BIRLA INSTITUTE OF TECHNOLOGY
MESRA RANCHI, INDIA

CHOICE BASED CURRICULUM

Undergraduate Programme

Department of Electrical and Electronics Engineering

(2021 Onwards)

Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research and technological service to the National needs.

Institute Mission

- To educate students at Undergraduate, Postgraduate, Doctoral and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching and learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

Department Vision

To become an internationally recognized centre of excellence in academics, research and technological services in the area of Electrical and Electronics Engineering and related inter-disciplinary fields.

Department Mission

- Imparting strong fundamental concepts to students and motivate them to find innovative solutions to engineering problems independently.
- Developing engineers with managerial attributes capable of applying latest technology with responsibility.
- Creation of congenial atmosphere and excellent research facilities for undertaking quality research by faculty and students.
- To strive for more internationally recognized publication of research papers, books and to obtain patent and copyrights.
- To provide excellent technological services to industry

Program Educational Objectives (PEO)

1. To develop capability to understand the fundamentals of Science and Electrical & Electronics Engineering for analysing the engineering problems with futuristic approach.

2. To foster a confident and competent graduate capable to solve real life practical engineering problems fulfilling the obligation towards society.
3. To inculcate an attitude for identifying and undertaking developmental work both in industry as well as in academic environment with emphasis on continuous learning enabling to excel in competitive participations at global level.
4. To nurture and nourish effective communication and interpersonal skill to work in a team with a sense of ethics and moral responsibility for achieving goal.

Program Outcomes (PO)

A graduate shall

1. Be competent in applying basic knowledge of science and engineering for the purpose of obtaining solution to a multi-disciplinary problem.
2. Gain skillful knowledge of complex engineering problem analysis.
3. Be able to design system components and processes meeting all applicable rules and regulations.
4. Be proficient in arriving at innovative solution to a problem with due considerations to society and environment.
5. Be capable of undertaking suitable experiments/research methods while solving an engineering problem and would arrive at valid conclusions based on appropriate interpretations of data and experimental results.
6. Continually upgrade his/her understanding and become masterly at modern engineering and soft tools and apply them along with other appropriate techniques and resources.
7. Exhibit understanding of societal and environmental issues (health, legal, safety, cultural etc) relevant to professional engineering practice and demonstrate through actions, the need for sustainable development.
8. Be committed to professional ethics, responsibilities and economic, environmental, societal, and political norms.
9. Demonstrate appropriate inter-personal skills to function effectively as an individual, as a member or as a leader of a team and in a multi-disciplinary setting.
10. Be able to comprehend and write effective reports and design documentations; give and receive clear instructions; make effective presentations and communicate effectively and convincingly on complex engineering issues with engineering community and with society at large.
11. Be conscious of financial aspects of all professional activities and shall be able to undertake projects with appropriate management control and control on cost and time.
12. Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

13. Pragmatic professional exposure in the domain of Power Engineering, Power Electronics, Measurement, and Control through systematically designed courses, laboratory contents, projects, and commensurate electives.
14. Development of analytical and designed skills for electrical & electronic systems as well as multidisciplinary areas of engineering utilizing appropriate conventional and modern tools.
15. Holistic amalgamation of managerial skills and research aptitude to strengthen industry-academia collaboration.

Graduate Attributes

1. **Engineering Knowledge**: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
4. **Conduct investigations of complex problems** using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
5. **Modern Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9. **Individual and Teamwork**: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
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, make effective presentations and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of 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.
12. **Life-long Learning**: Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

1ST and 2ND Semester B.Tech. Course Syllabus

FIRST	MA 103	Mathematics – I
	CH101	Chemistry
	EC101	Basic of Electronics and Communication Engineering
	ME101	Basic of Mechanical Engineering
	CH102	Chemistry Lab
	EC102	Electronics and Communication Lab
	ME102	Engineering Graphics
SECOND	MA107	Mathematics – II
	PH113	Physics
	CS101	Programming for problem-Solving
	EE101	Basic Electrical Engineering
	PH114	Physics Lab
	CS102	Programming for problem Solving Lab.
	PE101	Workshop Practice

COURSE INFORMATION SHEET

Course code: EE 101

Course title: Basics of Electrical Engineering

Pre-requisite(s): Basic Sciences

Co- requisite(s):

Credits: 04

L	T	P
3	**1**	**0**

Class schedule per week: 04

Class: B. Tech.

Semester: 1st/2nd

Level: I

Branch: ALL

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

1.	Classify different electrical circuit elements and apply suitable laws and theorems for the analysis of electrical systems.
2.	Represent series / parallel electric / magnetic circuits.
3.	Employ three phase circuits for transfer of electrical power both under balanced and unbalanced condition.
4.	Interpret the system responses under different operating conditions such as resonance, mutual coupling and star-delta conversion.
5.	Assess the working of different A.C. electrical machines

Course Outcomes

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

CO1	Solve electrical circuits using Kirchhoff's laws and apply concepts of magnetic circuits in electrical systems.
CO2	Analyze A.C. electrical circuits having dependent and independent sources for computation of responses such as voltage, current, power.
CO3	Evaluate the advantages of 3 phase system in electrical industrial applications and differentiate between balanced and unbalanced operation.
CO4	Assess the applicability of circuit theorems for practical applications.

CO5	Integrate the sources of energy for transferring power to the consumers (load).

Syllabus

Module 1

Introduction: Importance of Electrical Engineering in day-to-day life, Electrical elements, properties and their classification, Ideal and Real Sources, Source Conversion. D.C. Circuits: KCL and KVL, Loop current and Nodal voltage method Steady state analysis with independent and dependent sources, Star-Delta conversion.

Magnetic Circuits: Introduction, Series-parallel magnetic circuits, Analysis of Linear and Nonlinear magnetic circuits, Energy storage, A.C. excitation, Eddy currents and Hysteresis losses. [9L]

Module 2

Single-phase AC Circuits: Series Circuits: Common signals and their waveforms, RMS and Average value, Form factor & Peak factor of sinusoidal waveform, Impedance of Series circuits. Phasor diagram, Active Power, Power factor. Power triangle. Parallel Circuits: Admittance method, Phasor diagram. Power, Power factor. Power triangle, Series- parallel Circuit, Power factor improvement. Series and Parallel Resonance: Resonance curve, Q–factor, Dynamic Impedance and Bandwidth. [9L]

Module 3

Three-Phase Circuits: Line and Phase relation for Star and Delta connection, Power relations, Analysis of balanced and unbalanced 3 phase circuits, Measurement of Power. [9L]

Module 4

Circuit Theorems: Superposition theorem, Thevenin’s & Norton’s Theorem, Maximum Power Transfer theorem for Independent and Dependent Sources for DC and AC circuits. Coupled Circuits (Dot rule), Self and mutual inductances, Coefficient of coupling. [9L]

Module 5

Working principles of AC Generators, motors and transformers, working principles of measuring equipment such as digital voltmeter, ammeter, power factor meter and wattmeter. [9L]

Textbooks:

1. Hughes, Electrical Technology, Pearson, 10th Edition, 2011.

2. Fitzgerald and Higginbotham, Basic Electrical Engineering, McGraw Hill Inc, 1981.

3. D.P. Kothari and I.J. Nagrath, Basic Electrical Engineering, 3rd Edition, TMH, 2009.

Reference books:

1. W. H. Hayt, Jr J. E. Kemmerly and S. M. Durbin, Engineering Circuit Analysis, 7th Edn TMH, 2010.

2. Electrical Engineering Fundamental, Vincent Del Toro, Prentice Hall, New Delhi.

Gaps in the syllabus (to meet Industry/Profession requirements)

1. Application of principles of magnetic circuits to electrical machines like transformers, generators and motors.
2. Field applications of three phase equipment and circuits in power system.
3. Applications of circuit theorems in electrical and electronics engineering.

POs met through Gaps in the Syllabus: 3, 4, 12.

Topics beyond syllabus/Advanced topics/Design

1. Concepts of electric, magnetic and electromagnetic fields
2. 3 - Φ power generation and transmission
3. Power factor improvement for three phase systems
4. Utility of reactive power for creation of electric and magnetic fields

POs met through Topics beyond syllabus/Advanced topics/Design: 2, 3, 4, 12.

Course Delivery methods

Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination	25
End Semester Examination	50
Quiz (s)	10 + 10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

Indirect Assessment –

1. Student Feedback on Course Outcome

<u>Mapping of Course Outcomes onto Program Outcomes</u>

Course Outcome	**Program Outcomes**												**Program specific outcome**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2			
CO2	3	3	3	1	3	1	1	1				2			
CO3	3	3	3	3	3	1	2	2		1	1	2			
CO4	3	3	3	1	3	1	1	1		1	1	2			
CO5	3	3	3	3	3	1	1	1	1	1	1	2			

3= High, 2=Medium, 1=Low

COURSE INFORMATION SHEET

Course code: MA 103

Course title: Mathematics I

Pre-requisite(s): Basic Calculus, Basic Algebra

Co- requisite(s): ---

Credits: 04

L	**T**	**P**
3	**1**	**0**

Class schedule per week: 3 Lectures, 1 Tutorial.

Class: B.Tech.

Semester / Level: I / First

Branch: All

Name of Teacher:

Course Objectives:

This course enables the students to understand:

1.	Infinite sequences and series.
2.	Theory of matrices including elementary transformations, rank and its application in consistency of system of linear equations, eigenvalues, eigenvectors etc.
3.	Multivariable functions, their limits, continuity, partial differentiation, properties and applications of partial derivatives.
4.	Integrals of multivariable functions viz. double and triple integrals with their applications.
5.	Properties like gradient, divergence, curl associated with derivatives of vector point functions and integrals of vector point functions.

Course Outcomes: After the completion of this course, students will be able to

CO1	Decide the behaviour of sequences and series using appropriate tests.
CO2	Get an understanding of partial derivatives and their applications in finding maxima - minima problems.
CO3	Apply the principles of integral to solve a variety of practical problems in engineering and sciences.
CO4	Demonstrate a depth of understanding in advanced mathematical topics.
CO5	Enhance and develop the ability of using the language of mathematics in engineering.

(MA 103) Mathematics I

Syllabus

Module 1: Sequences and Series

Sequences, Convergence of Sequence. Series, Convergence of Series, Tests for Convergence: Comparison tests, Ratio test, Cauchy's root test, Raabe's test, Gauss test, Cauchy's Integral test, Alternating series, Leibnitz test, Absolute and Conditional Convergence. **[9 L]**

Module 2: Matrices

Rank of a Matrix, elementary transformations, Row - reduced Echelon form. Vectors, Linear Independence and Dependence of Vectors. Consistency of system of linear equations. Eigenvalues, Eigenvectors, Cayley - Hamilton theorem.
[9 L]

Module 3 : Advance Differential Calculus

Function of several variables, Limit, Continuity, Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Chain rules, Jacobians and its properties, Taylor series for function of two variables, Maxima – Minima, Lagrange's method of multipliers. **[9 L]**

Module 4: Advance Integral Calculus

Beta and Gamma functions: definition and properties.

Double integrals, double integrals in polar coordinates, Change of order of integration, Triple Integrals, cylindrical and spherical coordinate systems, transformation of coordinates, Applications of double and triple integrals in areas and volumes.
[9 L]

Module 5 : Vector Calculus

Scalar and vector point functions, gradient, directional derivative, divergence, curl, vector equations and identities. Line Integral, Work done, Conservative field, Green's theorem in a plane, Surface and volume integrals, Gauss – divergence theorem, Stoke 's theorem. **[9 L]**

Text Books:

1. M. D. Weir, J. Hass and F. R. Giordano: Thomas' Calculus, 11th Edition, Pearson Educations, 2008E.
2. H. Anton, I. Brivens and S. Davis, Calculus, 10th Edition, John Wiley and sons, Singapore Pte. Ltd., 2013.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books:

1. M. J. Strauss, G. L. Bradley And K. J. Smith, Calculus, 3rd Ed, Dorling.Kindersley (India) Pvt. Ltd. (P Ed), Delhi, 2007.

2. David C. Lay, Linear Algebra and its Applications, 3rd Edition, Pearson Ed. Asia, Indian Reprint, 2007.

3. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, 4^{th} Edition, 2011.

COURSE INFORMATION SHEET

Course code: MA 107

Course title: Mathematics II

Pre-requisite(s):

Co- requisite(s): Mathematics - I

Credits: 04

L	T	P
3	1	0

Class schedule per week: 3 Lectures, 1 Tutorial**. Class:** B.Tech.

Semester / Level: II / First

Branch: All

Name of Teacher:

Course Objectives:

This course enables the students to understand:

1.	Various methods to solve linear differential equations of second and higher order.
2.	special functions viz. Legendre's and Bessel's and different properties associated with them.
3.	Diverse mathematical techniques for solving partial differential equations of first order and higher order, along with their applications in wave and heat equations using Fourier series.
4.	The theory of functions of a complex variable, complex differentiation and integration.
5	About random variables and elementary probability distribution.

Course Outcomes:

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

CO1	Investigate the occurrence of differential equations in science and engineering and use methods available for their solutions.
CO2	Gain an understanding on complex variable functions and using their properties in real life problems.
CO3	Construct appropriate probability models in solving real world problems.
CO4	Demonstrate a depth of understanding in advanced mathematical topics.
CO5	Enhance and develop the ability of using the language of mathematics in engineering.

(MA 107) Mathematics- II

Syllabus

Module 1: Ordinary Differential Equations – I

Linear differential equations, Wronskian, Linear independence and dependence of solutions, Linear differential equations of second and higher order, Operator method, Legendre's and Euler – Cauchy's form of linear differential equation, Method of variation of parameters. **[9 L]**

Module 2: Ordinary Differential Equations – II

Ordinary and singular points of differential equation, Power and Frobenius series solutions. Bessel's differential equation, Bessel function of first kind and its properties. Legendre's differential equation, Legendre's polynomial and its properties. **[9 L]**

Module 3: Fourier series and Partial Differential Equations

Fourier series: Euler formulae for Fourier series, Dirichlet conditions, Half range Fourier series. Partial Differential Equations: Linear partial differential equations, Lagrange's method. Method of separation of variables and its application in solving one dimensional wave and heat equations. **[9L]**

Module 4: Complex Variable-Differentiation & Integration

Function of a complex variable, Limit, Continuity, Differentiability, Analyticity, Analytic functions, Cauchy – Riemann equations. Harmonic functions, Harmonic Conjugate. Cauchy's theorem, Cauchy's Integral formula, Taylor and Laurent series expansions. Singularities and its types, Residues, Residue theorem. **[9L]**

Module 5: Applied Probability

Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, variance, moment generating function. Introduction to Binomial, Poisson and Normal Distribution. **[9L]**

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, 4th Edition, 2011.

3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, McGraw Hill, 2004.

4. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, 3rd Edition, Narosa Publishing, 2009.

5. R. A . Johnson, I. Miller and J. Freund: Probability and Statistics for Engineers, PHI.

6. S. C. Gupta and V.K . Kapoor.: Fundamental of Mathematical Statistics, Sultan Chand and Sons.

Reference Books:

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary

Value Problems, 9th Edition ., Wiley India, 2009.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
4. G. F. Simmons, Differential Equations with Applications and Historical Notes, TMH, 2nd Edition, 2003.
5. P. L. Meyer: Introductory Probability and Statistical Applications, Oxford & IBH.

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination	25
End Semester Examination	50
Quiz (s)	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Semester Examination	√				√
End Semester Examination	√	√	√		√
Quiz (s)	√	√	√		
Assignment	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2	1	1	1	1	3	3	2	2
CO2	3	3	3	2	1	1	1	1	3	3	2	2
CO3	3	3	3	2	1	1	1	1	3	3	2	2
CO4	2	2	3	3	1	1	1	1	3	3	2	2
CO5	2	2	3	3	1	1	1	1	3	3	2	2

If satisfying< 34%=1, 34-66% =2, > 66% = 3

COURSE INFORMATION SHEET

Course code: CH 101

Course title: Chemistry

Pre-requisite(s): Intermediate level chemistry

Co- requisite(s):

Credits: 4 L: 3 T: 1 P: 0

Class schedule per week: 04

Class: B.Tech.

Semester /Level: I/First

Branch: ALL

Name of Teacher:

Course Objectives

This course enables the students:

1.	To create concept of Chemical bonding & Coordination Chemistry.
2.	To understand the basic 3D structure in organic chemistry including stereochemistry, aromaticity and reaction mechanism.
3.	To understand the reaction dynamics and to know different types of catalysis.
4.	To understand the modern techniques related to spectroscopy and structural characterization.
5.	To develop knowledge on the physical state and electrochemistry of molecules.

Course Outcomes

After the completion of this course, students will be:

CO1	Able to explain the bonding in a molecular structure.
CO2	Able to explain the 3D structure, aromaticity and stereochemistry of organic molecules.
CO3	Able to explain the spectroscopic data for structural characterization of the molecules.
CO4	Able to predict the rate, molecularity and mechanism of a simple as well as catalytic reaction.
CO5	Able to interpret the phases of solid and the electrochemical behavior of the molecules.

(CH 101) Chemistry

Syllabus

Module I: Chemical Bonding

Ionic bond: Radius ratio rule, Born-Landé equation, Born-Haber cycle. Metallic Bond: valence bond and band theories, defects in solids, Werner's Theory, Bonding in Transition metal complexes, Ligands, coordination complexes, Ligand Field, Crystal Field Theory, Octahedral, Tetrahedral and square planar complexes, CFSE, Jahn Teller theorem, electronic spectra, magnetism, and isomerization in coordination compounds. [9L]

Module II: Organic Structure and Stereochemistry

Covalent bond: Lewis structure, Valence Bond theory, Molecular orbital theory, Molecular orbital of diatomic and polyatomic system, hybridization, conjugated molecules, Huckel molecular orbital theory of conjugated systems. Isomerism, Geometrical isomerism: cis–trans and syn-anti isomerism; Optical isomerism & Chirality; Wedge, Fischer, Newmann and Sawhorse Projection formulae and interconversions; E/Z, D/L, R/S nomenclature system; Conformational studies of ethane, n-butane, Cyclohexane. [9L]

Module III: Kinetics and Catalysis:

Order & molecularity of reactions: chain, parallel, Competing, Side, Consecutive reactions; Kinetics of Fast reactions, Characteristics of catalyst, types of catalysis, catalytic poison; Theories of catalysis; Acid base catalysis: including kinetics, Enzyme catalysis, Mechanism and kinetics of enzyme catalyzed reaction, Michaelis-Menten equation, Important catalysts in industrial processes; Hydrogenation using Wilkinsons catalyst, Hydroformylation by using Cobalt-catalyst, Phase transfer catalyst. [9L]

Module-IV: Spectroscopic Techniques

Absorption and emission Spectroscopy, Lambert-Beers Law, Principles and applications of UV-Visible, Factors influencing for UV-VIS spectrum; Rotational and Vibrational spectroscopy, Principle of FT-IR, and NMR spectroscopy; Modern techniques in structural elucidation of compounds by UV-VIS, IR, & NMR Spectroscopy. [9L]

Module V: Phase and Chemical equilibrium

Phase Rule: Terms Involved, Phase diagram of one component (Water) & two component (Pb/Ag) system & their applications. Law of chemical equilibrium, equilibrium constants and their significance, Weak and strong electrolytes, Standard electrode potential and its application to different kinds of half cells, EMF and its measurement and application, Batteries and Fuel Cells, Chemical and Electrochemical corrosion, Factors affecting the rate of corrosion. [9L]

Textbooks:

1. Huheey, J. E., Inorganic Chemistry: Principles of Structure and Reactivity, 4th edition, Pearson.
2. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Seventh Edition, Pearson
3. Atkins, P. W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.

Reference books:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.
2. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier (2009).
3. William Kemp, Organic Spectroscopy, 3rd Ed., 2008 Macmillan.

Gaps in the syllabus (to meet Industry/Profession requirements): NA

POs met through Gaps in the Syllabus: NA

Topics beyond syllabus/Advanced topics/Design: NA

P**Os met through Topics beyond syllabus/Advanced topics/Design**

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	Y
Tutorials/Assignments	Y
Seminars	N
Mini projects/Projects	N
Laboratory experiments/teaching aids	Y
Industrial/guest lectures	Y
Industrial visits/in-plant training	N
Self- learning such as use of NPTEL materials and internets	Y
Simulation	N

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10+10
Teacher’s assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√	√		
End Sem Examination Marks	√	√	√	√	√
Quiz I	√	√			
Quiz II			√	√	

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping of Course Outcomes onto Graduate Attributes

Course Outcome #	Graduate Attributes											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2		3	3	3		3	2	2		3
2	3	3		3	3	3		3	2	2		3
3	3	1		2	1	2		3	2	2		3
4	3			3	2	2		2	2	2		3
5	2	3		3	3	3	3	2	2	2		3

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1 and CD2
CD2	Tutorials/Assignments	CO2	CD1 and CD2
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects	CO4	CD1 and CD2
CD5	Laboratory experiments/teaching aids	CO5	CD1 and CD2
CD6	Industrial/guest lectures	-	-
CD7	Industrial visits/in-plant training	-	-
CD8	Self- learning such as use of NPTEL materials and internets	-	-
CD9	Simulation	-	-

COURSE INFORMATION SHEET

Course code: CH 102

Course title: Chemistry Lab

Pre-requisite(s): Intermediate level Chemistry

Co- requisite(s):

Credits: 1.5 L: 0 T: 0 P: 3 Class schedule per week: 03 Class: B. Tech.

