4) Analysis and impacts of wind generation on distribution system.

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5) Analysis and impacts of Solar PV generation on distribution system.
6) Short term load forecasting for a given power system using ANN.
7) Fuzzy logic based load frequency control of power system.
8) Optimum location of FACTS devices using genetic algorithm in power system.
9) Computation of voltage and current harmonic distortion for a given power system with and without filter.
10) ATC computation and open access feasibility studies for the given power system network

*** Software MI POWER / MATLAB will be used.**

20PEPSL203	**Seminar**	**(0-0-2)1**

Contact Hours: 24

Course Learning Objectives (CLOs):

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion, and present and exchange ideas.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Communicate effectively on a technical topic	1,3	2	4
CO2	Learn new technical things by self-study	1,3	2	4
CO3	Involve in technical group discussion actively	1,3	2	4
CO4	Face and interact with class audience	1,3	2	4

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	2.0	3.0	1.0

Each student, under the guidance of a Faculty, is required to,

i. Choose, preferably, a recent topic of his/her interest relevant to the Course of Specialization.
ii. Carryout literature survey, organize the course topics in a systematic order.
iii. Prepare the report with own sentences.

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iv. Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
v. Present the seminar topic orally and/or through power point slides.
vi. Answer the queries and involve in debate/discussion.
vii. Submit two copies of the typed report with a list of references.
viii. The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.
ix. The Internal Assessment marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question-and-answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of two faculties from the department with the senior most acting as the Chairman.

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Academic Program: PG

Academic Year 2021-22

Department of Electrical & Electronics Engineering

Power Systems Engineering

III & IV Semester M. Tech. Syllabus

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)

Ph: 0836-2447465Fax: 0836-2464638 Web: www.sdmcet.ac.in

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SDM College of Engineering & Technology, Dharwad
Department of Electrical Engineering

*(Our motto: **P**rofessional **C**ompetence with **P**ositive **A**ttitude)*

College Vision and Mission

Vision:

To develop competent professionals with human values.

Mission:

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

SDMCET- Quality Policy

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

SDMCET- 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:

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

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for III & IV semester M.Tech in Power Systems 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	Digitally signed by KURAKUNDI RAGHAVENDRARAO GOPINATH Date: 2023-02-09 10:42+05:30	Chairman BoS & HoD

The Program Educational Objectives (PEOs):

I. To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms

II. To prepare graduates who will contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise

III. To prepare graduates who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, research, design and implementation skills

IV. To prepare graduates who will thrive to pursue life-long reflective learning to fulfill their goals

Program Outcomes (POs):

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: To demonstrate a degree of mastery over the area of power systems engineering.

PO4: Exposure to the state of the art practices in the domain of power systems engineering

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Scheme of Teaching and Examination

III-Semester M. Tech. (Power Systems Engineering)

Course Code	Course Title	Teaching		Examination				
		L -T - P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PEPSC300	Distribution System Design & Control	4-0-0	4	50	100	3	--	--
20PEPSEXXX	Elective 5	3-0-0	3	50	100	3.	--	--
20PEPSEXXX	Elective 6	3-0-0	3	50	100	3	--	--
20PEPSEXXX	Elective 7	3-0-0	3	50	100	3	--	--
OR								
20PEPSL301	Internship (In industry or R&D organization)	** Min 4 weeks during vacation after 2nd Sem.	3	50	--	--	100	3
20PEPSL302	***Project Phase 1	0-0-15	9	50	--	--	50	3
Total		**13-0-15/10-4 weeks-15**	**22**	**250**	**400/300**		**50/150**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

*SEE for theory courses is conducted for **100 marks** and reduced to **50 marks**.

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** The students are expected to undergo training in industry for a period of ***4 weeks*** during the vacation immediately after completion of II Semester examination. A faculty is to be allotted to guide the student. A committee consisting of three faculty members shall evaluate the work carried out and the knowledge the students have acquired**.** OR The students can take one elective course if they do not undergo internship.

***Project phase-I: The students are expected to formulate the problem and carry out the intensive literature survey along with preliminary investigations supporting the project phase-II in IV semester.