Semester / Level: I/First

Branch: ALL

Name of Teacher:

Syllabus

- Gravimetric estimation of Nickel by Dimethylglyoxime.
- Quantitative estimation of Ca2+ and Mg2+ ions by complexometric titration using Na2-EDTA.
- To verify Bears Law using Fe3+ solution by spectrophotometer/colorimeter and to determine the concentration of a given unknown Fe3+ solution.
- Separation of binary organic mixture by acid-base extraction and analysis using given FTIR and NMR spectrum.
- Preparation of Diazoamino Benzene and report the melting point and yield of product.
- Draw melting point-mass percent composition diagram for two component mixture and determine the Eutectic Temperature.
- To study the kinetics of acid-catalyzed hydrolysis of ethyl acetate and to evaluate the value of the rate constant.
- To determine the rate law for the reaction between iodide and hydrogen peroxide in an acidic environment and to determine the effect of a catalyst on the rate of reaction.
- To determine the strength of the given strong acid by strong base Potentiometrically.
- To determine the transition temperature of the given salt hydrate.
- Qualitative detection of special elements in organic compounds.
- To draw the pH-titration curve of strong acid vs strong base.

Reference book:

1. Experimental Physical Chemistry, By B. Viswanathan, P. S. Raghavan, Narosa Publishing House (1997).
2. Vogels Textbook of Practical Organic Chemistry.
3. Experiments in General chemistry, C. N. R. Rao and U. C. Agarwal.
4. Experimental Organic Chemistry Vol 1 and 2, P R Singh, D S gupta, K S Bajpai, Tata McGraw Hill

COURSE INFORMATION SHEET

Course code: EC 101

Course title: Basics of Electronics & Communication Engineering

Pre-requisite(s): N/A Co- requisite(s): N/A

Credits: L: 3 T: 1 P: 0 C: 4

Class schedule per week: 04

Class: B. Tech.

Semester / Level: I/First

Branch: ALL

Name of Teacher:

Course Objectives:

This course enables the students:

1.	To understand PN Junction, diodes and their applications.
2.	To comprehend BJT, FET and their bias configurations.
3.	To grasp importance of feedback in amplifier circuits, op amp and its applications.
4.	To understand number system, Logic Gates and Boolean algebra.
5.	To apprehend fundamentals of communication technology.

Course Outcomes:

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

CO1	Explain PN Junction, diodes and their applications.
CO2	Appraise the BJT, FET and their biasing techniques.
CO3	Comprehend feedback in amplifier circuits, op amp and its applications.
CO4	Translate one number system into another, build circuits with Logic Gates, electronic components and OPAMP IC 741 and analyze the measurement results using CRO.
CO5	Appraise the fundamentals of communication technology.

(**EC 101) Basics of Electronics & Communication Engineering**

Syllabus

Module-1

Diodes and Applications: Introduction to PN junction diodes; Characteristics of semiconductor diodes: V-I characteristics, diode-resistance, temperature-dependence, diode-capacitance; DC & AC load lines; Breakdown Mechanisms; Zener Diode – Operation and Applications; Diode as a Rectifier: Half Wave and Full Wave Rectifiers with and without C-Filters. [9L]

Module-2

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Input and Output Characteristics of CB, CE and CC Configurations, dc and ac load line analysis, operating point, Transistor biasing: Fixed bias, emitter bias/self-bias, Low-frequency response of CE amplifier.

Field Effect Transistors: JFET, Idea of Channel Formation, Pinch-Off and saturation Voltage, Current-Voltage Output Characteristics; MOSFET: Basic structure, operation and characteristics. [9L]

Module-3

Sinusoidal Oscillators: Concept of positive and negative feedback, Barkhausen criterion for sustained oscillations, Determination of Frequency and Condition of oscillation, Hartley and Colpitt’s oscillator.

Operational Amplifiers: Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Inverting and non-inverting amplifiers, Offset error voltages and currents; Power supply rejection ratio, Slew Rate and concept of Virtual Ground, Summing and Difference Amplifiers, Differentiator and Integrator, RC phase shift oscillator. [9L]

Module-4

Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators, Symbolic representation, Boolean algebraic function and Truth table of different Digital logic Gates (AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR); Realization of Basic logic gates using universal gates, Adder, Subtractor, adder/subtractor. [9L]

Module-5

Electronic communication: Introduction to electronic communication system, Electromagnetic Communication spectrum band and applications, Elements of Electronic Communication System; Merits and demerits of analog and digital communication, Modes of communication; Signal radiation and propagation; Need for modulation; Introduction to Amplitude modulation and Angle modulation. [9L]

Textbooks:

1. Millman J., Halkias C.C., Parikh Chetan, Integrated Electronics: Analog and Digital Circuits and Systems, 2nd Edition, Tata McGraw-Hill.

2. Mano M.M., Digital Logic and Computer Design, Pearson Education, Inc, Thirteenth Impression, 2011.
3. Singal T. L., Analog and Digital Communications, 2nd Edition, Tata McGraw-Hill.
4. Haykin S., Moher M., Introduction to Analog & Digital Communications, 2nd Edition, Wiley India Pvt. Ltd.

Reference Book:

1. Boylstead R.L., Nashelsky L., Electronic Devices and Circuit Theory, 10th Edition Pearson Education, Inc.

Gaps in the syllabus (to meet Industry/Profession requirements): Teaching through paper

POs met through Gaps in the Syllabus: P10 willbe met though report- writing/presentation-based assignment.

Topics beyond syllabus/Advanced topics/Design: Teaching through paper

POs met through Topics beyond syllabus/Advanced topics/Design: Teaching through paper

CD #	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Quizzes
CD3	Assignments/Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of NPTEL materials and internets
CD9	Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid SEM Examination Marks	25
End SEM Examination Marks	50
Quizzes	10+10
Assessment by teacher	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid SEM Examination Marks					
End SEM Examination Marks					
Quizzes					
Assessment by teacher					

If satisfying < 34% = 1, 34-66% = 2, > 66% = 3

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	3	1	2	3	1	1				3	
CO2	3	3	1	2	3	1	1				3	
CO3	3	3	1	2	3	1	2		1	1	3	2
CO4	3	3	1	2	3	1	2		1	1	3	2
CO5	3	3	1	2	3	1	1				3	

If satisfying < 34% = 1, 34-66% = 2, > 66% = 3

Mapping Between COs and Course Delivery (CD) methods			
CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1, CO2, CO3, CO4	CD1
CD2	Quizzes	CO1, CO2, CO3	CD2
CD3	Assignments/Seminars	CO3	CD3
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EC 102

Course title: Electronics & Communication Lab

Pre-requisite(s):

Co- requisite(s):

Credits: L: 0 T: 0 P: 3 C: 1.5

Class schedule per week: 03

Class: B. Tech.

Semester / Level: I/First

Branch: ALL

Name of Teacher:

Course Objectives:

This course enables the students:

1.	To demonstrate the measurement of voltage, frequency using CRO.
2.	To explain PN junction characteristics and its applications.
3.	To understand the frequency response of BJT amplifier and OPAMP.
4.	To Realize logic gates and implement simple Boolean expression.
5.	To explain the Amplitude Modulation and Frequency Modulation

Course Outcomes:

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

CO1	Make use of CRO for measuring different parameters.
CO2	Appraise PN junction characteristics and its applications.
CO3	Experiment with Diodes, BJT and OPAMP.
CO4	Design specified circuit using given electronic components/ICs/logic gates.
CO5	Demonstrate the working of Amplitude Modulation and Frequency Modulation

Syllabus

List of Compulsory experiments:

Measurement of voltage, time period and frequency of different signals on CRO.

Measurement of frequency and phase of two different signals using Lissajous pattern.

To determine the forward and reverse bias characteristics of PN junction diode.

To determine the reverse bias characteristics of Zener diode and application as a voltage regulator.

Measurement of rectification efficiency and ripple factor of Half-wave and Full-wave rectifier Circuits with and without C-Filter.

To determine the frequency response of CE transistor amplifier and finding its gain bandwidth product.

To determine the transfer characteristics of JFET and measurement of its voltage gain.

Design of RC phase shift oscillator using IC-741 Op-Amp and finding its frequency of oscillation.

Design of Inverting and Non-inverting amplifier using IC 741 OP-AMP and finding its frequency response.

Realization of Basic logic gates (AND, OR, NOT) using NAND Gate (IC-7400).

Implementation of Boolean expression F = (A.B.C + D.E) using AND Gate(IC 7408) and OR Gate (IC 7432).

Generation of Amplitude modulated wave and calculation of percentage of modulation using standard setup.

Generation of FM-wave and its detection using standard setup.

Textbooks:

1. Millman J., Halkias C.C., Parikh Chetan, Integrated Electronics: Analog and Digital Circuits and Systems, 2nd Edition, Tata McGraw-Hill.
2. Mano M.M., Digital Logic and Computer Design, Pearson Education, Inc, Thirteenth Impression, 2011.
3. Singal T. L., Analog and Digital Communications, 2nd Edition, Tata McGraw-Hill.
4. Haykin S., Moher M., Introduction to Analog & Digital Communications, 2nd Edition, Wiley India Pvt. Ltd..

Reference Book:

1. Boylstead R.L., Nashelsky L., Electronic Devices and Circuit Theory, 10th Edition Pearson Education, Inc.

Gaps in the syllabus (to meet Industry/Profession requirements): N/A

POs met through Gaps in the Syllabus: N/A

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

CD #	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects

CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of NPTEL materials and internets
CD9	Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	(60)
Attendance Marks	12
Lab Viva marks	24
Lab file Marks	12
Day-to-day performance Marks	12
End SEM Evaluation	(40)
Lab quiz Marks	20
Lab performance Marks	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Progressive Evaluation					
End SEM Evaluation					

If satisfying < 34% = 1, 34-66% = 2, > 66% = 3

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	1	2	1	1	1				3	
CO2	3	2	1	2	2	1	1				1	
CO3	3	2	1	2	2	1	2		1	1	1	1
CO4	3	3	1	2	3	1	2		1	1	3	1
CO5	3	2	1	2	1	1	1				3	

If satisfying < 34% = 1, 34-66% = 2, > 66% = 3

Mapping Between COs and Course Delivery (CD) methods			
CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors		
CD2	Tutorials/Assignments/Quiz (s)		
CD3	Seminars		
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids	CO1, CO2, CO3, CO4	CD5
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation	CO1, CO2, CO3, CO4	CD9

COURSE INFORMATION SHEET

Course code: ME 101

Course title: Basics of Mechanical Engineering

Pre-requisite(s):

Co- requisite(s):

Credits: 4 L: 3, T: 1, P: 0

Class schedule per week: 04

Class: B. Tech

Semester / Level: I/First

Branch: All

Name of Teacher:

Course Objectives

This course enables the students:

1.	To introduce system of forces, and write equation of equilibrium.
2.	To analyse motion of particle and rigid body subjected to force.
3.	To grasp the importance of internal, external combustion engines and heat transfer.
4.	To apprehend the fundamentals of friction and vibration.
5.	To understand the different sources of energy.

Course Outcomes

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

CO1	Write and solve the equations of equilibrium for particles and structures members subjected to forces.
CO2	Write and solve the equations of motion for particles and rigid bodies subjected to forces.
CO3	Discuss the basics of Boilers, IC Engines and heat transfer.
CO4	Aware of different types of vibrations and friction.
CO5	Outline the non-conventional energy resources.

(ME 101) Basics of Mechanical Engineering

Syllabus

Module 1: System of Forces and Structure Mechanics

Addition of Forces, Moment of a Force, Couple, Varignon's theorem, Free Body Diagram, Equilibrium in Two and Three Dimensions, Equivalent Forces and Moment. Types of Trusses, Plane and Space Trusses. Analysis of Plane Trusses by: Method of Joints and Method of Sections, Analysis of Frames with Hinged Joints. Hooke's Law of elasticity, Stress and Strain, Relation between elastic constants, Thermal Stresses, Properties of surfaces such as centroid and area moment of inertia. (9 L)

Module 2: Kinematics & Kinetics of rigid bodies

Types of rigid body motion– translation, rotation about fixed axis, equations defining the rotation of a rigid body about a fixed axis, plane motion, absolute and relative velocity in plane motion, instantaneous center of rotation. Equation of translational and rotational motion, Newton's law and D'Alembert's principle –inertia force and inertia couple. (9 L)

Module 3: Friction and Vibration

Interfacial Friction (a) Laws of dry friction, static & kinetic co-efficient of friction, Analysis of static, kinetic and rolling friction.(b) Analysis of frictional forces in inclined planes, wedges, screw jacks and belt drives.

Vibrations: Types of vibration, free un-damped longitudinal vibrations, free damped longitudinal vibrations. (9 L)

Module 4: Boilers and Internal Combustion Engine:

Boiler Mountings and Accessories, Fire Tube and Water Tube Boilers, Cochran Boiler, Babcock and Wilcox Boiler.

Basic components and terminology of IC engines, working of four stroke/two stroke - petrol/diesel engine, classification and application of IC engines.

Heat transfer: various modes of heat transfer, one dimensional steady state conduction, Application to composite walls and cylinder. (9 L)

Module 5: Non-Conventional Energy and their resources:

Renewable and Non-renewable Energy Resources, Advantages and Disadvantages of Renewable Resources, Renewable Energy Forms and Conversion, Solar Energy, Wind Energy, Tidal Energy, Ocean Thermal Energy; Geothermal Energy, Nuclear Energy, Hydro Energy. (9 L)

Textbooks

1. Engineering Mechanics, Irving H. Shames, P H I. ltd, 2011.
2. Engineering Mechanics, S. Timoshenko, D. H. Young, J. V. Rao, Sukumar Pati, McGraw Hill education, 2017.

3. Theory of vibrations with applications, Thomson and Dahleh, Pearson Education, 5th Edition, 2008.
4. Boiler operator, Wayne Smith, LSA Publishers, 2013.
5. Internal Combustion Engines, M. L. Sharma and R. P. Mathur, Dhanpat Rai Publications, 2014.
6. Heat Transfer, J. P. Holman, Souvik Bhattacharya, Mcgraw Higher Ed Publishers, 2011.
7. Fundamentals of Renewable Energy Processes, Aldo Vieira Da Rosa, Elsevier publication, 2012.

Reference Books

1. Engineering Mechanics: Statics, James L. Meriam, L. G. Kraige, Wiley, 7th Edition, 2011.
2. Engineering Mechanics, S. Rajasekaran & G. Sankarasubramaniam, Vikash publishing house, 2018.
3. Engineering Vibration, Daniel J. Inman, Pearson, 2013.
4. An Introduction to Steam Boilers, David Allan Low, Copper Press Publisher, 2012.
5. Internal Combustion Engines – V Ganesan, McGraw hill, 2017.
6. Heat and Mass Transfer: Fundamentals and Applications, Yunus A. Cengel, Afshin J. Ghajar, McGraw Hill Education Publisher, 2017.
7. Non-Conventional Energy Resources, B. H. Khan, McGraw Hill Education Publisher, 2017.
8. Principles of Mechanical Engineering, R. P. Sharma & Chilkesh Ranjan, Global Academic Publishers, 2016.

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quizzes (1 and 2)	10+10
Assignment	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√	√		
End Sem Examination Marks	√	√	√	√	√
Quizzes	√	√	√	√	√
Assignment	√	√	√	√	√

If satisfying< 34%=1, 34-66% =2, > 66% = 3

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	1	1	1		2
CO2	3	2	2	2	2	1	1	1	1	1		2
CO3	3	2	2	2	2	1	1	1	1	1		2
CO4	3	1	1	2	2	1	1	1	1	1		2
CO5	3	1	1	2	1	1	1	1	1	1		2

COURSE INFORMATION SHEET

Course code: ME 102

Course title: Engineering Graphics Lab

Credits: 2.0 L: 0, T:0, P:4

Class schedule per week: 04

Class: B. Tech

Semester / Level: I / First

Branch: All

Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand the basic principles of Engineering Graphics, which include projections of 1D, 2D and 3D objects.
2.	To visualize a solid object (including sectioned) and convert it into drawing.
3.	To visualize different views of any object.
4.	To develop skill to draw objects using software.
5.	To inculcate the imagination and mental visualization capabilities for interpreting the geometrical details of common engineering objects.

Course Outcomes

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

CO1	Understand the fundamentals of Engineering Graphics and sketch the orthographic projections of points, lines and planes.
CO2	Sketch the orthographic projections of solids and section of solids.
CO3	Sketch three dimensional isometric views and development of the surfaces.
CO4	Create and modify orthographic projections using AutoCAD software.
CO5	Create three dimensional solid models using AutoCAD software.

(ME 102) Engineering Graphics Lab

Syllabus

Module 1: Introduction to orthographic projections, Conventions, Fundamentals of First and Third Angle projection, Orthographic projections of points, lines and planes. (9L)

Module 2: Projections of simple solids - axis perpendicular to HP, VP and inclined to one or both planes, Sectioning of solids, section plane perpendicular to one plane and parallel or inclined to other plane. (9L)

Module 3: Development of surfaces- Development of prisms, pyramids and cylindrical & conical surfaces, Isometric projection and isometric views of different planes and simple solids, introduction to perspective projection. (9L)

Module 4: Working with AutoCAD Commands, Cartesian Workspace, Basic Drawing & Editing Commands, Drawing: Lines, Rectangles, Circles, Arcs, Polylines, Polygons, Ellipses, Creating Fillets and Chamfers, Creating Arrays of Objects, Working with Annotations, Adding Text to a Drawing, Hatching, Adding Dimensions, Dimensioning Concepts, Adding Linear Dimensions, Adding Radial & Angular Dimensions, Editing Dimensions. (9L)

Module 5: Create views of engineering parts in AutoCAD, case studies with examples of Mechanical/ Electrical/Civil engineering drawings. (9L)

Textbooks

1. Engineering Drawing by N. D. Bhatt, Charotar Publishing House Pvt.Ltd., 53rd, Edition, 2014.
2. Engineering Drawing and Graphics + AutoCAD by K. Venugopal, New Age International (P) Limited, 4th Reprint: June, 2017.

Reference Books

1. Engineering Graphics with Autocad by J. D. Bethune, Prentice Hall, 2007.

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive evaluation	60
End Semester Lab Examination Marks	40

Assessment Components	CO1	CO2	CO3	CO4	CO5
Progressive evaluation Marks	√	√	√	√	√
End Semester Lab Examination Marks	√	√	√	√	√

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	3	2	3	1			3	3	3		
CO2	3	3	2	3	1			3	3	3		
CO3	3	3	2	3	1			3	3	3		
CO4	3	3	2	3	3			3	3	3		
CO5	3	3	2	3	3			3	3	3		

COURSE INFORMATION SHEET

Course code: PH 113

Course title: PHYSICS

Pre-requisite(s): Intermediate Physics and Intermediate Mathematics

Co- requisite(s):

Credits: 4 L:3 T:1 P:0

Class schedule per week: 3+1

Class: B. Tech **Semester / Level:** I/First **Branch:** ALL

Name of Teacher:

Course Objectives

This course enables the students:

1	To explain principles of physical optics.
2	To construct Maxwell’s equations from basic principles and use it to solve electromagnetic plane wave equations.
3	To distinguish between Newtonian Mechanics and special theory of relativity and develop the relationship of length contraction, time dilation and Einstein energy mass relation and to apply the concepts of special theory of relativity in various field of physics and engineering.
4	To illustrate the phenomena of old quantum theory and derive Heisenberg uncertainty principle and Schrödinger’s equations.
5	To understand basic lasing action, study various types of lasers and to have basic idea of fiber optics.

Course Outcomes

After the completion of this course, students will be able:

CO1	To interpret the intensity variation of light due to Polarization, interference and diffraction.
CO2	To formulate and solve the engineering problems on electromagnetism.
CO3	To explain special theory of relativity and apply its concepts in various fields of physics and engineering.
CO4	To explain fundamentals of quantum mechanics and apply it to problems on bound states.
CO5	To analyze working principle of lasers and to summarize its applications.