Course Code	Elective (5, 6, 7)	Credits
20PEPSE311	Planning & Management of Deregulated Power Systems	3
20PEPSE312	Power Systems Reliability Engineering	3
20PEPSE313	Programmable Logic Controllers and Applications	3
20PEPSE314	Power Quality Issues and Mitigation Techniques	3

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Scheme of Teaching and Examination

IV-Semester M. Tech. (Power Systems Engineering)

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
20PEPSL400	Project Phase-II	0-0-20	22	100	--	--	100	3
Total		**0-0-20**	**22**	**100**	**--**	**--**	**100**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

***SEE** for theory courses is conducted for 100 marks and reduced to 50 marks.

****** Project phase-I: The students are expected to work on a project for the full semester in an industry or institution

Total Credits offered for the first year: **44**

Total Credits offered for the Second year: **44**

Credits Distribution:

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III – Semester M. Tech. (Power Systems Engineering)

20PEPSC300	Distribution System Design & Control	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

To explain the principles of design and operation of electric distribution system. To apply analytic techniques pertaining to primary distribution systems. To use basic design principles for distribution substations and facilities. To examine primary distribution systems with capacitor compensation. To obtain the reliability indices related to the distribution system.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Design, Develop and Analyze primary and secondary distribution systems.	1	3	2
CO2	Evaluate and suggest suitable power factor correction capacitors in the system.	1	3	2
CO3	Develop reliability model and obtain reliability indices.	1	3, 4	2

PO's	PO- 1	PO-2	PO-3	PO-4
Mapping Level	3.0	1.0	2.0	2.0

Prerequisites:

Contents:

1) Distribution System Planning & Automation:

Introduction, distribution system planning; factors affecting system planning, present technique, role of computers in distribution planning. **05 Hrs.**

2) Distribution Substation:

Introduction, load characteristics, relationship between loss and load factor, maximum diversified demand, Load management. Substation location, rating a distribution substation, substation services area with 'n' primary feeders,

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comparison of four and six feeder patterns, derivation of K constant, substation application curves, present voltage drop formula. **12 Hrs.**

3) Primary and Secondary Distribution Systems:

Introduction, feeder types and voltage levels, feeder loading rectangular type development, radial type development application of the A, B, C, D general circuit constants to radial feeders, secondary banking. **10 Hrs.**

4) Voltage Drop and Power Loss Calculations:

Three phase balanced primary lines, single phase lines, Four-Wire multigrounded Common Neutral system, Methods to analyze Distribution Cost. **07 Hrs.**

5) Application of Capacitors in Distribution Systems:

Introduction, Power capacitors series and shunt power factor correction, economic power factor, applications of capacitors and installation, types of control, economic justification, practical procedure to determine the best location, mathematical procedure for optimum- allocation, dynamic behavior of distribution system. **08 Hrs.**

6) Distribution System Reliability:

Introduction, basic reliability concepts, series, parallel and series-parallel systems, Markov Processes, Distribution Reliability Indices: Sustained, Momentary, Load and Energy based indices, Usage of indices, Benefits of Reliability Modeling in system performance. **10 Hrs.**

Reference Books:

1) Turan Gonen, "Electric Power Distribution System Engineering",2nd Edition, BSP Books Pvt. Ltd, 2010.

2) A.S. Pabla, "Electric Power Distribution System", 6th Edition, TMH, 2011.

3) Gorti Ramamurthy, "Hand Book of Electrical Power Distribution", University Press, 2nd Edition, 2009.

20PEPSE311 Planning & Management of Deregulated Power Systems (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about the competitive environment &current situation around the world and gaining importance of deregulation in power systems including the benefits & after effects of deregulation. The students are expected to have a focused insight of operating deregulated power systems under different market structures. Further, the different types of transmission open access and pricing issues practiced in various countries shall be studied in this

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course. The students also learn how power system reliability, security and power quality is achieved in deregulated systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Recite the concept of Deregulation of the Electricity Supply Industry.		1	
CO2	Demonstrate the knowledge of Economic Operation of Power systems.	1		4
CO3	Analyze the Power systems Operation in Competitive Environment, Transmission Open Access and Pricing Issues.	3		
CO4	Use the knowledge of Ancillary Services Management, reliability, and power quality aspects in deregulated scenario.	3	4	

PO's	**PO- 1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	2.5		3.0	1.5

Prerequisites:1) Power systems Analysis
2) Power Transmission &Distribution
3) Power systems Operation and Control
4) Power systems planning

Contents:

1) Deregulation of the Electricity Supply Industry

Introduction, meaning of deregulation, background to deregulation and the current situation around the world, benefits from a competitive electricity market, after effects of deregulation. **06 Hrs**.