(PH 113) PHYSICS

Module-1 Physical Optics:

Polarization, Malus' Law, Brewster's Law, Double Refraction, Interference in thin films (Parallel films), Interference in wedge-shaped layers, Newton's rings, Fraunhofer diffraction by single slit, Double slit. [9L]

Module-2 Electromagnetic Theory:

Curl, Gradient, Divergence, Gauss theorem, Stokes theorem, Gauss's law, Applications, Concept of electric potential, Relationship between E and V, Polarization of dielectrics, dielectric constant, Boundary conditions for E & D, Gauss's law in magnetostatics, Ampere's circuital law, Boundary conditions for B & H, Equation of continuity of charge, Displacement current, Maxwell's equations. [9L]

Module-3 Special Theory of Relativity:

Introduction, Inertial frame of reference, Galilean transformations, Postulates, Lorentz transformations and its conclusions, Length contraction, time dilation, velocity addition, Mass change, Einstein's mass energy relation. [9L]

Module-4 Quantum Mechanics:

Planck's theory of black-body radiation, Compton effect, Wave particle duality, De Broglie waves, Davisson and Germer's experiment, Uncertainty principle, physical interpretation of wave function, Schrodinger equation in one-dimension, free particle, particle in an infinite square well. [9L]

Module-5 Lasers:

Spontaneous and stimulated emission, Einstein's A and B coefficients, Population-inversion, Light amplification, Basic laser action, Ruby and He-Ne lasers, Properties and applications of laser radiation, Elementary ideas of fiber optics and application of fiber optic cables. [9L]

Textbooks:

T1: A. Ghatak, Optics, 4th Edition, Tata Mcgraw Hill, 2009

T2: Mathew N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 2001

T3: Arthur Beiser, Concept of Modern Physics, 6th edition, Tata McGraw- Hill, 2009

Reference books:

R1: Fundamentals of Physics, Halliday, Walker and Resnick

Gaps in the syllabus (to meet Industry/Profession requirements): NA

POs met through Gaps in the Syllabus: NA

Topics beyond syllabus/Advanced topics/Design: NA

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods	
Lecture by use of boards/LCD projectors/OHP projectors	Y
Tutorials/Assignments	Y
Seminars	N
Mini projects/Projects	N
Laboratory experiments/teaching aids	N
Industrial/guest lectures	N
Industrial visits/in-plant training	N
Self- learning such as use of NPTEL materials and internets	Y
Simulation	N

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Quiz	10+10
Teacher's assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Mid Sem Examination Marks	√	√	√		
End Sem Examination Marks	√	√	√	√	√
Quiz I	√	√			
Quiz II			√	√	

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Graduate Attributes

Course Outcome #	**Graduate Attributes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2		3	3	3		3	2	2		3
2	3	3		3	3	3		3	2	2		3
3	3	1		2	1	2		3	2	2		3
4	3			3	2	2		2	2	2		3
5	2	3		3	3	3	3	2	2	2		3

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1 and CD2
CD2	Tutorials/Assignments	CO2	CD1 and CD2
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects	CO4	CD1 and CD2
CD5	Laboratory experiments/teaching aids	CO5	CD1 and CD2
CD6	Industrial/guest lectures	-	-
CD7	Industrial visits/in-plant training	-	-
CD8	Self- learning such as use of NPTEL materials and internets	-	-
CD9	Simulation	-	-

COURSE INFORMATION SHEET

Course code: PH 114

Course title: PHYSICS LAB

Pre-requisite(s): Intermediate Physics (Theory and Lab)

Co- requisite(s):

Credits: 1.5 L:0 T:0 P:3

Class schedule per week: 3

Class: B. Tech

Semester / Level: I/ First

Branch: ALL

Name of Teacher:

List of Experiments

1. Error analysis in Physics Laboratory
2. To determine the frequency of AC mains with the help of sonometer
3. To determine the wavelength of sodium light by Newton's rings Method
4. To determine the resistance per unit length of a Carey Foster's bridge wire and then to find the resistivity of the material of a given wire.
5. Measurement of mechanical equivalent of heat by electrical method
6. Determination of refractive index of the material of a prism using spectrometer and sodium light
7. To determine the frequency of electrically maintained tuning fork by Melde's experiment
8. Measurement of voltage and frequency of a given signal using cathode ray oscilloscope
9. To determine the wavelength of prominent spectral lines of mercury light by a plane transmission grating using normal incidence
10. To determine the electromotive force (emf) of an unknown cell using a stretched wire potentiometer
11. To study the frequency response and quality factor of series LCR circuit.
12. To find the specific rotation of sugar solution by using a polarimeter.
13. To determine the Hall voltage and calculate the Hall coefficient and carrier concentration of a semiconductor sample.

COURSE INFORMATION SHEET

Course code: CS 101

Course title: Programming for Problem Solving

Pre-requisite(s):

Co- requisite(s): Programming for Problem Solving Lab

Credits: L: 3 T: 1 P: 0

Class schedule per week: 4

Class: B.Tech

Semester / Level: I / First

Branch: All

Course Objectives

This course enables the students:

1.	To learn computer language.
2.	To learn coding for solving scientific and engineering problems.
3.	To learn the problem-solving process through computer.
4.	To know the limitations of system during program execution.
5.	To know the practical application of various programming techniques.

Course Outcomes

After the completion of this course, students will be able:

CO1	To formulate simple algorithms for arithmetic and logical problems.
CO2	To translate the computer algorithms to computer programs.
CO3	To test and execute the programs and correct syntax and logical errors.
CO4	To apply programming to solve simple numerical method problems, differentiation of function and simple integration.
CO5	To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

(CS 101) Programming for Problem Solving

Syllabus

Module I **[9L]**

Introduction to Programming:

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Problem Solving: Steps to solve logical and numerical problems.

Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

Module II **[9L]**

Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals, Iterations, Loops.

Module III **[9L]**

Array, Character array, strings. Case studies to discuss the various Problems related to Basic science (Matrix addition, Matrix-matrix multiplication, Roots of an equation etc.), Sorting, Searching.

Module IV **[9L]**

Functions (including using built in libraries), Parameter passing in functions, call by value, call by reference. Passing arrays to functions, Recursion (Finding Factorial, Fibonacci series, Ackerman function etc.).

Module V **[9L]**

Structures, Defining structures and Array of Structures

Pointers: Defining pointers, Use of Pointers in self-referential structures, File Handling

Textbooks:

1. Jery R Hanly, Problem solving and Program design in C, 7th Edition, Pearson Education.
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
3. ReemaThareja, Introduction to C Programming, 2nd Edition, Oxford University Press, 2015.
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice.
5. Byron Gottfried, Schaum's Outline of Programming with C, Tata McGraw-Hill.

Mapping of Course Outcome with Program Outcomes

Course Outcome	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	2	1	3	1	2	1	1
CO2	3	3	3	3	3	1	1	2	1	2	1	1
CO3	3	3	2	3	3	1	1	1	1	2	2	2
CO4	3	3	3	3	2	1	1	2	1	2	3	2
CO5	3	3	2	2	3	1	1	2	1	2	2	2

COURSE INFORMATION SHEET

Course code: CS 102

Course title: Programming for Problem Solving Lab

Pre-requisite(s):

Co- requisite(s): Programming for Problem Solving

Credits: L: 0 T: 0 P: 3 **Class schedule per week:** 1 **Class:** B.Tech

Semester / Level: I / First

Branch: All

Course Objectives

This course enables the students:

1.	To learn computer language.
2.	To learn coding for solving scientific and engineering problems.
3.	To learn the problem-solving process through computer.
4.	To know the limitations of system during program execution.
5.	To know the practical application of various programming techniques.

Course Outcomes

After the completion of this course, students will be able:

CO1	To formulate simple algorithms for arithmetic and logical problems.
CO2	To translate the computer algorithms to computer programs.
CO3	To test and execute the programs and correct syntax and logical errors.
CO4	To apply programming to solve simple numerical method problems, differentiation of function and simple integration.
CO5	To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

Sample Program List

Module 1 & Module 2: Introduction and Control Flow

1. Write an interactive program that will read in a +ve integer value and determine the following.
    - If the integer is a prime number
    - If the integer is a Fibonacci number
2. WAP in C to compute sinx = $x - x^3/3! + x^5/3! - x^7/7!$ .. to five place of accuracy. Test the program for x = 1, x = 2, and x = 3. In each case display the number of terms used to obtain the final answer.
3. WAP to generate every 3rd integer beginning with I = 2 and continue for all integers that are less than 150. Calculate the sum of those integers that are evenly divisible by 5.
4. WAP to find whether a given year is a leap year or not. Modify it to generate a list of leap years between two-year limits given by user.
5. WAP to display the following pattern:

```
            11
        11  10  11
    11  10   9  10  11
11  10   9   8   9  10  11
```

6. Using Ternary / Conditional operator find the greatest among 3 numbers.
7. WAP to convert a decimal number into an equivalent number of the input base. Test your program for base 2, 8 & 16.
8. WAP to read a number n, and print it out digit-by-digit, as a series of words. For e.g. 123 would be printed as “one two three”.
9. WAP to check whether any input +ve integer is palindrome or not.
10. WAP to simulate a simple calculator (+ - / * %) that takes two operands and an operator as input and displays the result.
11. WAP to find the GCD of two input +ve integer numbers. Using this find GCD of 9 numbers.
12. WAP to swap the values of two variables without using a third variable.

Module 3: Array

13. Read a line of mixed text, and then write it out with all lower case and uppercase letters reversed, all digits replaced by 0s and all other characters (non-letters and non- digits) replaced by ‘*’.
14. WAP to find the product of two matrices A and B. Display the source matrices and product matrix C in matrix format.
15. WAP to find whether a given matrix is a triangular matrix or not.
16. WAP to find the transpose of a matrix. Display the source and the transposed matrix in matrix format.
17. Implement Prob. No. – 14 to 16 using functions for reading, manipulating and displaying the corresponding matrices in matrix form.
18. WAP to sort a list of strings alphabetically using a 2-dim. Character array.
19. WAP to display the row sum and the column – sum of an input 2- dim. Matrix. Display the source matrix with row and column sum.

Module 4: Functions, Pointer & String

20. Write a recursive function to calculate S = 2 + 4 + 6 + 8 + +2N. Implement the function in a complete C program.
21. Write a function that accepts two arguments an array and its size n. It performs Bubble up sort on the array elements. Using indirection operator '*' implement this in a complete C program. Display the source and the sorted array.
22. Using pointer, write a function that receives a character string and a character as argument. Delete all occurrences of this character in the string. The function should return corrected string with no holes.
23. Write a function for reading character string using pointer. Calculate the length of the string (without using strlen ()). Finally print the string in reverse order, using pointer.
24. Implement prob. No. 14 using pointers representation of 2 – dim. array.
25. Implement prob. No. 15 using pointer representation of 2 dim. array.
26. Implement prob. No. 16 using pointer representation of 2 dim. array.
27. WAP to sort a list of strings into alphabetical order using array of pointers.

Module 5: Structure and File

28. Create records of 60 students, where each record has fields-name, roll, GPA and fees. Write a function update () to reduce the fees of those students who have obtained GPA greater than 8.5 by 25% of the original fees. Write a complete program to exercise this function in the main program and display all the records before and after updation.
29. Define a structure that describes a hotel. It should have members that include the name, address, grade, average room charge and number of rooms. Write a function to perform the following operations:

a) To print out hotels of a given grade in order of charges.
b) To print out hotels with room charges less than the given value.

30. WAP to concatenate the contents of two files into a third file.
31. WAP to copy the content of one file into another file. Names of both the files are to be input as command line arguments.

Mapping of Course Outcome with Program Outcomes

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	1	3	1	2	1	1
CO2	3	3	3	3	3	1	1	2	1	2	1	1
CO3	3	3	2	3	3	1	1	1	1	2	2	2
CO4	3	3	3	3	2	1	1	2	1	2	3	2
CO5	3	3	2	2	3	1	1	2	1	2	2	2

3rd and 4th Semester B.Tech. Course Syllabus

Program Core (PC)	EE201 Electrical Measurement and Instrumentation (3) EE253 Engineering Electromagnetics (4) EC203 Digital System Design (3) EE203 Electrical Energy Generation and Control (3) EE205 Circuit Theory (4) EE102 Electrical Engineering Lab (1.5) EC204 Digital System Design Laboratory (1.5) EE305 Digital Signal Processing (4) EE251 DC Machines and Transformers (4) EE303 Introduction to Microprocessors and Microcontrollers (3) EE202 Electrical Measurement and Instrumentation Lab (1.5) EE306 Digital Signal Processing Laboratory (1.5) EE304 Microprocessors and Microcontrollers Laboratory (1.5) EE252 Electrical Machine Laboratory – I (1.5)

COURSE INFORMATION SHEET

Course code: EE 201

Course title: Electrical Measurement and Instrumentation

Pre-requisite(s): Basic knowledge of Mathematics, Basic knowledge of Natural and Engineering Physics, Basic knowledge of Electrical circuits, Basic knowledge of Laplace transform, Basic knowledge of digital electronics and communication

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week:

Class: B. Tech

Semester / Level: IV

Branch: EEE

Name of Teacher:

Course Objectives

This course enables the students:

A	To outline the students an idea of calibration, standards, different errors, static and dynamic performance characteristics.
B	To explain the operating principle of different analog and digital instruments used for electrical parameter measurement
C	To classify and outline the operation and construction of various a.c. and d.c. bridges for measurement and display devices.
D	To state the basic principle of commonly available transducers and their uses for measuring different electrical or non-electrical variables.

Course Outcomes

After the completion of this course, students will be:

1	Identify and analyze errors and state the static and dynamic characteristics of instruments.
2	Explain the working of different analog instruments (PMMC, Moving iron, electrodynamometer type) and their use for measuring voltage, current, power, phase and frequency
3	Show how to balance and design different bridge networks to find the value of unknown components.
4	State the working of digital instruments, display devices and recorders.
5	Reproduce the different working principles of transducers and also design transducers for measurement of non-electrical quantities

Syllabus

Module – I

Introduction: Definition of measurement, Generalized input-output configuration of measuring instruments and instrumentation systems. Performance characteristics (static and dynamic), Accuracy, Precision, Types of error, Statistical analysis, Standards of measurement. Systems of units. Fundamental and derived units. Dimensions. (5)

Module – II

Instruments: Basic requirement of a measuring instrument. Introduction to D' Arsonval galvanometer, Construction and principle of Moving coil, Moving iron, Induction types of instruments, Measurement of voltage, current and power, phase, frequency, Range extension including current and potential transformers. Digital voltmeter, vector voltmeter, Vector Impedance meter and Q-meter. (10)

Module – III

Bridge: DC bridges for measurement of resistance Wheatstone bridges, Kelvin's double bridges and AC bridges for measurement of L, R, C & M, Maxwell's bridges, Anderson's bridges, Wien's bridges. Measurement of frequency, localization of cable fault. Potentiometers: DC and AC potentiometers, Principles, Standardization and application. (9)

Module – IV

Oscilloscopes: CRT, Construction, Basic CRO circuits, Block diagram of a modern oscilloscope, Y-amplifiers, X-amplifiers, Triggering, Oscilloscopic measurement. Special CRO's: Dual trace, Dual beam, Sampling oscilloscope, Storage CROs. Display Devices & Recorders: Digital display, LED, LCD, Strip chart recorder, X-Y recorder. (10)

Module – V

Transducers: Classification, Inductive, Resistive and Capacitive transducers, Analog and Digital Transducers with applications. Hall effect, Piezo Electric, Photovoltaic transducer. Measurement of temperature and pressure. (6)

Textbooks:

1. Helfrick and Cooper - Modern Electronic Instrumentation and Measurement, Pearson Education, New Delhi.
2. Sawhney A.K. - Electrical & Electronic Measurement and Instrumentation, Dhanpat Rai & Son's

Reference books:

1. Patranabis D – Sensors and Transducers, Wheeler, 1996.

2. Kalsi - Electronics Instrumentation, TMH Publication, New Delhi.
3. Deoblin – Measurement Systems.
4. Patranabis D – Principles of Industrial Instrumentation, TMH Publication, New Delhi, 1976.
5. Golding- Electrical Measurement, Wheeler Publication.

Gaps in the syllabus (to meet Industry/Profession requirements): Signal generators and signal analysers, Data acquisition system.

POs met through Gaps in the Syllabus: 1, 2, 3, 5, 6, 9, 10, 11, 12.

Topics beyond syllabus/Advanced topics/Design: Process Measurement and Control

POs met through Topics beyond syllabus/Advanced topics/Design: 1, 2, 3, 5, 9, 10, 11, 12.

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure:

<u>Direct Assessment</u>

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	**25**
End Sem Examination Marks	**50**
Assignment / Quiz (s)	**25**

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

<u>Indirect Assessment</u>

1. Student Feedback on Faculty

2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes:

Mapping of Course Outcomes onto Program Outcomes

CO	Program Outcomes												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	3	3	3	1	3	2	1	1	3	3	2	3			
2	3	3	2		2	2			2	3	2	3			
3	3	3	3		3	2			2	3	2	3			
4	3	3	3		2	3	1		2	3	1	3			
5	3	3	2	2	3	2	1	1	3	2	2	3			

< 34% = 1, 34-66% = 2, > 66% = 3

Mapping Between COs and Course Delivery (CD) methods

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1 &CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, & CD8
CD3	Seminars	CO3	CO3 CD1 & CD8
CD4	Mini projects/Projects	CO4	CO4 CD1& CD8
CD5	Laboratory experiments/teaching aids	CO5	CO5 CD1 & CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE253

Course title: Engineering Electromagnetics

Pre-requisite(s): Electric drives

Co- requisite(s): Vector analysis, co-ordinate geometry, applied mathematics (differential equation),

Credits:

L	T	P
3	1	0

Class schedule per week: 04

Class: B.Tech.

Semester / Level: 2^{nd}/4

Branch: EEE

Name of Teacher:

Course Objectives:

The course objective is to provide students with an ability to:

A	Understand the basic laws dealing with Electrostatics and Magnetostatics. (It is covered in modules 1 and 2).
B	Derivation and Importance of Maxwell's equations in interpreting electromagnetic waves (It is covered in module 2).
C	Application of Maxwell's equations to describe wave behavior in various media (It is covered in modules 3, and 4)
D	To under reflection and refraction phenomena of electromagnetic waves (It is covered in module 4).
E	Design a simple antenna and evaluate its radiation efficiency (It is covered in module 5).

Course Outcomes:

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

1	Understand the basic laws of static electric fields & steady magnetic fields and along with time-varying Maxwell’s equation in different forms (differential and integral).
2	Understand the importance of Poisson's equation in the determination of potential distribution and electric fields with respect to the boundary conditions.
3	Understand the boundary conditions to interpret the behavior of electric and magnetic fields at different media.
4	Examine the wave propagation phenomena in different media and its interfaces while

	associating its significance to the reflection and refraction of EM waves.
5	Evaluate the source of radiation: the antenna, its radiation patterns and different parameters.

Syllabus

Module – I

Electrostatic and Magnetostatic Energy, Forces and Torques: Electrostatic energy: Electrostatic forces and torques in terms of stored electrostatic energy. Magnetic energy: Magnetic forces and torques in terms of stored magnetic energy.

Module – II

Electrostatic Boundary-Value Problems: Introduction, Maxwell's Equation for static and time varying fields, Poisson's and Laplace's equations. Boundary conditions. Uniqueness theorem. Solution of one-dimensional Laplace's and Poisson's equations.

Module – III

Plane Electromagnetic Waves: Wave equations. Helmholtz equations. Plane waves. Propagation of uniform plane waves in dielectric and conducting media. Polarization of plane waves.

Module – IV

Reflection and Refraction of Plane Waves: Electromagnetic boundary conditions. Reflection of normally and obliquely incident plane waves from perfect conductor and dielectric. Total reflection. Total transmission.

Module – V

Radiation and Antennas: Introduction. Scalar and vector potentials. Retarded potentials. Radiation from elemental electric dipole. Antenna pattern and antenna parameters. Thin linear antennas.

Textbook:

1. Cheng, D.K., "Field and Wave Electromagnetics", Pearson Education (Singapore) Pte. Ltd., 2nd Edn., 1989.
2. Hayt, W.H., J.A. Buck, "Engineering Electromagnetics", Tata Mc Graw Hill.

Reference Book:

1. Edward C. Jordan & Keith G. Balmain, "Electro-magnetic waves & Radiating System", PHI.
2. Deepak Sood, "Field & Wave, A Fundamental Approach", University Science Press.

3. S. C. Matapatra, Sudipta Mahapatra, “Principles of Electromagnetics”, Tata McGraw Hill.
4. Matthew Sadiku, “Principles of Electromagnetics”, Oxford University Press.
5. A. R. Harish, M. Sachidananda, “Antennas & Wave Propagation”, Oxford University Press.

Gaps in the syllabus: Simulation based analysis of electromagnetic wave pattern.

POs met through Gaps in the Syllabus: PO (5)

Topics beyond syllabus/Advanced topics/Design: Assignment: Simulate Hertzian Dipole antenna.

POs met through Topics beyond syllabus/Advanced topics/Design: PO (5)

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination Marks	**25**
Quizzes	**20**
Independent teacher’s assessment	**5**
End Semester Examination Marks	**50**

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

Indirect Assessment –

1. Student Feedback on Faculty

2. Student Feedback on Course Outcome

1. MAPPING I: (Course Objectives & Outcomes)

Course Objectives / Outcomes	1	2	3	4	5
A	3	2	2	2	1
B	3	3	2	2	2

C	3	3	2	2	2
D	3	3	3	2	2
E	3	3	3	3	3

2. MAPPING II: (CO vs PO)

CO	**Program Outcomes**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	3	3	3	3	3	1	1	1	1	1	1	1			
2	3	3	3	3	3	2	2	1	1	1	1	1			
3	3	3	3	3	3	2	2	2	2	1	1	1			
4	3	3	3	3	3	3	2	2	2	2	2	2			
5	3	3	3	3	3	3	3	3	3	3	2	2			

3. Mapping between COs and Course Delivery (CD) methods:

CD	**Course Delivery methods**
CD1	Lecture by use of boards/LCD projectors/OHP
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of NPTEL materials
CD9	Simulation
Course Outcome	**Course Delivery Method**
CO1	CD1, CD8
CO2	CD1, CD8
CO3	CD1, CD8
CO4	CD1, CD2, CD8
CO5	CD1, CD2, CD8

COURSE INFORMATION SHEET

Course code: EC203

Course title: Digital System Design

Pre-requisite(s): Basics of Electronics & Communication Engineering

Co- requisite(s):

Credits: L: 3 T:0 P:0 C:3

Class schedule per week: 3

Class: B. Tech

Semester / Level: III/02

Branch: ECE

Name of Teacher:

Course Objectives

This course enables the students to:

1	Understand the basics of the digital electronics.
2	Apply the knowledge of digital electronics to construct various digital circuits.
3	Analyze the characteristics and explain the outputs of digital circuits.
4	Evaluate and asses the application of the digital circuits.
5	Design digital machine for simple computing and control.

Course Outcomes

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

CO1	Explain the concept of digital electronics.
CO2	Apply the knowledge to produce digital electronics circuits.
CO3	Analyze and categorize digital circuits.
CO4	Justify the uses of different digital circuits.
CO5	Schematize and demonstrate simple computing machines.

Syllabus

Module – 1:

Basics of Digital Electronics: Number representation, Binary number system, Number base conversion, Octal, Hexadecimal and BCD codes, binary Arithmetic, Logic gates, Introduction to VHDL and Verilog, VHDL Models, Logic Families: TTL, ECL, and CMOS Logic Circuits, Logic levels, voltages and currents, fan-in, fan-out, speed, power dissipation. Comparison of logic families.

Module – 2:

Simplification of Boolean functions: Boolean Algebra, Basic theorems and Properties, De Morgan's theorem, Canonical & Standard forms, Simplification of Boolean function using Karnaugh map, POS & SOP simplification, Prime implicant, NAND and NOR implementation.

Module – 3:

Design of Combinational Circuits: Analysis and design procedure, Parity Generators and Checkers, Adders, Subtractors, Look ahead carry, Adder, 4-bit BCD adder/subtractor, Magnitude comparator, Decoders, Encoders, Multiplexers, De-multiplexers, , Design of 1 bit ALU for basic logic and arithmetic operations.

Module – 4:

Design of Sequential Circuits and Memories: Basic Latch, Flip-Flops (SR, D, JK, T and Master-Slave), Triggering of Flip Flops, Synchronous and asynchronous counters, Registers, Shift Registers, Memories and Programmable Logic design, Types of memories, Memory Expansion and its decoding, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL)

Module – 5:

Design of simple computing machines: SAP-I concepts with stress on timing diagrams, Microinstructions, Fetch and Execution cycle variable machine cycle, Hardware control Matrix, Macroinstructions, Microprogramming, Bus concepts, Multiplexed Minimum system. Pipelining concepts.

Textbooks:

1. "Digital Design", Morris Mano and Michael D. Ciletti ,5th edition PHI
2. "Digital System Design using VHDL", Charles H Roth, Thomson Learning

Reference books:

Digital computer Electronics AP Malvino, 3rd Edition Mc Graw Hill

COURSE INFORMATION SHEET

Course code: EE 203

Course title: Electric Energy Generation and Control

Pre-requisite(s): Basic knowledge about working of alternator and electric power systems.

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 3 Classes per week

Class: B.Tech.

Semester/Level: III

Branch: EEE

Name of Teacher:

Course Objectives

This course enables the students:

A	To enumerate the energy generation scenario and understand the principle of operation of different types of power generation systems.
B	To relate the structure and principles of the controls related to electrical power generating stations.
C	To outline power generation from renewable energy sources and assess impact of such non-polluting energy conversion systems.
D	To compare salient features of different generating stations and substantiate sustainable and economic generation.

Course Outcomes:

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

1.	Outline the significance of various components of the power generation plants and explain the principle of their operation for bulk energy generation.
2.	Apply the basic knowledge of electric power generation as well as control related to real and reactive power for load-frequency and voltage control.
3.	Outline the significance of Nuclear and Diesel power plants.
4.	Contrast and choose non-conventional energy sources for sustainable energy generation.
5.	Assess and integrate different power generation systems for interconnected operation.

Syllabus:

Module – I:

Overview of Power Generation Scenario and Thermal Power Stations Overview of power generation scenario from thermal, hydro and nuclear and non-conventional sources. Selection of site for a thermal station, layout, main components, boiler, economizer, air preheater, super heater, reheater, condenser, feed heater, cooling powers, FD and ID fans, Coal handling plant, water treatment plant, Ash handling plant, Types of boilers and their characteristics, Steam turbines, and their characteristics, governing system for thermal stations.

Module – II:

Hydro Electric Stations Selection of site, layout, classification of hydro plants, general arrangement and operation of a hydro - plant, governing system for hydel plant, types of turbines.

Module – III:

Nuclear Power Station Nuclear reaction for nuclear power, nuclear fuels, feasibility of a nuclear power station, layout, main part of a nuclear station, nuclear reactor classification, control system for nuclear power station, Safety of nuclear power reactor.

Module – IV:

Diesel Electric Station Site selection, layout, main components, choice and characteristics of diesel engines, diesel engines, diesel plant efficiency and heat balance, maintenance.

Module – V:

Non-conventional Sources of Energy Solar: Operating principles. Photovoltaic cell concepts. Cell, module, array. Series and parallel connections. Maximum power point tracking, Wind: Operating principles, types of wind turbines, Bio-Mass, Tidal.

Textbooks:

1. Power Plant Engineering - PK Nag TMH publications, 2nd Edition.
2. A Textbook on Power System Engg. – A Chakravarti, ML Soni, PV Gupta and U.S. Bhatnagar, Dhanpat Rai & Co., New Delhi, 2nd Edition.

Reference Books:

1. Elements of Electrical Power Station Design-MV Deshpande, Pitman and Sons Ltd.
2. Electric Power Generation, Transmission and Distribution - S.M. Singh, Prentice Hall of India, Delhi.
3. Generation, Distribution and Utilization of Electrical Power – C.L. Wadhwa, New Age Publications

Course Evaluation: Individual assignment, Seminar before a committee, Theory (Quiz and End semester) examinations

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure:

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination	25
End Semester Examination	50

Quiz (s)	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

<u>Indirect Assessment –</u>

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

CO	Program Outcomes											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	3	3	1	3	1	1	1				2
CO2	3	3	3	1	3	1	1	1				2
CO3	3	3	3	3	3	1	2	2		1	1	2
CO4	3	3	3	1	3		1	1		1	1	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2

3= High, 2=Medium, 1=Low

Course Delivery Methods:

CD	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Industrial visits/in-plant training
CD5	Self- learning such as use of NPTEL materials and internets
CD6	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Mapping Between COs and Course Delivery (CD) methods	
Course Outcome	**Course Delivery Method**
CO1	CD1, CD2, CD3, CD5
CO2	CD1, CD2, CD3, CD5
CO3	CD1, CD2, CD3, CD5
CO4	CD1, CD2, CD3, CD5
CO5	CD1, CD2, CD3, CD5

COURSE INFORMATION SHEET

Course code: EE205

Course title: CIRCUIT THEORY

Pre-requisite(s): Basics of Electrical Engineering

Co- requisite(s): Mathematics

Credits: 4

L	T	P
3	1	0

Class schedule per week: 04

Class: B.Tech.

Semester/Level: 3rd/2nd

Branch: EEE

Name of Teacher:

Course Objectives:

This course enables the students to:

A.	list the Properties and discuss the concepts of graph theory
B.	solve problems related to network theorems
C.	illustrate and outline the Multi- terminal network in engineering
D.	select and design of filters

Course Outcomes:

After the completion of this course, students will:

1.	be able to solve problems related to DC and AC circuits
2.	become adept at interpreting network analysis techniques
3.	be able to determine response of circuits consisting of dependent sources
4.	analyse linear and non-linear circuits
5.	be able to design the filters with help of electrical element

Syllabus

Module – I

Network Topology: Definition and properties, Matrices of Graph, Network Equations &Solutions: Node and Mesh transformation; Generalized element; Source transformation; Formulation of network equations; Network with controlled sources; Transform networks; Properties of network matrices; Solution of equations; Linear time-invariant networks; Evaluation of initial conditions; Frequency and impedance scaling.

Module – II

Network Theorem: Substitution theorem, Tellegen's theorem, Reciprocity theorem; State space concept and State variable modelling.

Module – III

Multi-terminal Networks: Network function, transform networks, natural frequency (OCNF and SCNF); Two-port parameters, Equivalent networks.

Module – IV

Elements of Network Synthesis: Positive real function, Reactance functions, RC functions, RL Network, Two-port functions, Minimum phase networks.

Module – V

Approximation: Filter specifications; Butterworth approximation; Chebyshev approximation; Frequency transformation; High pass; Band pass; all pass and notch filter approximation.

Textbooks:

1. V.K. Aatre, Network Theory & Filter Design, New Age International Pvt. Ltd., New Delhi. (T1)
2. M.S. Sukhija, T.K.Nagsarkar, Circuits and Networks, Oxford University Press, 2nd ed., New Delhi.(T2)

Reference Books:

1. M.E. Van Valkenberg, Introduction to Modern Network Synthesis, John Wiley & Sons (1 January 1966) (R1)
2. Balabanian, N. and T.A. Bickart, “Electric Network Theory”, John Wiley & Sons, New York, 1969. (R2)
3. C. L. Wadhwa, Network Analysis and Synthesis, New Age International Pvt. Ltd., New Delhi(R2)

Gaps in the syllabus (to meet Industry/Profession requirements):

Practical aspects and demonstration of electrical and non-electrical systems

POs met through Gaps in the Syllabus:

Demonstrate appropriate inter-personal skills to function effectively as an individual, as a member or as a leader of a team and in a multi-disciplinary setting (PO 9)

Be able to comprehend and write effective reports and design documentations; give and receive clear instructions; make effective presentations and communicate effectively and convincingly on complex engineering issues with engineering community and with society at large. (PO 10)

Be conscious of financial aspects of all professional activities and shall be able to undertake projects with appropriate management control and control on cost and time. (PO 11)

Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all- round development throughout the professional career. (PO 12)

Topics beyond syllabus/Advanced topics/Design:

Design of filter using operational amplifier

POs met through Topics beyond syllabus/Advanced topics/Design: NA

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure:

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50
Assignment	05
Quiz (s)	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping between Objectives and Outcomes:

Mapping of Course Outcomes onto Program Outcomes

CO	Program Outcomes												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	3	3	2							1	1	1			
2	3	3	3	2	1					1	1	1			
3	3	3	3	3	2	2				1	1	1			
4	3	3	3	3	3	3				2	2	2			
5	3	3	3	2	2	3	3	3	3	1	3	3			

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE102

Course title: Electrical Engineering Laboratory

Pre-requisite(s): Physics, Fundamentals of Mathematics and Electrical Engineering.

Credits: L:0 T:0 P:3

Class schedule per week: 3

Course Overview: Concepts of measuring instruments, AC RLC series parallel circuit operation, resonance, KVL and KCL, circuit theorems, 3-phase star and delta connections, measurement of low and high resistance of D.C. machine, measurement of power by three voltmeter, three-ammeter methods, measurement of power of 3-phase induction motor by two-wattmeter method.

Course Objectives

This course enables the students:

1.	To describe students' practical knowledge of active and passive elements and operation of measuring instruments
2.	To demonstrate electrical circuit fundamentals and their equivalent circuit models for both 1-φ and 3- φ circuits and use circuit theorems
3.	To establish voltage & current relationships with the help of phasors and correlate them to experimental results
4.	1. To conclude performance of 1 – Φ AC series circuits by resonance phenomena 2. To evaluate different power measurement for both 1-φ and 3- φ circuits

Course Outcomes

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

CO1	classify active and passive elements, explain working and use of electrical components, different types of measuring instruments;
CO2	illustrate fundamentals of operation of DC circuits, 1-φ and 3- φ circuits and also correlate the principles of DC, AC 1-φ and 3- φ circuits to rotating machines like Induction motor and D.C machine
CO3	measure voltage, current, power, for DC and AC circuits and also represent them in phasor notations;

CO4	analyze response of a circuit and calculate unknown circuit parameters;
CO5	recommend and justify power factor improvement method in order to save electrical

LIST OF EXPERIMENTS ***(The experiment list may vary to accommodate recent development in the field)***

1. **Name:** Measurement of low & high resistance of DC shunt motor

Aim:

(i) To measure low resistance of armature winding of DC shunt motor

(ii) To measure high resistance of shunt field winding of DC shunt motor

2. **Name:** AC series circuit

Aim:

(i) To obtain current & voltage distribution in AC RLC series circuit and to draw the phasor diagram

(ii) To obtain power & power factor of single-phase load using 3- Voltmeter method and to draw phasor diagram.

3. **Name:** AC parallel circuit

Aim:

(i) To obtain current & voltage distribution in AC RLC parallel circuit and to draw the phasor diagram

(ii) To obtain power & power factor of single-phase load using 3- Ammeter method and to draw the phasor diagram

4. **Name:** Resonance in AC RLC series circuit

Aim:

(i) To obtain the condition of resonance in AC RLC series circuit

(ii) To draw phasor diagram

5. **Name:** 3 phase Star connection

Aim:

(i) To establish the relation between line & phase quantity in 3 phase star connection

(ii) To draw the phasor diagram

6. **Name:** 3 phase Delta connection

Aim:

(i) To establish the relation between line & phase quantity in 3 phase delta connection

(ii) To draw phasor diagram

7. **Name:** 3 phase power measurement

Aim:

(i) To measure the power input to a 3-phase induction motor using 2 wattmeter method

(ii) To draw the phasor diagram

8. **Name:** Self & mutual inductance

Aim: To determine self & mutual inductance of coils

9. **Name:** Verification of Superposition, Thevenin's and the Reciprocity theorem

Aim:

(i) To verify the Superposition theorem for a given circuit

(ii) To verify Thevenin's theorem for a given circuit

10. **Name:** Verification of Norton's, Tellegen's and Maximum Power transfer theorem

Aim:

(i) To verify Norton's theorem for a given circuit

(ii) To verify the Maximum Power transfer theorem for a given circuit

Gaps in the syllabus (to meet Industry/Profession requirements)

1. Application of principles of magnetic circuits to electrical machines like transformers, generators and motors

2. Visualize Phase sequence

POs met through Gaps in the Syllabus: 1, 2, 3, 7.

Topics beyond syllabus/Advanced topics/Design

1. Assignment: Simulation of electrical circuits with dependent/independent sources by various techniques (Mesh current/Node Voltage/Thevenin's theorem/Norton's theorem/Maximum power transfer theorem etc.) using MATLAB/PSIM/C++ softwares.

2. Active/reactive power calculation for 3 – Φ circuits

POs met through Topics beyond syllabus/Advanced topics/Design: 5, 6, 7, 8, 9.

Mapping of lab experiment with Course Outcomes

Experiment	**Course Outcomes**				
	CO1	**CO2**	**CO3**	**CO4**	**CO5**
1	**3**	**3**	**3**	**2**	
2	**3**	**3**	**3**	**3**	**2**
3	**3**	**3**	**3**	**3**	**2**
4	**3**	**3**	**3**	**3**	**2**
5	**3**	**3**	**3**	**1**	
6	**3**	**3**	**3**	**1**	
7	**3**	**3**	**3**	**2**	**2**
8	**3**	**3**	**3**	**3**	
9	**3**	**3**	**3**	**2**	
10	**3**	**3**	**3**	**2**	

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Mini projects/Projects
CD4	Laboratory experiments/teaching aids
CD5	Self- learning such as use of NPTEL materials and internet
CD6	Simulation

COURSE INFORMATION SHEET

Course code: EC204

Course Title: Digital System Design Lab

SYLLABUS

List of experiments ***(The experiment list may vary to accommodate recent development in the field)***

1. Design and implement a controlled CMOS Inverter.

2. To study and verify the truth table of NAND and EX-OR gate using IC 7400.

3. Design and implement SEVEN segment display unit.

4. Design and verify half adder and full Adder circuits using gates and IC 7483.

5. Design and implement a 3:8 Decoder.

6. Design and implement 8:3 priority encoder.

7. Design a 4-bit magnitude comparator using combinational circuits.

8. Design and implement 8:1 multiplexer and 1:4 demultiplexer.

9. Design ALU with functions of ADD, SUB, INVERT, OR, AND. XOR, INC, DEC and CMP.

10. Design and verify decade Counter.

11. Design a ROM (8X4) using decoder, gates and diodes.

12. Design of pre settable up/down counter.

COURSE INFORMATION SHEET

Course code: EE 305

Course title: DIGITAL SIGNAL PROCESSING

Pre-requisite(s): Fundamentals of transform methods, Signals and Systems, Filter theory.

Credits: 04

L	T	P
3	1	0

Class schedule per week: 4 lectures

Class: B.Tech.

Semester: 4th

Course Coordinator:

Course Objectives:

This course enables the students to:

A.	Enumerate the basic concepts of signals and systems and their interconnections in a simple and easy-to-understand manner by summarizing different mathematical operations like folding, shifting, scaling, convolutions, Z-transform etc.
B.	Sub-divide and construct different realization structures.
C.	Determine transfer function and predict frequency response of discrete-time systems by applying various techniques like Z-transform, DFT and FFT.
D.	Design digital IIR and FIR filters using filter approximation theory, frequency transformation techniques and window techniques.
E.	Apply DSP processor in processing of 1D and 2D signals.

Course Outcomes:

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

1.	State sampling theorem and reproduce a discrete-time signal from an analog signal;
2.	Classify systems based on linearity, causality, shift-variance, stability criteria and represent transfer function of the selected system;
3.	Evaluate system response of the system using convolution methods, frequency transformation technique, DFT, DIF-FFT or DIT-FFT algorithm, window techniques;
4.	Design FIR and IIR filters for real time application.
5.	Construct (structure) and recommend environment-friendly filter for real- time applications.

Syllabus

MODULE – I

Introduction: Classification of Signals and systems, Fourier analysis of periodic and a periodic continuous time signal, Application of Laplace Transform to system analysis, Discrete-Time Signals, Shanon's sampling theorem, difference equation description, properties of discrete time system (linearity, time-variance, convolution), BIBO stability, structure for realization of LTI discrete time systems, direct form I&II, cascade, parallel. (7)

MODULE – II

Frequency Domain Analysis: Z-transform definition, region of convergence (ROC), Relationship between Laplace and Z-transforms. Discrete Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT), Periodic convolution, Direct evaluation of DFT, FFT algorithms decimation in time and frequency, Relationship between Fourier and Z-transforms (8)

MODULE – III

Filter Function Approximations and Transformations. Review of approximations of ideal analog filter response, Butterworth filter, Chebyshev Type I & II. Frequency Transformations: Frequency transformation in analog domain, frequency transformation in digital domain. Design of IIR Filter based on Impulse invariance method and Bilinear transformation. (7)

MODULE – IV

Design of FIR Filters: Characteristic of FIR filters with linear phase, Symmetric and anti-symmetric FIR filters, design of linear phase FIR filters using windows and frequency sampling methods, comparison of FIR and IIR filters.

MODULE-V

Application of DSP: Introduction to DSP processors, Types of architectures, DSP support tools, code composer studio, compiler, assembler and linker, Introduction TMS320 C6x architecture, Digital signal processing application in the area of biomedical signal, speech, and image.

Books:

1. John G. Proakis, Dimitris G. Mamalakis, Digital Signal Processing, Principles, Algorithms and Applications, Third edition, Pearson International Edition.
2. Alan V. Oppenheim Ronald W. Schafer, Digital Signal Processing, PHI, India.

Reference Book:

1. S. Salivahanan C Gnanapriya, Digital Signal Processing, Tata McGraw Hill Education Private Limited.
2. Antonious, Digital Filter Design, Mc-Graw-Hill International Editions.

Mapping between Course Outcomes and Program Outcomes:

CO	Program Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	3	3	3	2	2	2	2	2	1	1	1	1			
2	3	3	3	3	3	3	2	2	2	2	2	1			
3	1	2	1	2	3	3	3	2	2	2	1	1			
4	1	1	1	3	3	2	2	2	2	1	1	1			
5	1	1	1	1	1	2	2	2	3	3	3	3			

*3: High, 2: Medium, 1: Low

Mapping between Course Objective and Course Outcomes:

Course Objectives	Course Outcomes				
	1	**2**	**3**	**4**	**5**
A	3	3	2	2	1
B	3	3	2	2	1
C	2	2	2	3	2
D	1	2	2	3	3
E	1	1	2	3	3

Gaps in the syllabus (to meet Industry/Profession requirements)

Examine different signal processing techniques such as STFT, Wavelet Transform etc. in real time applications.

Implementation of 1D, 2D digital filters in many important applications such as image compression, video processing etc.

POs met through Gaps in the Syllabus: 1, 2, 3, 7

Topics beyond syllabus/Advanced topics/Design:

Adaptive Signal Processing, Image Processing, Application of TMS kit.

POs met through Topics beyond syllabus/Advanced topics/Design: NA

Course Delivery Methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Laboratory experiments/teaching aids
CD4	Self- learning such as use of NPTEL materials and internets
CD5	Simulation

Mapping between COs and Course Delivery (CD) methods

Course Outcome	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD5
CO2	CD1, CD2, CD4, CD5
CO3	CD1, CD2, CD4, CD5
CO4	CD1, CD2, CD4, CD5
CO5	CD1, CD2, 3, CD4, CD5

COURSE INFORMATION SHEET

Course code: EE 251

Course title: DC Machines & Transformers

Pre-requisite(s): Basics of Electrical Engineering Co- requisite(s):

Credits: 03

L	T	P
3	0	0

Class schedule per week: 3

Class: B.Tech.