2) Power systems Economic Operation Overview

Introduction, economical load dispatch, optimal power flow as a basic tool, unit commitment and formation of power pools. **06 Hrs.**

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3) **Power systems Operation in Competitive Environment**
Introduction, role of independent system operator (ISO), operational planning activities of ISO, Operational planning activities of a Genco. **06 Hrs.**

4) **Transmission Open Access and Pricing Issues**
Introduction, power wheeling, transmission open access, cost components in transmission, pricing of power transactions, security management in deregulated environment and congestion management in deregulation. **06 Hrs.**

5) **Ancillary Services Management**
Ancillary services and management in various countries and reactive power as an ancillary service. **06 Hrs.**

6) **Reliability and Deregulation**
Terminology, reliability analysis, network model, reliability costs, hierarchical levels, reliability and deregulation, performance indicators. **05 Hrs.**

7) **Power Quality**
Terminology, interest in power quality, events, and variations. Power quality issues. **04 Hrs.**

Reference Books:

1) Kankar Bhattacharya, Math H J Bollan, Jaap E Daalder, "Operation of Restructured Power systems", Kluwer Academic Publishers, 2001.

2) Loi Lei Lai, "Power systems Restructuring and Deregulation; Trading, Performance and Information Technology", John Wiley and Sons, Ltd, 2002.

20PEPSE312 Power Systems Reliability Engineering (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

To give the students' knowledge on how to use reliability analysis as a tool for decision support during planning, design, operation and maintenance of electric power systems in particular electrical distribution systems.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Describe adequacy and security and evaluate reliability indices using probabilistic processes	1,2	4	3

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CO2	Perform reliability analysis of the power systems such as generators and transmission lines, using analytical simulation tools.	1,2	4	3
CO3	Evaluate reliability indices for distribution systems.	1	1,2	4
CO4	Analyze the system modes of failure to enhance the power systems reliability and evaluate reliability worth.		1,2	3,4

PO's	**PO- 1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	2.0	3.0	2.0

Prerequisites: Power systems Engineering, Graph Theory

Contents:

1) **Basic Concepts**
   Adequacy and Security, System Analysis, Reliability Cost and Reliability Worth. **3 Hrs.**
2) **Generating capacity**
   Basic Probability Methods, generation system model, Loss of load indices, Equivalent forced outage rate, scheduled outages, evaluation methods, load forecast and forced outage rate uncertainty, Loss of Energy indices. Frequency and Duration Methods: generation model, system risk indices. **6 Hrs**.
3) **Interconnected Systems**
   Probability array method in two and three interconnected systems, factors assisting emergency assisting systems. Frequency and Duration approach. **6 Hrs**.
4) **Composite Generation and Transmission Systems**
   Conditional probability approach, network configurations, state selection, system and load point indices, data requirements for composite system reliability evaluation. **6 Hrs.**
5) **Distribution Systems**
   Basic techniques and radial networks, Additional interruption indices, application to radial system, probability distribution of reliability indices. Plant station availability. Parallel and meshed networks: - basic evaluation

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techniques, inclusion of busbar failures, scheduled maintenance, temporary and transient failures, common mode failures etc. **6 Hrs.**

6) **Monte Carlo simulation**

Concept, application to generation capacity reliability evaluation, application to composite generation and transmission systems, application to distribution systems. **6 Hrs.**

7) **Evaluation of Reliability worth**

Implicit/explicit evaluation of reliability worth, customer interruption cost evaluation, basic approaches and customer damage functions. **6 Hrs.**

Reference Books:

1) Roy Billington, "Reliability Evaluation of Power systems Reliability", Springer India, 1996.