Semester/Level: 4th/2

Branch: EEE

Name of Teacher:

Course Objectives:

This course enables the students:

A.	To explore the basic principles of transformer and dc machines and analyse comprehensively their steady –state behaviours
B.	To examine characteristic of static and dynamic dc machines
C.	A technique to draw armature winding of dc machine and magnetic circuit of transformer in order to evaluate their performance
D.	To design and recommend low cost and high-performance machines which finds application in modern industries, homes and offices

Course Outcomes:

After the completion of this course, students will be:

1.	State and explain working principle, constructions as well as steady- state behaviour of an ac static and dc machines
2.	Interpret the different transformer and dc machines
3.	Identify, formulate and solve problems related to power transformer and dc machines
4.	Specify, interpret data, design an electrical machine and make a judgment about the best design in all respect
5.	Aspire for developing career with specialization in areas of electric machine drives, recognize the need to learn, to engage and to adapt in a world of constantly changing electric machine technology

Syllabus:

Module – I

Single Phase Transformers: Introduction to transformer, Basic Principle of operation, Classification, Rating, Construction of single phase transformer and Practical considerations, transformer winding, Ideal and physical transformers, EMF equation, transformation ratio, Phasor diagram, Performance analysis, Equivalent circuit, Losses and efficiency, Condition for maximum efficiency, Determination of equivalent circuit parameters by O.C. and S.C. tests, Per-unit calculation, Voltage regulation, all day efficiency. [8]

Module – II

Three Phase Transformer: Advantage, Principle of operation, Connections of 3-phase transformer, Transformer vector grouping, Open delta connection, three-phase to two-phase conversion (Scott connection) and six phase conversion, three winding transformer, rating. OC & SC Test, Polarity test, Sumpner's back-to-back test. Parallel operation and Load sharing in single & three phase transformer. Different types of transformers: Autotransformer- construction, working, advantage & disadvantage and application. Introduction to Power transformers, Distribution transformers, Instrument transformers, Tap changing transformers, Pulse Transformer, Welding Transformer. Transformer cooling, grounding, maintenance, and rating. [8]

Module – III

Basic Concept of Rotating Machines: Electromagnetism, Electromagnetic induction, Flux Linkage, Force on a conductor in a magnetic field & between two current carrying conductor, statistically & dynamically induced EMF, Magnetomotive Force (MMF), Classification of Rotating Machines, Electromagnetic Torque, Constructional parts of DC machines and their function. Armature Winding, Ring winding, Drum Winding, type of DC machine Winding, Principle of DC Generator and its operation, EMF generated in DC Generator, Principle of DC Motor. [8]

Module – IV

DC Generators: Types of DC Machines, EMF equation, Losses in DC Generator, Power Stages, Efficiency, Condition for maximum efficiency, Armature reaction, Compensating winding, Inter-poles, Process of Commutation, Reactance Voltage, Methods of improving commutation, equalizer rings, Method of excitation, Characteristics of DC Generators- Magnetization, Process of voltage build-up of shunt generator, Internal and external characteristics, voltage regulation, Critical resistance and Critical speed, Parallel operation of DC generators, Applications of DC Generators. [8]

Module – V

DC Motors: Basic equation for voltage, Back EMF, Power, condition for maximum power, armature Torque, Rotational losses, and speed of DC Motors. Operating characteristics of DC Motors – speed – back emf & flux, Torque-current, Speed-current and Torque-speed characteristics. Speed regulation, Speed control of DC motors, Starters for DC Motors, Electric Breaking. Testing of DC machines: Break test, Swinburne's, Hopkinson's and Series field tests, Retarding or Running Test. Calculation of efficiency. Applications of DC Motors, Special DC motors, Brushless DC Motor. [8]

Textbooks:

1. J. Nagrath, D.P. Kothari, Electric Machines, 4th Edition, TMH, New Delhi, 2014.
2. P. S. Bimbhra, Electrical Machines, Khanna Publishers, New Delhi, 7th Edition 2014.

Reference books:

1. E. Fitzgerald, Charles Kingsley, Stephen D. Umans; Electric Machinery, McGraw Hill Education (India) Pvt. Ltd., Noida, 6th Edition, 2003.
2. Alexander Suss Langsdorf; Theory of Alternating Current Machinery, McGraw-Hill, New York 1955.
3. Smarajit Ghosh, Electrical Machines; Pearson, New Delhi, 2nd Edition, 2012.

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design: Design of Electrical Machines

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination Marks	25
Quiz (s)	20 (10x2)
Teacher Assessment	05
End Semester Examination Marks	50

Indirect Assessment –

Student Feedback of Faculty

Student Feedback of Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes:

CO	Program Outcomes												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	3	3	3	3	3	2	1			1		1			
2	3	3	3	3	3	3	1			1	1	1			
3	2	2	3	3	2	3	1	1	1	1	1	2			
4	3	3	3	3	3	3	1	2	2	2	2	2			
5	3	3	3	3	3	3	3	3	3	3	3	3			

Mapping Between COs and Course Delivery (CD) methods			
CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: EE 303

Course Title: Introduction to Microprocessors & Microcontrollers

Pre-requisite(s): Fundamentals of Binary system, Logical Gates, Flip flops

Co- requisite(s): Switching Theory and Logic Design.

Credits: 03

L	T	P
3	0	0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: 3rd

Branch: Electrical & Electronics Engineering

Name of Teacher:

Course Objectives

This course enables the students to:

A.	Enumerate the architecture and fundamentals of microprocessors and microcontrollers
B.	Interpret and articulate the microprocessor and microcontroller instruction set for writing an Assembly Language Program, estimating the machine cycles
C.	Correlate different Data transfer schemes for interfacing peripherals, while emphasizing on 8086/8051 interrupt structure
D.	Adapt to Memory mapped I/O or I/O mapped I/O for interfacing peripherals and memory
E.	Integrate the microprocessor or microcontroller with other peripherals for practical applications like stepper motor etc.,

Course Outcomes

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

1	Select a microprocessor or microcontroller suitable to the application.
2.	Architect a microprocessor or microcontroller system and estimate the required hardware and software resources.
3.	Perform the detailed hardware design of a microprocessor or microcontroller system.
4.	Program the microprocessor or microcontroller using suitable techniques including use of allocation schemes and device drivers.
5.	Find effective solutions and debug to a wide range of real-world microprocessor and microcontroller applications.

SYLLABUS

Module – I

Architecture of Microprocessors General definitions of minicomputers, microprocessors, microcontrollers, Introduction to 8085 Microprocessor, 8086 Architecture-Functional diagram. Register Organization, Memory Segmentation. Programming Model, Physical memory organization, signal descriptions of 8086- common function signals. Minimum and Maximum mode signals. Timing diagrams. Interrupts of 8086. 10

Module – II

Instruction set and Assembly Language programming of 8086: Instruction formats, addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch and call instructions, Looping, sorting, evaluating arithmetic expressions, string manipulations. 10

Module – III

I/O Interface 8255 PPI various modes of operation and interfacing to 8086. Interfacing keyboard, display, stepper motor interfacing, D/A and A/D converter, Memory interfacing to 8086, Interrupt structure of 8086, Vector interrupt table, Interrupt service routine, Interfacing Interrupt Controller 8259, DMA Controller 8257 to 8086, Serial data transfer schemes. 8251 USART architecture and interfacing, RS- 232. 10

Module – IV

Architecture of Microcontrollers 8051 Microcontroller hardware- I/O pins, ports and circuits- External memory –Counters and Timers-Serial Data I/O, Interrupts. 7

Module – V

8051 Microcontroller Programming and Applications 8051 instruction set – Addressing modes – Assembly language programming –I/O port programming -Timer and counter programming, 8051 interfacing: LCD, Stepper Motors, and Keyboard. 5

Textbooks:

1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with8085, 4th Edition, Penram International Publishing, New Delhi, 2000. (Module I, II)
2. John Uffenbeck, The 80x86 Family, Design, Programming and Interfacing, Third Edition. Pearson Education, 2002.
3. Mohammed Ali Mazidi and Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education Asia, New Delhi, 2003. (Module IV, V)

Reference books:

1. A.K. Ray and K.M. Burchandi, Intel Microprocessors Architecture Programming and Interfacing, McGraw Hill International Edition, 2000.
2. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application,2nd Edition, Penram International Publishers (India), New Delhi, 1996.
3. M. Rafi Quazzaman, Microprocessors Theory and Applications: Intel and Motorola prentice Hall of India, Pvt. Ltd., New Delhi, 2003.

Gaps in the syllabus (to meet Industry/Profession requirements):

Programming of 8051 microcontroller for Serial communication and interrupt programming.

POs met through Gaps in the Syllabus: PO 5

Topics beyond syllabus/Advanced topics/Design: Bit Processors like 80286.

POs met through Topics beyond syllabus/Advanced topics/Design: PO 5

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure:

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

CO	Program Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	3	3	3	3	3	1	1	1	1	1	1	1	2	1	1
2	3	3	3	3	3	2	2	1	1	1	1	1	3	1	1
3	3	3	3	3	3	2	2	2	2	1	1	1	3	2	1
4	3	3	3	3	3	3	2	2	2	2	2	2	3	3	3
5	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		

CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE 202

Course title: Electrical Measurement and Instrumentation Lab

Pre-requisite(s): Knowledge of Physics, Electrical Circuits, Measurement and Instrumentation

Credits: 03

L	T	P
3	0	0

Class schedule per week: 03

Course Objectives:

This course enables the students:

A	To state the procedures of measurement of low, medium and high resistances
B	To outline the working of display devices like CRO, recorders and plotters.
C	To explain testing on dc bridge (Wheatstone bridge) for finding fault location and ac bridge, perform experiment on Energy meter and Range extension of ammeter and voltmeter
D	To list the different types of transducers and their use in measurement of speed, force, displacement, temperature and light intensity.

Course Outcomes:

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

1	Show proper use of measurements on a variety of physical quantities with accuracy.
2	Explain the basic principles of measurement and experimental methods for measuring mechanical and electrical quantities with the use of transducers
3	Reproduce his acquaintance with the use of AC and DC bridges and display devices.
4	Outline the various methods of measurement of resistances.
5	Design techniques using knowledge of measurement of electric quantities.

List of Experiments (The experiment list may vary to accommodate recent development in the field)

Experiment No. 1

Name: Wheatstone bridge

Objective: Measurement of medium range resistance using Wheatstone bridge

Experiment No. 2

Name: Kelvin Double Bridge

Objective: Measurement of low resistance by Kelvin Double Bridge method.

Experiment No. 3

Name: Loss of charge method

Objective: Measurement of high resistance using Loss of charge method.

Experiment No. 4

Name: Localization of cable fault

Objective: Determination of location of point of fault in a cable.

Experiment No. 5

Name: Breakdown voltage of transformer oil

Objective: Measurement of breakdown voltage of transformer oil

Experiment No. 6

Name: Maxwell’s Inductance - Capacitance Bridge

Objective: Measurement of coil constant using Maxwell’s Inductance - Capacitance Bridge.

Experiment No. 7.

(a)Name: Linear Variable Differential Transformer (LVDT) Objective: Measurement of linear displacement using LVDT.

(b)Name: Strain Gauge

Objective: Measurement of strain by the use of strain gauge.

Experiment No. 8

Name: Energy meter

Objective: Calibration of single-phase Energy meter

Experiment No. 9

Name: Speed Measurement using Stroboscope

Objective: Measurement of speed of a rotating element (DC motor) using stroboscope.

Experiment No. 10

Name: Study Experiment

Objective: Study of recorders and plotters like Strip chart recorders, X- Y recorders and Magnetic tape recorders.

Objective: Study of CRO and applications of CRO for measurement of voltage, current, phase and frequency for sinusoidal, square, and triangular waveforms.

Objective: Determination of characteristics of optical transducers such as Photovoltaic cell, Photoconductive cell, Phototransistor cell, and Pin photodiode.

Objective: Determination of characteristics of thermal transducers such as RTD (Resistance Temperature Detector), IC Temperature sensor, and NTC (Negative temperature coefficient) Thermistor.

Books recommended:

Textbook:

1. A Course in Electrical & Electronics Measurement and Instrumentation, A. K. Sawhney, Dhanpat Rai & Sons.

Reference book:

1. Electrical Measurements and Measuring Instruments, Rajendra Prasad, Khanna Publishers, Delhi – 6.
2. Electrical Measurement, Golding, Wheeler Publication.

Gaps in the syllabus (to meet Industry/Profession requirements):

Extra experiments given above can be added.

POs met through Gaps in the Syllabus: POs 1, 2, 3, 5, 6, 9, 10, 12.

Topics beyond syllabus/Advanced topics/Design:

Process measurement and control.

POs met through Topics beyond syllabus/Advanced topics/Design: POs 1, 2, 3, 4, 5, 6, 9, 10, 11, 12.

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation Marks	60
End Sem Examination Marks	40

Assessment Components	CO1	CO2	CO3	CO4	CO5
Progressive Evaluation Marks	√	√	√	√	√
End Sem Examination Marks	√	√	√	√	√

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

CO	Program Outcomes												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	3	3	2	1	2	2			1	3	2	3			
2	3	3	3	2	3	2	1	1	2	3	2	3			
3	3	3	3		3	2		1	1	3	2	3			
4	2	3	3		2	1			2	2	1	3			
5	2	3	3	1	3	2	1		2	3	1	3			

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD5 & CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5 & CD8
CD3	Seminars	CO3	CD5 & CD8
CD4	Mini projects/Projects	CO4	CD4, CD5 & CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5 & CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

Mapping between course objective and course outcome

Course objective	Course outcomes				
	1	**2**	**3**	**4**	**5**
A	3			3	1
B	3		3		2
C	2	1	3		1
D	3	3	1	1	3

COURSE INFORMATION SHEET

Course code: EE306

Course title: Digital Signal Processing Laboratory

Pre-requisite(s): Basics of signals and systems, Transform methods.

Credits: 02

L	T	P
0	0	4

Class schedule per week: 4

Class: B.Tech.

Semester / Level: V

Branch: EEE

Course Objectives:

This course enables the students to:

A	Enumerate the basic concepts of signals and systems and their interconnections in a simple and easy-to-understand manner through different mathematical operations like folding, shifting, scaling, convolutions, etc. using MATLAB; also gain Knowledge of TMS kit, digital image filter;
B.	determine transfer function and predict frequency response of discrete-time systems by applying various techniques like Z-transform, DFT and FFT using MATLAB;
C.	Realization of digital filter structures;
D.	Apply the concept of adaptive filter in speech processing applications using adaptive linear combiner (ALC).
E.	Design and implementation of filter using DSP kit.

Course Outcomes:

At the end of the course, a student should be able to:

1.	convert analog signal into digital signals and vice-versa, generation of different signals and basic knowledge of TMS kit;
2.	compute frequency response of the systems using frequency transformation technique, DFT, DIF-FFT or DIT-FFT algorithm, window techniques and visualization using MATLAB;
3.	design and Implementation of FIR and IIR filters;
4.	apply the concept of adaptive filter in speech processing applications using adaptive linear combiner (ALC).
5.	recommend environment-friendly filter for different real- time applications such as optical filter design, acoustic filter design etc. Implement signal processing tools to biomedical and engineering applications.

List of Experiments *(The experiment list may vary to accommodate recent development in the field)*

1. **Name: -** Generation and representation of different types of signal. The Cross-correlation, Auto- correlation between two sequences. Linear convolution of two sequences using circular matrix method.

Aim: To perform generation of different signals in MATLAB. To write a MATLAB program to perform Linear and circular convolution of two sequence. Perform Linear convolution of two sequence using circular matrix method.

2. **Name: -** Discrete Fourier transform and Inverse- Discrete Fourier transform.

Aim: To write a MATLAB program to find discrete Fourier transform and Inverse- discrete Fourier transform.

3. **Name:** DFT by DIT-FFT and DIF-FFT method.

Aim: To perform DFT by DIT-FFT and DIF-FFT methods in MATLAB.

4. **Name:** The low pass, high-pass, band-pass and band-stop filter using Butterworth approximation.

Aim: To write a MATLAB program for low pass, high pass and band pass filter using Butterworth approximation.

5. **Name:** IIR filter realization.

Aim: Design and implementation of IIR filter using Direct form I and Direct form-II structure.

6. **Name:** FIR filter realization.

Aim: Design and implementation of FIR filter using Direct form I and Direct form-II structure.

7. **Name:** Familiarization with TMS-320C6713 DSP starter Kit. Convolution using TMS-320C6713 DSP starter Kit.

Aim: To perform a descriptive and practical study for hardware of TMS- 320C6713 DSP starter Kit. To perform convolution and circular convolution by applying TMS-320C6713 DSP starter Kit.

8. **Name:** DFT and IDFT using TMS-320C6713 DSP starter Kit.

Aim: To perform DFT and IDFT by applying TMS-320C6713 DSP starter Kit.

9. **Name:** Introduction to adaptive filter. Speech processing using adaptive linear combiner (ALC).

Aim: To remove noise from a speech signal by applying adaptive linear combiner (ALC).

10. **Name:** Fundamentals on image processing. To change the intensity of specific part of given gray scale image. Noise suppression from digital image.

Aim: To write a program to remove Salt &pepper type noise from a given gray scale image using mean and median filters.

11. **Name:** Noise suppression from digital image using adaptive filter.

Aim: Write a program to remove Gaussian noise from given image by applying adaptive filter. Books Recommended:

Book Recommended:

1. Digital signal processing and applications with C6713 and C6416 DSK by Rulph Chassaing, wiley publication.
2. Real-Time digital signal processing based on the TMS320C6000 by Nasser Kehtarnavaz, ELSEVIER publication.
3. DSP applications using C and the TMS320c6x DSK by Rulph Chassaing, Wiley Publication.

Reference Books:

1. Antonious, Digital Filter Design, Mc-Graw-Hill International Editions. Wavelate Transform, S. Rao.
2. Wavelate Analysis: "The scalable structure of Information" Springer 2008–Howard L. Resinkoff, Raymond O.Wells

Course Evaluation:

Group project evaluation, Progressive and End semester evaluations

Gaps in the syllabus (to meet Industry/Profession requirements) :

Visualize different signal processing techniques in real time.

Application of real time implementation of digital filter.

POs met through Gaps in the Syllabus: PO 5& PO 6

Topics beyond syllabus/Advanced topics/Design:

Adaptive signal processing, Image processing.

POs met through Topics beyond syllabus/Advanced topics/Design: PO 5 & PO 6

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Progressive Evaluation Marks	√	√	√	√	√
End Sem Examination Marks	√	√	√	√	√

Indirect Assessment

Student Feedback on Faculty

Student Feedback on Course Outcome

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	1	2	1	1	1	1	2	2		1		1	3	2	
CO2	2	2	1	1	1	2	1	2		1		3	3	2	2
CO3	3	3	3	3	2	2	2	2	1	1	2	2	3	3	3
CO4	3	3	3	2	2	2	2	2	1	1	2	2	3	3	3
CO5	3	3	3	1	2	2	2	2	1	1	2	2	3	3	2

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

COURSE INFORMATION SHEET

Course code: EC304

Course title: Microprocessors and Microcontrollers Lab Pre-requisite(s):

Co- requisite(s):

Credits: 03

L	T	P
0	0	4

Class schedule per week: 03

Class: B. Tech.

Semester / Level: V/ 03

Branch: ECE, EEE

Name of Teacher: Dr. Kartik Mahto

Course Objectives

A.	To develop efficient 8085 based program for different tasks.
B.	To develop efficient 8086 based program for different tasks.
C.	To develop efficient 8051μc based program for different tasks.
D.	To build interfacing circuits for different tasks.
E.	To be able to develop microprocessor and microcontrollers-based systems for industrial applications.

Course Outcomes

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

1.	Demonstrate the programming concepts of 8085/8086/8051 for efficient coding.
2.	Show the interfacing of different peripherals with 8085/8086/8051.
3.	Analyse the output of different peripherals when programmed in different modes using 8085/8086/8051.
4.	Develop the interfacing circuits for different applications with appropriate peripherals.
5.	Design 8085/8086/8051 based system for various real time applications.

SYLLABUS

Lab is the application of the theory (i.e., hands-on experiments related to the course contents). Therefore, EC303 Microprocessors and Microcontrollers is the syllabus for the EC304 Microprocessors and Microcontrollers Lab. Following experiments are the guidelines for the students. However, the questions for exams are not limited to this experiment list.

List of experiments (The experiment list may vary to accommodate recent development in the field)

8085 AND 8086 PROGRAMMING

Name of the Experiment: Data Transfers

Aim1: REARRANGING BYTES

Aim2: GROUPING ODD, EVEN, DIVIDE BY 4 AND DIVIDE BY 16 BYTES

Aim3: FORMATION OF A THIRD BLOCK

Aim4: FILLING UP 128 LOCATIONS

Name of the Experiment: Arithmetic Operations

Aim1: ADDITION OF 12 BYTES

Aim2: MULTIPLICATION OF SINGLE BYTE BY SINGLE BYTE

Aim3: ADDITION OF 18 BCD NO'S

Aim4: ADDITION OF TWO 10-BYTE NO'S Aim5: ADDITION OF TWO 20-DIGIT BCD NO's:

Aim5: BCD SUBTRACTION

Aim6: MULTIPLICATION OF TWO 5-BYTE BINARY NUMBERS

Aim7: BCD MULTIPLICATION

Aim8: BINARY DIVISION

Name of the Experiment: Logical Operations

Aim1: CHECKING BITS OF A WORD

Aim2: LOGICAL OPERATION

Name of the Experiment: Data Processing

Aim1: NUMBER OF BITS IN BYTES

Aim2: MAXIMUM AND MINIMUM BYTES

Aim3: SIZE OF A BLOCK ENDING WITH A SPECIFIED BYTE

Aim4: SIZE OF A BLOCK STARTING WITH 00H AND ENDING WITH 60H Aim5: SIZE OF A BLOCK ENDING WITH THREE ALTERNATE 00H Aim6: NUMBER OF TIMES FFH OCCURS AS PAIR

Aim5: CONSECUTIVE MEMORY LOCATIONS WITH IDENTICAL DATA

Aim6: COUNT OF SPECIFIED BYTES

Aim7: ADDRESS OF LAST NON-BLANK CHARACTER Aim10: REPLACING TRAILING ZEROS WITH BLANKS Aim11: ADDING EVEN PARITY TO ASCII CHARACTERS

Name of the Experiment: Sorting

Aim1: SORTING IN DESCENDING ORDER

Aim2: SORTING EVEN AND ODD PARITY BYTES

Aim3: SORTING SIGNED BYTES

Aim4: SORTING SIGNED BINARY BYTES IN ASCENDING ORDER

Name of the Experiment: String Operations

Aim1: COMPARISON OF TWO ASCII STRINGS Aim2: AN ASCII STRING TO BYTE CONVERSION Aim3: INSERTION TO A LIST

Name of the Experiment: Parallel Communication

Aim1: WRITE AN ASSEMBLY LANGUAGE PROGRAM FOR GENERATION OF SQUAREWAVE USING 8255.

Aim2: WRITE AN ASSEMBLY LANGUAGE PROGRAM FOR INPUTTING AN 8-BIT BITDATA THROUGH PORT A OF 8255 IN MODE – 0

Aim3: WRITE AN ASSEMBLY LANGUAGE PROGRAM FOR INPUTTING AN 8-DATA THROUGH PORT A OF 8255 IN MODE – 1 THROUGH STATUS CHECK.

Aim4: WRITE AN ASSEMBLY LANGUAGE PROGRAM FOR GENERATION OF SQUAREWAVE USING 8253.

Aim5: WRITE AN ASSEMBLY LANGUAGE PROGRAM TO GENERATE TRIANGULAR WAVE USING DAC 0808.

Aim6: WRITE AN ASSEMBLY LANGUAGE PROGRAM TO GENERATE SAW TOOTH WAVE OF MAGNITUDE 0 VOLT TO +4 VOLTS USING DAC 0808.

Aim7: WRITE AN ASSEMBLY LANGUAGE PROGRAM TO CONVERT ANALOG SIGNALS OF MAGNITUDE +3.5 VOLTS TO +5 VOLTS IN STEPS OF 0.1 VOLTS TO DIGITAL EQUIVALENT HEX VALUES.

Aim8: WRITE AN ASSEMBLY LANGUAGE PROGRAM TO CONTROL THESPEEDOF STEPPER MOTOR USING 8255 PPI.

Aim9: WRITE AN ASSEMBLY LANGUAGE PROGRAM TO CONTROL THE TRAFFIC LIGHTS USING 8255 PPI

Name of the Experiment: Serial Communication

Aim1: WRITE AN ASSEMBLY LANGUAGE PROGRAM FOR GENERATION OF SQUAREWAVE USING SERIAL OUTPUT PIN

Aim2: WRITE AN ASSEMBLY LANGUAGE PROGRAM FOR INPUTTING AN 8- BIT DATA SERIALLY THROUGH SERIAL INPUT PIN.

Name of the Experiment: Interrupts

Aim1: To study the software and hardware interrupts of 8085.

Aim2: To study the Interrupt controller 8259.

Aim3: To study the Interrupt features of 8051.

Name of the Experiment: Timers

Aim1: WRITE AN ASSEMBLY LANGUAGE PROGRAM TO CALCULATE THE CONVERSION TIME OF ADC USING 8253 TIMER.

Aim2: WRITE AN ASSEMBLY LANGUAGE PROGRAM TO OBSERVE WAVEFORMS OF 8253 TIMER IN DIFFERENT MODES.

Name of the Experiment: Keyboard and Display

Aim1: WRITE AN ASSEMBLY LANGUAGE PROGRAM TO FLASH AND ROTATE "HELP US" USING 8259 PIC.

Name of the Experiment: Code Conversion

Aim1: BINARY TO BCD CONVERSION

Aim2: BCD TO BINARY CONVERSION

Aim3: CONVERSION OF NIBBLES TO ASCII CODES

Aim4: ASCII TO HEXADECIMAL CONVERSION

Books recommended:

Textbooks:

1. Microprocessor Architecture, Programming and Applications with 8085 by R. S. Gaonkar.
2. Advanced Microprocessors and Peripherals by K. M. Bhurchandi and A. K. Ray.
3. The 8051 Microcontroller and Embedded System by Muhammad Ali Mazidi.

Reference books:

1. Intel Manual's for 8085, 8086, 8051 and other peripheral chips.Advanced Microprocessor" by Y. Rajasree.
2. Microprocessor and Interfacing, Programming of Hardware" by Douglas Hall.

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus: N/A.

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	(60)
Attendance Marks	10
Lab file Marks	06
Day-to-day performance Marks	44
End SEM Evaluation	(40)
Lab quiz Marks	08
Lab Viva marks	12
Lab performance Marks	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Progressive Evaluation Marks	√	√	√	√	√
End Sem Examination Marks	√	√	√	√	√

Indirect Assessment

Student Feedback on Faculty

Student Feedback on Course

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	2	3	3	1	1			2		2	2	2	1
CO2	3	3	2	3	3	3	2			2		2	2	2	1
CO3	3	3	2	3	3	3	2			2		2	2	2	1
CO4	3	3	2	3	3	2	2			2		2	2	2	1
CO5	3	3	2	3	3	2	2			2		2	2	2	1

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods			
CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP Projectors	CO1	CD5, CD9
CD2	Tutorials/Assignments/Quiz (s)	CO2	CD5, CD9
CD3	Seminars	CO3	CD5, CD9
CD4	Mini projects/Projects	CO4	CD5, CD9
CD5	Laboratory experiments/teaching aids	CO5	CD5, CD9
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

Lab Turn Wise Experiment Planning Details:

Wee k No.	Ex p. No.	Tentative Date	Ch . No .	Topic/experiment to be covered	Text Book / References	COs mapped	Actual Content covered	Methodology used	Remark by faculty if any
1	-		-	Familiarization with 8085 Kit and its Programming.	-	-		8085/8086/8051 trainer kits	
2				8085 programming				…. do …	
3				8085 programming				…. do …	
4				8085 programming				…. do …	
5				Familiarization n with 8086 Kit and its Programming.				…. do …	
6				8086 programming				…. do …	
7				8086 programming				…. do …	
8				8086 programming				…. do …	

9				Familiarization with 8051 Kit and its Programming.				…. do …	
10				Interfacing peripherals with 8085/86/8051				…. do …	
11				Interfacing peripherals with 8085/86/8051				…. do …	
12				Interfacing peripherals with 8085/86/8051				…. do …	
13				Interfacing peripherals with 8085/86/8051				…. do …	
14				Surprise test**					
15				Final Lab Test					

COURSE INFORMATION SHEET

Course Code: EE252

Course Title: ELECTRICAL MACHINE LABORATORY – I

Designation: Compulsory Course

Pre-requisite: Fundamental of Electrical Machines (Transformer and DC Machines), Electrical Measurement

Credits: 02

L	T	P
0	0	4

Class schedule per week: 03

Class: B.Tech.

Semester/Level: 4th/2nd

Branch: EEE

Name of Teacher:

Course Objectives:

This course enables the students:

A	to the basic fundamentals related to the principle, construction and operation of Transformer and DC Machines and to give them experimental skill
B	to measure the performance of a transformer and DC Machines by conducting various tests and to calculate the parameters.
C	to basic skills needed to test and analyse the performance leading to design of electric machines.
D	to work in a group and evaluate the results to prepare the report.

Course Outcomes:

Upon completion of this course, the student will:

1	Able to recognize various types of Transformer and DC Machines, detail of name plate data of the machines and sketches the various connection diagrams involving these machines.
2	Describe the features and working principle of transformers, DC Machine and starters.
3	Able to perform experiments which are necessary to determine the parameters and the performance characteristics of the transformer and dc machines.
4	Analyse the experimental results and write the report.
5	Able to work in the field of operation, control and maintenance in a group as well as individual.

List of the Experiments (The experiment list may vary to accommodate recent development in the field)

Experiment No. 1

Name: Study of Transformers

Objective: To study the construction and operational details of 1-phase, 3-phase and autotransformers.

Experiment No. 2

Name: Study of D.C. Machines and Starters

Objective: To study the construction and operational details of D.C. Machines and Starters (3 points & 4 Points Starters)

Experiment No. 3

Name: O.C and S.C. Test of a Single-Phase Transformer

Objective: a) To find equivalent circuit parameters

b) To find different types of losses and efficiency to draw the OCC and SCC.

Experiment No. 4

Name: Load test of Single-Phase Transformer

Objective: (a) To perform load test at unity power factor

(b) To calculate the voltage regulation and efficiency

Experiment No. 5

Name: Magnetization Characteristic of separately Excited D.C. Generator

Objective: To plot Magnetization curve (E Vs. If) for different values of speed

Experiment No. 6

Name: Load test of a D.C. Series Generator

Objective: (a) To Study how the terminal voltage of a DC series generator varies with load current at constant rated speed

(b) To draw the external Characteristics

Experiment No. 7

Name: Load test of a D.C. Shunt Generator

Objective: Plot the following Characteristics Terminal voltage vs. load current Field current vs. load current Internal or total Characteristics

Experiment No. 8

Name: Load test of a D.C. Shunt Motor

Objective: Plot the following Characteristics Speed vs. BHP and torque Vs. BHP Current and efficiency vs. BHP Speed vs. torque.

Experiment No. 9

Name: Speed Control of a D.C. Shunt Motor

Objective: Plot the following Characteristics Speed vs. armature voltage (field current being constant) Speed vs. field current (armature voltage being constant).

Experiment No. 10

Name: Swinburne's Test

Objective: To conduct Swinburne's test on D.C. Shunt machine and determine its efficiency while operating as (i) Motor and (ii) Generator

References:

1. The performance and design of DC machines by A.E. Clayton
2. Theory of AC machines by A. S. Langsdorf,
3. Laboratory experiments on electrical machines by C. K. Chanda & A. Chakraborty, Dhanpat Rai & Co., New Delhi
4. Laboratory manual for electromechanics by S. S. Murty, B.P. Singh C. S. Jha and D. P. Kothari, Wiley Eastern Ltd., Delhi.

Gaps in the syllabus (to meet Industry/Profession requirements):

Maintenance and troubleshooting of Electrical Machine, Special Machines and Drives

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design: Electrical Drives

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Evaluation	40

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√	√	√	√
End Sem Examination Marks	√	√	√	√	√

Indirect Assessment –

Student Feedback

Mapping between Course Objectives and Course Outcomes:

Course Objectives	Course Outcomes				
	1	2	3	4	5
A	√	√	√		√
B		√	√	√	√
C	√		√	√	√
D			√	√	√

Mapping between CO and PO

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	1			2	2	1				1				
CO2	3	2	1	1	3		1					1			
CO3		3	2	2	3	2									
CO4	2	3	3	1		2				3	2				
CO5		3	1		3	1		2	3		1	1			

Course Delivery methods
Lecture by use of boards/LCD projectors
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Mapping Between COs and Course Delivery (CD) methods	
Course Outcome	**Course Delivery Method**
CO1	CD1, CD2, CD3, CD4, CD5
CO2	CD1, CD2, CD4, CD5
CO3	CD1, CD2, CD5
CO4	CD1, CD5, CD6
CO5	CD1, CD5, CD6

5th and 6th Semester B.Tech. Course Syllabus

Program Core (PC)	1. EE301 AC Rotating Machines (3) 2. EE353 Power Electronics (4) 3. EE307 Electrical Power Transmission and Distribution (3) 4. EE351 Control Theory (4) 5. EE302 Electrical Machine Laboratory – II (1.5) 6. EE404 Power Electronics Laboratory (1.5) 7. EE352 Control System Laboratory (1.0) 8. EE401 Switchgear and Protection (3) 9. EE355 Power System Analysis (4) 10. EE402 Power System Laboratory (1.0)
Program Elective (PE)	1. Program Elective – I (3) 2. Program Elective – II (3) 3. Program Elective – III (3) 4. Program Elective-III Laboratory (1.5)

COURSE INFORMATION SHEET

Course code: EE301

Course Title: AC Rotating Machines

Pre-requisite(s): Basic Electrical Engineering

Co- requisite(s):

Credits: 03

L	**T**	**P**
3	**1**	**0**

Class schedule per week: 03

Class: B.Tech.

Semester / Level: V/3

Branch: EEE

Name of Teacher:

Course Objectives

This course enables the students:

A.	the basic principles of operation of ac dynamic machines and analyze their steady –state behaviour;
B.	examination and discrimination of characteristics of ac rotating machines;
C.	a technique to draw winding diagram and circle diagram to validate performance of an Induction motor;
D.	knowledge to design and recommend high performance machines for applications in industries, homes and offices

Course Outcomes

After the completion of this course, students will:

1.	state and explain working, constructions as well as steady state behaviour of ac rotating machines,
2.	interpret the various rotating electric machines, its significance in daily life;
3.	identify, formulate and solve problems related to electrical machines;
4.	specify, interpret data, apply the techniques, skills and modern engineering tools necessary for electrical machines and select an electrical machine while making judgment about the best performance in all respect;
5.	aspire a career with specialization in areas of electric machine drives; in addition, recognize the need to learn, engage and adapt in a world of constantly changing electric machine technology

Syllabus

MODULE–I

Basic Concept of A.C. Rotating Machines: Introduction to Armature winding, integral slot and fractional slot winding, Distribution factor (Kd), Pitch factor (Kp) and winding factor (Kw). Production of rotating magnetic field, EMF and torque equations. Effect of tooth harmonics and methods of reduction. (4)

MODULE–II

Synchronous Machines:

Synchronous Generator: Construction, Cylindrical rotor and salient pole rotor, Principle of operation, Excitation system, Effect of winding factor on EMF, Armature reaction, Circuit model, Phasor diagram, O.C. and S.C. tests, Short-circuit ratio, Determination of voltage regulation by synchronous impedance, MMF and zero-power factor methods. (8)

Performance Characteristics of Synchronous Generator: Two reaction theory, Phasor diagram, Power-angle characteristic of synchronous generators, Synchronizing power and torque, Synchronizing methods, Parallel operation of synchronous generator, Effect of change in excitation and mechanical power input on load sharing, Operation of alternator on infinite bus-bars, Slip test. (7)

MODULE–III

Synchronous Motor: Construction, Principle of operation, Equivalent circuit, Phasor diagram, Circuit model, Effect of change in excitation on armature current and power factor, Starting of synchronous motor, Synchronous condenser, Hunting, Applications. (7)

MODULE–IV

Induction Motor: Introduction, Construction, Principle of operation, Slip and rotor frequency, Comparison with transformer, Equivalent circuit model, Representation of mechanical load, No load and blocked rotor tests. Torque and power output, Losses and efficiency, Separation of losses.

Performance Characteristics of 3-phase Induction Motor: Circle Diagram, Torque-slip characteristics, Effect of rotor resistance, starting torque and maximum torque, Starting and speed control methods, Cogging and crawling, Introduction to induction generator, Applications. (7)

MODULE–V

Single-phase Induction Motor: Introduction, Double revolving field theory, Cross field theory, Torque-speed characteristic, Equivalent circuit model, Starting methods, Applications. (5)

Textbooks:

1. D.P. Kothari and I.J.Nagrath;ElectricMachines,TMHNewDelhi,4th Edition,2010

Reference books:

1. A.E. Fitzraul, Charles Kinsley, Stephen D. Umansd; Electric Machinery, McGraw Hill Education (India) Pvt. Ltd, Noida, Indian 6th Edition 2003.
2. E. H. Langsdrof; Theory of Alternating Current Machinery, McGraw-Hill New York 1955.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination Marks	25
Quiz (s)	20 (10x2)
Teacher Assessment	05
End Semester Examination Marks	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

Indirect Assessment –

1. Student Feedback on Faculty

2. Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	H	H	H	H	H	M	L	-	-	L	-	L	M	L	M
2	H	H	H	H	H	H	L	-	-	L	L	L	L	L	H
3	M	M	H	H	M	H	L	L	L	L	L	M	L	L	H
4	H	H	H	H	H	H	L	M	M	M	M	M	L	M	H
5	H	H	H	H	H	H	H	H	H	H	H	H	M	M	M

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE 353

Course title: Power Electronics

Pre-requisite(s): Analog Electronics, Digital Electronics

Co- requisite(s): Semiconductor devices, Frequency analysis

Credits:	04	L:	T:	P:
		3	1	0

Class schedule per week: 04

Class: B.TECH.

Semester / Level:5

Branch: EEE

Name of Teacher:

Course Objectives:

The course objective is to provide students with an ability to:

A.	Describe various type of high power switches and their switching technique.
B.	Explain operating principle of power electronic converters with voltage and current waveforms and illustrate their applications in electrical technology.
C.	Apply different converters for energy management
D.	Analysis and performance evaluation of power electronics based technology.
E.	Planning and design procedure for a power electronics based system.

Course Outcomes:

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

1.	List different types of high power semiconductor switches and interpret their operating characteristics.
2.	Classify various kinds of power converters. Explain the working principle of power converters. Solve problems of voltage regulation with the help of power converters.
3.	Analysis of power electronic converters using fourier series technique in order to Identify design parameters for high performance converters.
4.	Estimate the cost and long term impact of power based installations.
5.	Reorganize existing power electronics based installations. Develop new power converters and Plan to design a power processing unit. Play the role of a dynamic leader or supporter in a team of skilled professionals.

Syllabus

Module–I

Scope of power electronics, Overview of high-power semiconductor switches, two transistor analogy of SCR terminal characteristics, Rating and protection of SCR, Dynamic and static characteristics of MOSFET, IGBT and IGCT, Industrial firing circuit.
[10]

Module–II

Dynamic characteristics of SCR, Gate characteristics, series and parallel operation of SCR, power diodes, diode circuits, commutation circuits.
[10]

Module–III

Single phase controlled, Half-wave, Full-wave rectifier with R, RL and RLE loads, Single phase semi-converter, Effect of Source impedance performance, Evaluation of converter using Fourier series analysis, Three phase uncontrolled rectifier with resistive load, Three phase half wave, Full wave rectifiers with R-load,3-phasesemi-converter, RMS, Average value, Fourier analysis, THD, HF and PF of converter. [10]

Module–IV

Chopper, Introduction, Principle of operation control, Strategies, Step-up and step-down chopper, Chopper configuration, Type A, B, C, D & E chopper uses.
[7]

Module–V

Single phase inverter, VSI and CSI, Analysis with R, RL, and RLC loads, 180^o and 120^o mode of operation of 3-phase VSI, SPM, MPM and Sinusoidal PWM techniques, Series inverters, Overview of Electric drive. [8]

Textbook:

1. M.D. Singh, K. B. Khanchandani, Power Electronics, TMH, New Delhi 2008.
2. P. S. Bimbhra, Power Electronics, Khanna Publications, 5^{th} Edition, New Delhi, 2012.

Reference Book:

1. M.H. Rashid, Power Electronics: Circuits, Device and Applications, 2nd Edn, PHI, New Jersey, 2003.
2. Mohan, Underland, Robbins; Power Electronics Converters, Applications and Design, 3rd Edn. 2003, John Wiley & Sons.
3. R.S. Ramshaw, Power Electronics Semiconductor Switches, Chapman & Hall 2nd Edition, 1993, Chennai.

Gaps in the syllabus:

Role of converters for renewable energy integration

POs met through Gaps in the Syllabus: PO 5

Topics beyond syllabus/Advanced topics/Design:

Assignment: Simulation of grid connected SPV system

POs met through Topics beyond syllabus/Advanced topics/Design: PO 5

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	3	1	1	1	1	1	1	1	2	2	1
CO2	3	3	3	3	3	2	2	1	1	1	1	1	3	2	2
CO3	3	3	3	3	3	2	2	2	2	1	1	1	3	3	2
CO4	3	3	3	3	3	3	2	2	2	2	2	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2, and CD3

CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: EE 307

Course Title: Electrical Power Transmission and Distribution

Pre-requisite(s): EE101 Basics of Electrical Engineering

Co- requisite(s): PH113 Physics

Credits: 03

L	T	P
3	0	0

Class schedule per week: 03

Class: B.Tech.

Semester / Level: V/ III

Branch: Electrical & Electronics Engineering

Name of Teacher:

Course Objectives

This course envisions imparting the following objectives to students:

A.	To provide the basics and fundamental concepts on power system structure and effect of different factors in economic operation of power system.
B.	To enable the students to determine the line parameters of balanced system and construct mathematical modelling of transmission and distribution system.
C.	To make use of fundamental concepts of transmission and distribution system design in line with enhancing transmission line efficiency and voltage regulation.
D.	To expose voltage and current equations for different types of distribution networks and effect of reactive power on voltage improvements.
E.	To expose the students to the mechanical design concept like effective sag, enhancement of insulator string efficiency, structure, types of underground cables and grading of cables.

Course Outcomes

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

1.	To understand the importance of the different factors like load curve, load factor, diversity factor, plant load factor for economic and effective operation of power systems.
2.	To determine the different parameters of overhead lines and underground cables.
3.	To formulate the relevant mathematical equations involved for different types of line and to apply the equations for electrical design of the line in the context of voltage regulation, efficiency, corona etc.
4.	To explain the core concept involving mechanical design of lines with the objective to keep effective sag, number of insulators.

5.	To apply the understanding in designing distribution systems in the context of satisfying voltage constraint and the size of reactive power compensator for receiving proper voltage at load end.