2) R. Billington and A.N. Allen, "Reliability Evaluation of Engineering Systems; Concepts and Techniques" Springer, 1992.

3) Hammersley J. M., Handscomb D.C, "Monte Carlo Methods", John Wiley and Sons Inc. NY, 1964.

4) Roy Billington, "Reliability Assessment of Large Electric Power systems", Kluwer Academic Press/Springer India, 2008.

20PEPSE313 Programmable Logic Controllers and Applications (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 different controllers used in PLC applications.

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 4)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO1	Recite the various aspects programming logic controllers			3

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CO2	Construct the ladder diagrams for different process control applications using PLC		3	
CO3	Comprehend the operation of PLC registers, timers, and counters		3	
CO4	Use the different controllers for the PLC applications in process control.			4

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level			2.5	1.0

Prerequisites: Digital Electronics, Microcontrollers, Control System

Contents:

1) PLC Basics

PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules. **6 Hrs.**

2) PLC Programming

Input instructions, outputs, operational procedures, programming examples using contacts and coils, drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system. **6 Hrs.**

3) PLC Registers

Characteristics of Registers, module addressing, holding registers, input registers, output registers. **7 Hrs.**

4) PLC Functions

Timer functions and Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions**.** **7 Hrs.**

5) Data handling functions

SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions. **7 Hrs.**

6) Analog PLC operation:

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Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions. **6 Hrs.**

Reference Books:

1) Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI

2) Programmable Logic Controllers – Programming Method and Applications by J. R. Hackworth and F.D. Hackworth Jr. – Pearson, 2004.

3) Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning.

4) Programmable Logic Controllers –W. Bolton-Elsevier publisher

20PEPSE314 Power Quality Issues and Mitigation Techniques (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs):

1) The basic concept of power quality phenomenon occurring in a power system.
2) The causes of power quality phenomena and their effects
3) Behavior of electronics devices, variable speed ac/dc drives and power system components due to power quality phenomenon
4) The performance evaluation of power system and analysis methods
5) Mitigation of power quality phenomenon in power system.

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 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	Explain the basic concept of power quality phenomenon occurring in a power system	1	3	2
CO2	Comprehend behavior of electronics devices, variable speed ac/dc drives and power system components due to power quality phenomenon	3, 4		2
CO3	Analyze performance of power	4	3	2

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	system using different analysis methods			
CO4	Compare different methods of mitigation of power quality phenomenon in power system	1	3	2

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	3.0	1.0	2.25	3.0

Prerequisites: Basics of power quality issues

Contents:

1) Introduction:

Introduction to power quality, overview of power quality phenomena, power quality and EMC standard. **04 Hrs.**

2) Long Interruptions and Reliability Evaluation:

Introduction, observation of system performance, standards and regulations, overview of reliability evaluation, reliability evaluation techniques, cost of interruptions, comparison of observation and reliability evaluation, examples. **06 Hrs.**

3) Short Interruptions:

Introduction, terminology, origin of short interruptions, monitoring of short interruptions, influence on equipment, single phase tripping, stochastic prediction of short interruptions. **06 Hrs.**

4) Voltage Sags - Characterization:

Introduction, voltage sag magnitude, voltage sag duration, three phase unbalance, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, other characteristic of voltage sags, load influence on voltage sags, sag due to starting of induction motors. **06 Hrs.**

5) Voltage Sags – Equipment Behavior:

Introduction, computers and consumer electronics, adjustable speed AC drives, adjustable speed DC drives, other sensitive load. **05 Hrs.**

6) Voltage Sags – Stochastic Assessment:

Compatibility between equipment and supply, voltage sag coordination chart, power quality monitoring, method of fault positions, method of critical distances. **06 Hrs.**

7) Mitigation of Interruptions and Voltage Sags:

Overview of mitigation methods, power system design – redundancy through switching and parallel operation, system equipment interface. **06 Hrs.**

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Reference Books:

1) Math H J Bollen, "Understanding Power Quality Problems; Voltage Sags and Interruptions", Wiley India, 2011.

2) Roger C Dugan, et. el, "Electrical Power Systems Quality", 3rd Edition, TMH, 2012.

3) G. T. Heydt, "Electric Power Quality", Stars in a Circle Publication, 1991.