SYLLABUS

Module–I

Introduction: Structure of a power system, Effect of transmission voltage, Different curves: load curves, Load duration curve, Different factors for Powerplant operation: Demand factor, Load factor, diversity factor, plant capacity factor, plant utilisation factor, cost of electrical energy, different types of tariffs: simple type, flat rate types, bulk rate, two-part, three-part tariff, availability-based tariff. [9]

Module–II

Constants of O/H lines: Types of conductors, bundle conductor, resistance calculation, skin effect, inductance and capacitance of overhead lines: Inductance and capacitance of single-phase and three-phase line, Transposition, Double ckt. Three-phase lines. [7]

Module–III

Overhead line insulators: Types of insulators, potential distribution over a string of suspension insulators, methods of enhancing string efficiency, Under-ground cable: types, extra-high voltage cables: electrostatic stresses, grading of cables.

Mechanical design of transmission line: Sag tension, length calculation, effect of wind and ice loading. corona effect. [12]

Module–IV

Transmission System: Performance of transmission line, representation of short, medium and long transmission lines, Ferranti effect, SIL, Tuned Power Line, Power flow through transmission lines. [7]

Module–V

Distribution Systems: Feeders, distributors, and service mains, redial and ring main system, different types of DC and AC distribution systems, calculation, Voltage control: Dependency on reactive power, method of reactive power injection at load end. [10]

Textbooks:

1. Power System Analysis–Hadi Saadat, Tata McGraw-Hill Edition.
2. Power System Engineering–A. Chakrabarti, M. L. Soni, P. V. Gupta, U. S. Bhatnagar.

Reference Books:

1. Modern Power System Analysis–D. P. Kothari, I. J. Nagrath, Tata-Mc Graw Hill.
2. Electric Energy Systems Theory-An Introduction–O. I. Elgerd, TMH Edition.

3. Electric Power System– C. L. Wadhwa, New Age International Publishing.
4. Principles of Power System- V. K. Mehta and Rohit Mehta, S. Chand.

Gaps in the Syllabus (to meet Industry/Profession requirements)

More examples from practical networks for more complex design problem.

POs met through Gaps in the Syllabus

3rd,4th and 5th of POs can be met with higher level of satisfaction

Topics beyond syllabus/Advanced topics/Design

Transmission Line Design Problem

Power Circle Diagram

Basics of FACT devices

POs met through Topics beyond syllabus/Advanced topics/Design

3rd, 4th and 5th with higher satisfaction.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination Marks	10
End Semester Examination Marks	25
Assignment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks					
End Sem Examination Marks					
Assignment					

Indirect Assessment

1. Student Feedback on Faculty .
2. Student Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	2	1	1	1	2	1	2	1	1	2	2	3	1	3
CO2	3	2	1	2	1		1	1	1	1		2	3	1	3
CO3	3	2	2	2	2		2	1	1	1		2	3	1	3
CO4	3	3	3	3	2	1	2	2	1	1		2	3	1	3
CO5	3	3	3	3	2	1	2	2	1	1		2	3	1	3

Correlation Levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

Course Delivery Methods	Course Outcome
CD1	CO1
CD1, CD2 and CD8	CO2
CD1, CD2 and CD8	CO3
CD1, CD2 and CD8	CO4
CD1, CD2 and CD8	CO5

COURSE INFORMATION SHEET

Course Code: EE351

Course Title: Control Theory

Pre-requisite(s): Applied Mathematics, Introduction to System Theory

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: VI/Third

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

A.	State basic concepts of control systems and various methods to represent a system.
B.	Illustrate and interpret a system using time and frequency domain techniques.
C.	Classify different types of systems, solve different control problems and construct root locus, Bode plot and Nyquist plots for different systems.
D.	Examine the time and frequency domain techniques and analyze stability of control systems.
E.	Summarize and design controllers and compensators for systems.

Course Outcomes

After the completion of this course, students will be:

1.	Identify a closed loop system and represent system in terms of block diagram, signal flow graph, state diagrams and state model.
2.	Describe techniques such as root locus, Bode plot and Nyquist plot for a system.
3.	Solve problems and analyze performance and stability of system using time and frequency domain techniques.
4.	Evaluate and judge different controllers for a system
5.	Design compensators for the control system.

Syllabus

Module–I

Introduction: Examples of control systems and applications, Basic components of control systems, Open-loop and closed-loop control systems, Effect of feedback, Classification of the control system.

Linearization of nonlinear systems using Taylors series. Modeling. Laplace transform method. Analogous systems. Block diagrams representation of control systems, Block diagram reduction, Signal Flow Graph (SFG)- Basic properties of SFG, SFG algebra, Gain formula to SGP, Application of gain formula to block diagrams.
[8]

Module–II

Time Domain Analysis of Control Systems: Transient and steady-state response, Time response specifications, Typical test signals, Steady-state error, and error constant, Stability-Absolute, relative and conditional stability, Dominant poles of a transfer function, Root locus concept, Properties and construction of root locus, Determination of relative stability from root locus, Root sensitivity to parameter variation, Root contours, Systems with transportation lag and effect of adding poles or zeros. [8]

Module–III

Frequency Domain Analysis of Control Systems: Frequency response specifications, Correlation between time and frequency domain, bode plot, Determination of stability using Bode plot, Nyquist stability criterion, Nyquist Plot, Polar Plot, Theory of Magnitude phase plot, Constant M, constant N circle and Nichols chart. [8]

Module–IV

Control System Components and Basic Control Actions: Sensors and encoders in control system, Potentiometer, Tachometers, incremental encoders, Synchros, Operational Amplifiers, Basic control actions: on-off control, P, PI, PD and PID. Introduction to design, lead, lag & lead-lag compensation. [8]

Module–V

Concepts of State, State Variables: Development of state-space models. State and state equations, State equations from transfer function Transfer function from state equations, State transition matrix. [8]

Textbooks:

1. J. Nagrath & Gopal, "Control Systems Engineering", 4th Edition New Age International Publication.
2. K. Ogata, "Modern Control Engineering",3rd Edition, Pearson Education.

Reference books:

1. Norman Nise, "Control System Engineering, 4th Edition, Wiley.
2. Graham C. Goodwin, "Control System Design", PHI.
3. B. C. Kuo, "Automatic Control System", 7th Edition, PHI.

Gaps in the syllabus (to meet Industry/Profession requirements)

Solving real time problems of industrial applications

POs met through Gaps in the Syllabus: 2, 5, 6

Topics beyond syllabus/Advanced topics/Design:

Controllability and Observability of a system

Response of different types of systems with different inputs using simulation

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	2	1	2	2	1	1	1	1	1	2	3	3	2
CO2	3	3	3	2	2	1	2	1	1	1		2	3	3	2
CO3	3	3	3	2	2	2	1	1	2	1	2	1	3	3	2
CO4	3	3	3	3	3	2	1	1	1	1	2	2	3	3	3
CO5	3	3	3	1	3	3	2	2	1	1	2	1	3	3	3

Correlation Levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD5

CD2	Tutorials/Assignments	CO2	CD1, CD5, CD8
CD3	Seminars	CO3	CD1, CD2, CD8, CD9
CD4	Mini projects/Projects	CO4	CD1, CD2, CD5, CD8, CD9
CD5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD5, CD8, CD9
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: EE302

Course Title: Electrical Machine Laboratory – II

Pre-requisite: Fundamental of Electrical Machines (DC Machines and Transformer), Electrical Measurement

Credit:

Contact Hours:	L	T	P	C
	0	0	3	1.5

Course Evaluation: Progressive Evaluation (Class performance, Lab. Record, Viva, Quiz) and End Semester Evaluation (Viva-voce and performance).

Course Objectives:

This course enables the students:

A.	to the basic fundamentals related to the principle, construction and operation of Transformer and DC Machines and to give them experimental skill.
B.	to measure the performance of a transformer and DC Machines by conducting various tests and to calculate the parameters.
C.	to basic skills needed to test and analyze the performance leading to design of electric machines.
D.	to work in a group and evaluate the results to prepare the report.

Course Outcomes:

Upon completion of this course, the student will:

1.	Able to recognize various types of Transformer AC and DC Rotating Machines, detail of name plate data of the machines and sketches the various connection diagrams involving these machines
2.	Describe the features and working principle of transformers, AC and DC rotating Machine and starters.
3.	Able to perform experiments which are necessary to determine the parameters and the performance characteristics of the transformer, AC and DC rotating machines.
4.	Analyze the experimental results and write the report.
5.	Able to work in the field of operation, control and maintenance in a group as well as individual.

List of the Experiments (The experiment list may vary to accommodate recent development in the field)

ExperimentNo.:01

Name: Study of A.C. Machines and Starters.

Objective: Tostudytheconstructionandoperationaldetailsof1–phaseand3-phase A.C. rotating Machines and Starters.

ExperimentNo.:02

Name: Load test on a D.C. compound Generator.

Objective: Draw the load characteristics for the following:

As Shunt generator

Differentially compounded generator

Cumulatively compounded generator

ExperimentNo.:03

Name: Hopkinson’s test.

Objective: Determine the efficiency of shunt generator and motor for 50% and 100% at full load generator current.

ExperimentNo.:04

Name: Scott connection.

Objective: a) Connect two single-phase transformers for converting 3-phase to 2-phase supply.

b) Determine the 3-phase current for different values of 2-phase.

(i) Balanced load, (ii) unbalanced load, and draw the corresponding phasor diagram.

ExperimentNo.:05

Name: Parallel operation of a 1–phase transformer.

Objective:

(a)to test the polarity and transformation ratio.

(b)Load sharing of the transformers.

ExperimentNo.:06

Name: No-load and blocked-rotor test on 3-phase induction motor.

Objective: a) Determine equivalent circuit parameters and draw equivalent circuit.

Draw circle diagram and calculate power factor, efficiency and slip at full load

Draw performance characteristics.

ExperimentNo.:07

Name: Load test on 3-phase induction motor.

Objective: a) To obtain load characteristics of 3-phase induction motor.

b) Percent speed, BHP, Efficiency, Torque, Power factor and Slip vs Percent normal full-load current curves.

ExperimentNo.:08

Name: Voltage regulation of a single-phase alternator by direct loading and synchronous impedance method.

Objective: Plot

The O. C. characteristic

The S. C. characteristic

The synchronous impedance versus exciting current

The percent regulation versus percent full load curve for 0.8 p.f. lag and unity p.f.

Percent voltage regulation versus load current curve by direct loading

ExperimentNo.:9

Name: V-curvesofa3-phasesynchronousmotor.

Objective: Draw the armature current vs field current for no-load.

ExperimentNo.:10

Name: O. C. and S .C. test on a single-phase induction motor.

Objective:

Study:

The induction motor does not develop starting torque without auxiliary winding.

The starting torque is developed by connecting capacitor either in main or auxiliary winding; note the direction of rotation in each case.

Draw equivalent circuit and mention the values of parameters.

References:

1. The performance and design of DC machines by A. E. Clayton
2. Theory of A C machines by A. S. Langsdorf,
3. Laboratory experiments on electrical machines by C. K. Chanda & A. Chakraborty, Dhanpat Rai &Co., New Delhi
4. Laboratory manual for electromechanics by S. S. Murty, B. P. Singh C. S. Jhaand, D. P. Kothari, Wiley Eastern Ltd., Delhi.

Gaps in the syllabus (to meet Industry/Profession requirements): Maintenance and troubleshooting of Electrical Machine, Special Machines and Drives

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design: Electrical Drives

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Evaluation	40

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√	√	√	√
End Sem Examination Marks	√	√	√	√	√

Indirect Assessment –

1. Student Feedback

Mapping between Course Objectives and Course Outcomes:

Course Objectives	Course Outcomes				
	i	ii	iii	iv	v
1	√	√	√		√
2		√	√	√	√
3	√		√	√	√
4			√	√	√

Mapping between CO and PO

Course Outcomes	Programme Outcomes												PSOs		
	a	**b**	**c**	**D**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
1	H	L			M	M	L				L		M	L	L
2	H	M	L	L	H		L					L	M	L	L
3		H	M	M	H	M							H	L	M
4	M	H	H	L		M				H	M		H	M	H
5		H	L		H	L		M	H		L	L	L	L	L

Course Delivery methods
Lecture by use of boards/LCD projectors
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Mapping Between COs and Course Delivery (CD) methods	
Course Outcome	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD5
CO2	CD1, CD2, CD4, CD5
CO3	CD1, CD2, CD5
CO4	CD1, CD5, CD6
CO5	CD1, CD5, CD6

Course Information Sheet

Course code: EE404

Course title: Power Electronics Laboratory

Pre-requisite(s): Power System, Power Electronics,

Co- requisite(s): Circuit Theory and Digital Signal Processing

Credits: L: T: P: 0 0 3

Class schedule per week: 03

Class: B.Tech.

Semester / Level: VII /IV

Branch: EEE

Name of Teacher:

Course Objectives:

This course envisions to impart to students to:

A.	Identify semiconductor switches and carryout experimentation to reproduce the I-V characteristics.
B.	Explain the operation of triggering circuits, commutation circuits for the semiconductor switches and different energy conversion topologies through experimentation.
C.	Demonstrate and draw the waveforms of the circuit variables such as current through and voltage across the switches and load in different energy conversion topologies, though experimentation.
D.	Calculate the performance parameters of energy conversion topologies through experimental and analytical approach. Design assigned circuit topology for given specification and fabricate the circuitry of any of the power converter;
E.	Design the proper closed loop controller and to evaluate the performance of controller in case of a power converter topologies.

Course Outcomes:

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

1	Identify different types of semiconductor based switching devices available in market
2	Observe different characteristics of semiconductor based switching devices
3	Choose a suitable and proper switching device for a required power electronics based design
4	Evaluate the performance of power converter based systems such as electrical drive , renewable energy integration and battery management system
5	Design power electronics system which requires a multidisciplinary approach and teamwork

List of Experiments (The experiment list may vary to accommodate recent development in the field)

Experiment – I

DoanexperimentonPowerMOSFETinordertodrawitsTransferandOutputcharacteristics.

Aim:

To obtain saturation, cut off and active region of a Power MOSFET.

To measure minimum gate voltage required for turning on Power MOSFET

Experiment–II

Study and observe different methods of commutation.

Aim:

To observe load voltage wave form under natural commutation.

To observe load voltage wave form under forced commutation.

Experiment –III

Execute an experiment on synchronized UJT firing circuit in order to generate a pulse to fire an SCR and draw the various voltage waveforms at different stages of firing circuit.

Aim:

To find out valley point in UJT

To find minimum gate turn on delay time of SCR.

Experiment–IV

Perform an experiment on Multilevel (5Level) three phase inverter.

Aim:

Observe line voltage and current voltage wave form on a DSO and compute voltage stress across each switch.

Compute THD and compare it with three level inverter.

Experiment –V

Execute an experiment in order to find the ripple factor of a single-phase bridge diode rectifier.

Aim:

To find relative error between theoretical calculation and practical observation of rectifier load voltage.

To calculate the value of a capacitor to reduce the ripple factor by a given percentage.

Experiment–VI

Do an experiment in order to find the performance measures of a single phase fully controlled thyristor rectifier with LC filter and resistive load.

Aim:

Obtain relationship between firing angle and average output voltage of fully controlled rectifier

Calculation of filter parameters for reducing ripple factors.

Calculation of Transformer Utilization Factor (TUF).

Experiment–VII

InordertofindtheperformancedotestonPowerMOSFETbasedstepdownchopperwithRand RL load for different duty cycle and frequency.

Aim:

TofindrelativeerrorbetweencalculatedandobservedoutputloadvoltageofStepDownChopperwithchange in duty cycle.

To observe the effect of free-wheeling diode.

Experiment –VIII

PSIMdrawandsimulatetheperformanceofathreephasebridgerectifierwithcontinuouscurrentmode and different load.

Aim:

Introduction to simulation using PSIM

Calculation of average output voltage and ripple factor using PSIM

Experiment – IX

Hardware based project for a power converter-Modelling.

Aim:

Develop a mathematical model of the converter.

Simulate the model and observe time domain response.

Experiment – X

Hardware based project for a power converter-Prototyping.

Aim:

PCB prototyping of the converters.

Testing and experimentation with the developed power converter.

Textbooks:

1. M. D. Singh, K. B. Khanchandani, Power Electronics, TMH, Delhi 2001.
2. M.H. Rashid, Power Electronics: Circuits, Device and Applications, 2nd Edn, PHI, New Jersey, 1993,

Reference Books:

1. B K Bose: Modern Power Electronics and AC Drives, 2001, Delhi, PHI.
2. G K Dubey, Fundamentals of Electric Drives, 2nd Edition, PHI, Delhi.
3. C. M. Ong, Dynamic Simulation of Electric Machinery, PH, NJ.

Course Information Sheet

Course Code: EE352

Course Title: Control System Laboratory

Pre-requisite(s): Fundamentals of Mathematics and Physics, Introduction to System Theory, Control Theory

List of Experiments (The experiment list may vary to accommodate recent development in the field)

ExperimentNo.:01

Name: Study of AC servomotor

Objective: To study AC servo motor and analyses the response of motor transfer function using time domain and frequency domain methods.

ExperimentNo.:02

Name: Study of motor and brake characteristics

Objective: (a) To learn the steady state speed of motor is ideally proportional to applied voltage.

(b)To determine the time constant of given motor.

ExperimentNo.:03

Name: Compensation networks

Objective: To design, implement and study the effects of different cascade compensation networks for a given system, and analyses the response of network using time domain and frequency domain specifications.

ExperimentNo.:04

Name: ON-OFF Temperature controller

Objective: To study of performance of ON-OFF Temperature controller

ExperimentNo.:05

Name: First and Second order System

Objective: To derive the transfer function of the system using time response and simulate first order RC series circuit and second order RLC series circuit and analyses its transient response characteristics.

ExperimentNo.:06

Name: Low pass and high Pass filter

Objective: To design and analyze characteristics of low pass and high pass filter circuit.

ExperimentNo.:07

Name: Simulation of system using LTI viewer using Bode plot and root locus

Objective: To use LTI viewer to simulate a given the transfer function for varying parameters and record different specifications.

ExperimentNo.:08

Name: Effect of time delay on the system performance using Bode and Nyquist plot

Objective: To study frequency responses of a system without time delay and compare it in presence of time delay using Bode plot and Nyquist plot.

ExperimentNo.:09

Name: Effect of non-linearities

Objective: To study the effect of different non-linearities upon transient response of a system.

ExperimentNo.:10

Name: Study of Potentiometric error detector and Synchros

Objective: (a) To study the performance characteristics of an angular position error detector using two potentio-meters.

(b)Study the principle of operation, application of Synchros and measurement of angular shaft displacement versus AC voltage.

ExperimentNo.:11

Name: Analog PID controller

Objective: To study the performance characteristics of an analog PID controller using simulated systems, in presence of time delays.

ExperimentNo.:12

Name: Inverted Pendulum

Objective: Modelling and design of controller for Inverted pendulum.

Course Information Sheet

Course code: EE 401

Course title: Switchgear and Protection

Pre-requisite(s): Knowledge in Electrical Machines, Power Transmission and Distribution, Measurement and Instrumentation, Analysis of Power System.

Co- requisite(s):

Credits:	L:	T:	P:
	3	1	0

Class schedule per week: 4

Class: B. Tech.

Semester / Level: VII/IV

Branch: EEE

Name of Teacher:

Course Objectives

This course enables the students:

A.	To outline significance of protective devices in power system network
B.	To explain the principle of operation, types of relays and circuit breakers.
C.	To classify the protection mechanism of generation transmission and distribution and its significance at individual location.
D.	To analyze the significance of electromechanical relays for applying it in digital relays.

Course Outcomes

After the completion of this course, students will be:

1.	Outline of the power system protection mechanism significances.
2.	Explain the operation, classification and structure of the relays and circuit breakers.
3.	Classify and relate the protection mechanism at different zones of power system, such as HL1, HL2 and HL3.
4.	Analyze and differentiate digital relays with electromechanical relays.
5.	Ability to predict and design the protection mechanism at different zones of power system as per the modernization of the grid.

Syllabus

MODULE–I:

Circuit Breakers: Introduction, construction, classification and application of Oil CBs, Air CBs, Vacuum CBs, Sf6 CBs, HVDC CBs. Testing and rating of CBs. Arc voltage, Mechanism of arc interruption, Re-striking voltage and recovery voltage.
[8]

MODULE– II:

Protective Relaying: Introduction to electromagnetic protective relaying, static relaying, and microprocessor based digital protective relaying. Advantage, limitations and basic elements of protective relays. Thermal relay, Over current relay, Directional relay, Differential relay, distance relay. [8]

MODULE– III:

Generator Protection: using electromagnetic relay and digital relay: Protection against stator and rotor faults and abnormal operating conditions such as unbalanced loading, loss of excitation, over speeding.

Motor Protection: Introduction, Protection against phase fault, ground fault and abnormal operating conditions such as single phasing, Phase reversal and overloading.
[8]

MODULE– IV:

Transformer Protection: using electromagnetic relay and digital relay: Types of faults, over current protection, Differential protection, Differential relay with harmonic restraint, Protection against high resistance ground faults, Inter-turn faults, Buchholz relay.
[8]

MODULE–V:

Transmission Line and Feeder Protection: using over current relay, directional relay, distance relay (Impedance relay, Reactance relay, MHO relay) and carrier aided protection and numerical protection.
[8]

Textbooks:

1. Power System Protection & Switch Gear: Badriramand Vishwa Karma, TMH Publications, 2nd edition, 2013.
2. Switch Gear and Protection Sunil S. Rao, Khanna Publications, 3rd edition, 2008.

Reference Books:

1. Power System Protection & Switch Gear: Ravindranath & Chander, New Age Publications, 2nd edition, 2014.
2. The Art and Science of Protective Relaying: C. Russel Mason, Wiley Bastern Ltd, 1956.