4) Ewald F Fuchs, et. el, "Power Quality in Power System and Electrical Machines", Academic Press, Elsevier, 2009.

20PEPSL301	Internship	3 Credits

Duration: 4 weeks

Course Learning Objectives (CLOs):

Internship provides the opportunity for the students to get exposure to the real time systems that include personal training , time and stress management, presentations, marketing, liability and risk management, maintenance and responding to emergencies etc. Further they learn to relate theory and practice. They also learn the significance of adhering to the professional standards in the field**.**

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1, 4)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO1	Know the industrial environment.		3	1
CO2	Acquire knowledge and skill to use in professional career.		3	1
CO3	Acquire the ability of report preparation and presentation skills.	2		
CO4	Follow the code of practice in power system related activities.		4	

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	1.0	3.0	2.0	2.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value added information.

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Contents:

1) The students are expected to undergo industrial training in power system engineering or related domain. They are required to know the functions of Engineers in managing the floor. The skills required in installation, commission, operation, service and maintenance shall be studied and obtained. The organizational behavior and management need to be understood. The above skills obtained need to be documented and presented.
2) Know the current challenges to power system engineers and try suggesting solutions.

Reference materials/books:

1) Industrial reference manuals
2) Data sheets.
3) Software packages.
4) Product information brochures.
5) Interaction with industrial experts.
6) Internet

20PEPSL302	Project Phase – I	(0-0-15) 9

Contact Hours: 100

Course Learning Objectives (CLOs):

The students are expected to learn carrying out literature survey to locate the state of the art technology while formulating/defining the project problem in power systems engineering domain. The students are expected to select a topic from an emerging area relevant to electrical power systems and/or other relevant branches/Electrical industry related real time problems and define the problem for the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The same work shall be continued in the next phase in IV semester.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1, 4)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO1	Carry out the literature survey to locate the state of the art technology in Power systems		1	4

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	Engineering field.			
CO2	Define/formulate the problem for the project work		1	3
CO3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code, prepare report, etc. relevant to his/her project work		3	
CO4	Summarize the work in to a project report and present	2		

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	3.0	1.5	1.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous semesters and relevant value-added information.

Contents:

1) The students are expected to locate the state of the art technology in power systems engineering domain through proper literature survey and select a topic from an emerging area relevant to electrical power systems engineering and/or other relevant branches and define the problem for the project work. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase.
2) Know the current challenges to power systems engineers and try suggesting technical solutions.

Reference materials/books:

1) Engineering books pertaining to their work.
2) International reputed Journals.
3) Manuals and data sheets.
4) Software packages.
5) Previous project reports.
6) Product information brochures.
7) Interaction with academia and industrial experts.
8) Internet Material.

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IV-Semester M. Tech. (Power Systems Engineering)

20PEPSL400	Project Phase – II	(0-0-20) 22

Contact Hours: 200

Course Learning Objectives (CLOs):

The students are expected to find out solutions individually for the power systems related problems preferably. They are expected to carry out the intensive literature survey to locate the state of the art technology in power systems engineering. They must learn to formulate/define/locate real time problem for the project work. They will also learn to design, develop, analyze, test, interpret the results, fabricate, simulate, write code, and convert report in to papers for publication in journals to add value to the existing literature. They are also expected to acquire the skills of summarizing the work in to a project report and present the same.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1, 4)**		
		Substantial Level (3)	**Moderate Level(2)**	**Slight Level (1)**
CO1	Carry out the literature survey to locate the state of the art technology in power systems engineering.		1	4
CO2	Define/formulate/locate real time problem for the project work		1	3
CO3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code, prepare papers etc.	3		
CO4	Summarize the work in to a project report and present the same	2		

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	3.0	2.0	1.0

Prerequisites:

Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value added information.

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Contents:

The students are expected to continue the work with real time power systems operation and control related challenges and providing feasible solutions.

Reference materials/books:

1) Engineering books pertaining to their work.
2) International reputed Journals.
3) Manuals and data sheets.
4) Software packages.
5) Previous project reports.
6) Product information brochures.
7) Interaction with academia and industrial experts.
8) Internet Material.

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