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Students' Feedback on Course Outcome.

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2									2	3	2	3
CO2	3	3	2	1	2						1	2	3	2	3
CO3	3	3	3	2	2	2	2	2	1	1	1	2	3	3	3
CO4	3	3	3	3	3	2	2	2	1	1	1	2	3	2	3
CO5	3	3	3	3	3	2	2	2	1	1	1	2	3	3	3

Mapping Between COs and Course Delivery (CD) methods

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		

CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: EE355

Course Title: Power System Analysis

Pre-requisite(s): Basic Electrical Engineering, Electrical Power System Transmission and distribution

Co- requisite(s):

Credits:

L	T	P	C
3	0	0	3

Class schedule per week: 03

Class: B. Tech

Semester / Level: VI/III

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions imparting the following objectives to the students:

A	To describe power system by single line, impedance and reactance diagrams
B	To explain steady state operation of large-scale power systems and analyze power flow problems using numerical methods
C	To demonstrate the voltage and current condition of power systems under symmetrical fault conditions
D	To understand the representation of sequential network and apply Thevenin Equivalent technique to evaluate the currents and voltages at unsymmetrical fault condition.

Course Outcomes

After the completion of this course, students will be:

1	outline per unit representation of power system and explain with suitable examples;
2	apply different methodologies to solve load flow problems and evaluate their efficacies;
3	understand the consequences for short circuit events in power systems and solve the short circuit current and voltages under symmetrical fault.
4	construct different sequence networks and solve the short circuit current and voltages under unsymmetrical faults
5	solve different types of power system stability problems and recommend commensurate remedial measures;

SYLLABUS

Module–I

Introduction: Power System Components and their representation: Components representation, Single Line diagram, Per unit system representation, advantages of Per unit system, Transformer effect in per unit system, Reactance diagram, Impedance diagram.
[8]

Module–II

Load flow Analysis: Load flow problem, Different types of buses, Ybus formulation, Derivation of load flow equations, Solution technique using Gauss-Siedel method, overview of NR method for Load Flow Problem.
[10]

Module–III

Symmetrical Short Circuits Analysis: Short circuit of a Synchronous machine on no-load, short circuit of loaded synchronous machine, Thevenin's equivalent circuit approach and calculation for the event of short circuit.
[5]

Module–IV

Symmetrical Components: Transformation, Phase shift in star-delta transformer, Sequence impedance and sequence networks of transmission line, Synchronous machine, Transformer and load. Unsymmetrical Short Circuits: Symmetrical component analysis of unsymmetrical short circuits, Single line to ground fault, Double line to ground fault and line to line fault.
[10]

Module–V

Power system stability problem, Swing equation, System response to small disturbances, Power angle equation and diagram, Transient stability, Equal area criterion, Measures for improving transient stability.
[7]

Textbooks:

1. Electric Energy Systems Theory-an Introduction by Olle I. Elgerd; Mc Graw Hill Education.
2. Power System Analysis by Grainger and Stevenson; Tata McGraw Hill, New Delhi

Reference Books:

1. Modern Power System Analysis by Nagrath– Kothari, McGraw Hill Education, New-Delhi,2003.
2. Electrical Power Systems by C. L. Wadhwa, New Age International, 2005.

Gaps in the Syllabus (to meet Industry/Profession requirements)

Apply solution techniques on practical example of utility network.

Details in Circuit breaker rating and relay setting considering power system network.

POs met through Gaps in the Syllabus: 3 and 4

Topics beyond syllabus/Advanced topics/Design

Load flow for IEEE standard networks, Circuit breaker rating.

POs met through Topics beyond syllabus/Advanced topics/Design: 3 and 4

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Semester Examination	25
End Semester Examination	50
Quiz (s)	10 + 10
Assignment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

Indirect Assessment –

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

MAPPING II: (CO vs PO)

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	2		2	1			2	1			1	1	
CO2	2	2	3	2	2	2	1	2	2	1			2	1	2
CO3		1	3	2	2	2	2	2	2	1	2		2	1	2
CO4	3	3	3	2	2	2	2	2	2	1	2	2	2	1	2
CO5	3	3	3	1	2	1	1	2	2	1	2	2	2	1	2

Correlation Levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods:

CD	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors/OHP
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of NPTEL materials
CD9	Simulation
Course Outcome	**Course Delivery Method**
CO1	CD1, CD8
CO2	CD1, CD8
CO3	CD1, CD8
CO4	CD1, CD2, CD8
CO5	CD1, CD2, CD8

Course Information Sheet

Course code: EE402

Course title: Power System Lab

Pre-requisite(s): Power system analysis and protection, A.C. & D.C. machines, power electronics, linear control

Co- requisite(s): knowledge of basics in electrical engineering

Credits:	L:	T:	P:
	0	0	3

Class schedule per week: 3

Class: B. Tech.

Semester / Level: VII/IV

Branch: EEE

Name of Teacher:

Course Objectives:

This course enables the students to:

A.	. Apply theoretical knowledge for practical outcomes
B.	Handle and testing prototype models of the practical systems used in industries.
C.	Show exposure towards physical significance of machineries.
D.	Understand how to use various equipments.

Course Outcomes:

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

1	Recall the theoretical knowledge and practical outcomes.
2	Understanding the possible practical values of different experiments and individual parameters measured
3	Apply and analyze the techniques, skills and modern engineering tools necessary for engineering practice
4	Conclude by justifying the output of the experimental output with theoretical and practical outputs respectively
5	Ability to compile the experimental data and prepare write-ups.

List of Experiments (The experiment list may vary to accommodate recent development in the field)

1. Power factor controls an inductive load.
2. Power system fault analysis using D.C network analyzer.
3. Determination of ABCD parameters and voltage profile for an artificial transmission line.
4. Determination of over current relay characteristics using Relay Test kit.
5. A micro-computer controlled static VAR compensator for receiving end voltage.
6. Determination of negative and zero sequence reactance of a 3-phase alternator.
7. Phase sequence determination using RC and two bulbs method.
8. Ferro-resonance phenomenon for a transformer at no load.
9. Determination of zero sequence impedance of 3-phase transformer.
10. Earth resistance measurement using Earth tester.
11. Operation of different type of renewable integration in power system under Grid Connected Mode and Islanded Mode using Typhoon HIL
12. Determination operation of distance relay in power system network using Typhoon HIL
13. Study of different configuration of transformer in Balanced and Unbalanced load Condition using Typhoon HIL
14. Monitoring the dynamics of three phase grid tied converter using PMUs using Typhoon HIL
15. Study of IEEE-13bus unbalance distribution system network using Typhoon HIL

Referred Books:

1. Electric Machinery: 7th edition, Fitzgerald & Kingsley's Electric Machinery
2. Power System Protection & Switchgear: Badriram and Vishwa Karma, TMH Publication 2nd edition,2014.
3. Performance and Design of DC Machines-A. E. Clayton,1st edition, CBS Publisher, 2004.
4. Extra High Voltage AC Transmission Engineering (2nd Ed.) by R. D. Begamudre, Wiley Eastern Ltd.
5. Alternating Current Machines, A. S. Langsdorf, Tata McGraw-Hill, 2001
6. Microprocessor Architecture-Programming Applications by Ramesh S. Gaonkar, 5th edition, 1998 , Prentice Hall.
7. Power System Analysis, Stevenson and Grainger, 1994, Mc-Graw Hill
8. Electric Energy Systems Theory an Introduction, O. I. Elgerd, TMH, 1973.
9. Power Electronics, M. D. Singh, K. B. Khanchandani, TMH, Delhi, 2001.
10. I. J. Nagrath & Gopal, “Control systems Engineering,” 4th ed., New Age International Publication.
11. K. Ogata, “Modern Control Engineering,” 3rd ed., Pearson Education

Gaps in the syllabus (to meet Industry/Profession requirements): N/A

POs met through Gaps in the Syllabus: N/A

Topics beyond syllabus/Advanced topics/Design: N/A

POs met through Topics beyond syllabus/Advanced topics/Design: N/A

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	(60)
Attendance Marks	12
Day-to-day performance Marks	06
Lab Viva marks	20
Lab file Marks	12
Lab Quiz-I Marks	10
End SEM Evaluation	(40)
Lab Quiz-II Marks	10
Lab performance Marks	30

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	1	1	1		3		3	2	2	1
CO2	3	3	3	3	3	1	1	1		3		3	2	2	1
CO3	3	3	3	3	3	1	1	1		3		3	2	2	1
CO4	3	3	3	3	3	1	1	1		3		3	2	2	1
CO5	3	3	3	3	3	1	1	1		3		3	2	2	1

Correlation Levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods:

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD5, CD9
CD2	Tutorials/Assignments	CO2	CD1, CD5, CD9
CD3	Seminars/ Quiz (s)	CO3	CD1, CD5, CD9
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD5, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation	CO5	CD1, CD5, CD9

7th and 8th Semester B.Tech. Course Syllabus CBCS

Program Core (PC)	EE354 Electrical Workshop
Program Elective (PE)	1. Program Elective – IV 2. Program Elective – V 3. Program Elective V Laboratory
	EE400 Research project / Industry Internship

COURSE INFORMATION SHEET

Course Code: EE 354

Course Title: Electrical Workshop

Pre-requisite(s): Knowledge of electrical machine, switchgear, and protective devices, and circuit & symbols.

Co- requisite(s):

Credits: L: 0 T: 0 P: 3 C:2

Class schedule per week: 03

Class: B. Tech.

Semester / Level: Sixth

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

A.	Understand the concept of Indian Electricity Rules, Safety precautions, First Aid, Tools, Measuring Instruments and Specifications
B.	Design and construct Single Phase Transformer;
C.	Design, construct, and explain different types of circuits for domestic, and commercial electrification;
D.	Design, construct, and test various types of Relay Logic Circuits used in industries.

Course Outcomes

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

1.	Understand about Indian Electricity Rules, Safety measures, Symbols, Circuits, Electrical components, and Specifications.
2.	Design, and construct small transformers, and methods to test their performance
3.	Design, and construct light, and power circuits for domestic and commercial electrification and relay logic circuits for industrial application
4.	Identify and troubleshoot the problem.
5.	Develop complete practical knowledge to become successful practicing engineer, maintenance engineer and design engineer.

List Of Experiments (The experiment list may vary to accommodate recent development in the field)

Name: Study of IER, First Aid, Measuring instruments, tools, and symbols.

Aim:

(a)Introduction to safety precautions, elementary first aid, and treatment of electrical shocks.

(b) Introduction to Tools, Measuring instruments, and symbols of electrical components, and devices.

(c) Introduction to Indian Electricity Rules pertaining to domestic electrification, industrial electrification, and earthing.

Name: Cable Jointing

Aim: Different types of joints of conductors: Splice joint, Britannia joint, married joint, and sleeve joint.

Name: Testing and troubleshooting of motor and cables.

Aim: Testing and troubleshooting of induction motor. DC motor, Transformer, and Cable. Continuity Test Insulation resistance test between phase winding and phase winding to earth. Polarity Test.

Name: Domestic Electrical circuits

Aim: Explain with the help of circuit diagram. How the single-phase supply enters the energy meter and leaves the distribution load with one light sub circuit and power sub circuit.

Name: Domestic field circuit

Aim: Draw a schematic and construct the following arrangements. Switch on and off a lamp, a fan, a call bell and switch on and off a lamp from two places.

Name: Starter for Induction motor

Aim: In a workshop a 5H.P., 400V and 50 Hz 3-phase squirrel cage induction motor needs to be run with Interlock switches. Suggest a automatic starter and construct it.

Name: Starter to run motor in both directions

Aim: Construct a starter to run above motor in both directions manually with the help of a push button or automatically using limit switches. Also interlock the operation of another motor with main motor.

Name: Starter for 3-Phase

Aim: To observe Direct online starting of 3-phase induction motor with control circuit.

Name: Design of Small Transformer.

Aim: Design a single phase two winding Transformer suitable for 230/240V, 50Hz having a rating of 100VA. The secondary voltage is 24V. Make suitable assumptions.

Name: Domestic Power Circuit.

Aim: Connect a power socket to power sub-circuit

Textbooks:

1. Testing, Commissioning, Operation and Maintenance of Electrical Equipments-S. Rao, 6th Edition, ISBN- 9788174091858, 8174091858, Khanna Publishers-Delhi.
2. Control of Electrical Machines–Dr.S. K. Bhattacharya, Brijendra Singh, Reprint edition ISBN–9788122418187, 812241818X, New Age International (P) Limited 2016, Publishers.
3. Electrical Design Estimating and Costing–K. B. Rainaand S. K. Bhattacharya, ISBN–8122403368, 9788122403633, New Age International (P) Limited 2010, Publishers.
4. Electrical Installation Estimating and Costing–J. B. Gupta, 9th Edition ISBN–9350142791, 9789350142790, S. K. Kataria & sons, Publishers.

Gaps in the Syllabus (to meet Industry/Profession requirements): PLC Logic.

POs met through Gaps in the Syllabus: NIL

Topics beyond syllabus/Advanced topics/Design: NIL

POs met through Topics beyond syllabus/Advanced topics/Design: NIL

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation Marks	40
End Sem Examination Marks	60

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks					
End Sem Examination Marks					
Assignment					

Course Evaluation:	
Daily individual assessment through viva:	25
Regular evaluation of fair and rough copy:	25
Regularity/Punctuality:	10
Practical examinations:	20
End Sem Viva-voce	20

Indirect Assessment

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2		1	3	3	1	3	2	2	3	3	3
CO2	3	3	3	2	2	1		1	1	2	2	3	2	2	1
CO3	3	3	3	3	3	3	1	2	2	2	3	3	3	2	3
CO4	3	3	3	3	3	3	1	1	2	2	2	3	3	1	2
CO5	3	3	3	3	3	3	3	3	2	2	2	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	**Course Delivery Methods**	**Course Outcome**	**Course Delivery Method Used**
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD4 and CD 5
CD2	Tutorials/Assignments	CO2	CD1, CD4 and CD5
CD3	Seminars	CO3	CD1, CD3, CD4, CD5 and CD6
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD4 and CD5
CD5	Laboratory Experiments/Teaching Aids	CO5	CD4 and CD5
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Program Electives

	Pre-requisites	Course Code	Subjects	Credits
PE-I	Basics of Electronics & Communication Engineering	EE357	Electronic Devices and Analog Circuits	3
	Electrical Measurement & Instrumentation	EE413	Sensors and Transducers	3
	Basics of Electronics & Communication Engineering	EE417	Fundamentals of Communication System	3
PE-II	Mathematics	EE449	Artificial Intelligence for Electrical Engineering	3
	Mathematics	EE447	Machine Learning	3
	Basic Electrical Engineering	EE365	Introduction to Sustainable Energy	3
	Basic Electrical Engineering	EE463	Specifications & Estimation of Electrical Installations	3
	Control Theory	EE425	Robotics	3
PE-III	Mathematics	EE519	Computational Techniques in Electrical Engineering	3
	Electrical Measurement & Instrumentation	EE415	Bioinstrumentation and concepts	3
	Electrical Machines	EE465	Electrical Machine Design	3
PE-IV	DC Machine and Transformers; AC Rotating Machines	EE419	Special Electrical Machines	3
	Basics of Electrical Engineering; Electric Power Transmission and Distribution	EE443	Utilization of Electrical Power	3
	Basics of Electrical Engineering; Basics of Electronics & Communication Engineering	EE573	Embedded Systems and Applications	3
	Electric Power Transmission and Distribution; Power System Analysis	EE531	EHV AC Power Transmission	3
	Basics of Electrical Engineering; Electrical Measurement & Instrumentation; Engineering Electromagnetics	EE593	High Voltage Engineering	3
	Electric Power Transmission and Distribution; Power System Analysis; Power Electronics	EE535	HVDC and FACTS	3
	Electrical Machines, Switchgear, and Protection	EE461	Testing & Commissioning of Electrical Equipment	3
	Electric Power Transmission and Distribution; Power System Analysis	EE539	Power System Dynamics	3

	DC Machine and Transformers; AC Rotating Machines; Power Electronics	EE629	Hybrid Electric Vehicle	3
	Electric Power Transmission and Distribution; Power System Analysis; Power Electronics	EE605R1	Micro-Grid Operation and Control	3
PE-V	Power Electronics; Control Theory	EE437	Industrial Drives and Control	3
	Control Theory	EE439	Applied Control Theory	3
	Electric Power Transmission and Distribution; Power System Analysis	EE441	Computer-Aided Power System Analysis	3
	Power Electronics	EE507	Advanced Power Electronics	3

PROGRAM ELECTIVE – I

COURSE INFORMATION SHEET

Course code: EE357

Course Title: Electronic Devices and Analog Circuits

Pre-requisite(s): Basic Electronics

Corequisite(s): Circuit Theory, Basic electrical

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B.TECH.

Semester / Level: 5^{th} / 3

Branch: EEE

Name of Teacher:

Course Objectives:

This course envisions to impart to students to:

A.	Understand the structure of basic electronic devices.
B.	Analyze the dynamic performance of Diode, BJT, MOSFET.
C.	Compare dynamic performance of amplifiers in different configuration.
D.	Design circuits for obtaining the characteristics of amplifier gain and frequency response.
E.	Evaluate design cost of an embedded system using oscillator based clock.

Course Outcomes:

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

1.	To describe method of switching of basic electronic devices.
2.	Analyze the dynamic switching characteristics of Diode, BJT, MOSFET.
3.	Compare the time domain and frequency domain response of different amplifiers.
4.	Design proper circuits for obtaining desired amplification and signal of desired frequency.
5.	Optimize the cost of an embedded system using various amplifiers and oscillators.

SYLLABUS:

MODULE – I

PN JUNCTION DEVICESPN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diode characteristics- Zener Reverse characteristics – Zener as regulator.

MODULE – II

TRANSISTORS AND THYRISTORSBJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT –Structure and characteristics.

MODULE – III

ANALOG AMPLIFIERSBJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

MODULE – IV

MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER Bi CMOS cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – FET, input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

MODULE – V

FEEDBACK AMPLIFIERS AND OSCILLATORS Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

Textbook:

1. David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5^{th} edition 2008.
2. Robert L.Boylestad, "Electronic devices and circuit theory", Prentice Hall, 2002.

Reference Book:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition, 2014.
2. R. A. Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson, 4th Edition, 2000

Gaps in the syllabus :

Common Mode Noise Mitigation in OPAMP,

POs met through Gaps in the Syllabus: PO (4)

Topics beyond syllabus/Advanced topics/Design :

Assignment: Filter design for common mode noise mitigation in opamps.

POs met through Topics beyond syllabus/Advanced topics/Design: PO (4)

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5

Indirect Assessment

1. Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	2	2	2	2	1	1	1	1	3	2	2
CO2	3	3	3	3	2	2	2	2	2	2	1	1	3	3	2
CO3	3	3	3	3	3	3	3	3	3	2	2	2	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	arning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: EE413
Course Title: Sensors and Transducers
Pre-requisite(s): Basic electrical, Physics
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 03
Class: B. Tech.
Semester / Level: Fourth
Branch: Electrical & Electronics Engineering
Name of Teacher:

Course Objectives

This course envisions imparting to students the:

A.	Importance of sensor and transducer
B.	Identification of mechanical and electromechanical sensor
C.	Familiarity with thermal, radiation and magnetic sensor
D.	Application of sensor
E.	Recent trend in sensor technology

Course Outcomes

After the completion of this course, students will be:

1.	Familiar with different types of sensors and transducers
2.	Able to analyze the performance characteristics
3.	Able to identify the particular sensor relevant to the area of application
4.	Capable of integrating various engineering principles to design suitable sensors
5.	Able to find the current trends of sensor

SYLLABUS

Module – I

Basic idea of sensors and transducers, Principles of operation and their classification, Characteristics of sensors. Conventional sensors Type: Based on Resistive principles- Potentiometer and Strain Gauge. Based on Inductive principles- Ferromagnetic Plunge type, LVDT. Based on capacitive principles- The parallel plate capacitive sensor, Variable Permittivity Capacitive Sensor Electrostatic and Piezoelectric Transducers, Quartz Resonators and Ultrasonic Sensors. Based on Magnetic principles: Magneto resistive, Hall effect, Inductance and Eddy current sensors. Electromagnetic Flow meter. [10]

Module – II

Thermal Sensors: Acoustic Temp Sensor, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type thermometric sensor, Thermo emf, Junction Semiconductor Types, Thermal Radiation, Quartz Crystal. Radiation Sensors: Basic Characteristics, Photo-emissive Cell and Photomultiplier, Photoconductive Cell- Photovoltaic and Photojunction Cell, Position-Sensitive Cell Fibre Optic Sensors. [10]

Module – III

Smart Sensors: Introduction, Primary Sensors Excitation, Amplification, Fitters, Converters, Compensation, Information Coding/Processing.
[7]

Module – IV

Recent trends in sensor technologies: Introduction, Film Sensors, Semiconductor IC technology, Micro-electromechanical System (MEMS), Nano Sensors, Application of Sensors: Automotive Sensors, Home Appliance Sensors, Aerospace Sensors.
[8]

Module – V

Digital Transducers: Digital Encoder, Shaft Encoder, Switches: Pressure, Level, Flow, Temperature, Proximity Switches, Limit Switches and its types, Isolators (or Barriers). [7]

Textbooks:

1. Sensors and Transducers, 2nd Edition by D. Patranabis, 2nd edition, PHI Learning Pvt. Limited, New Delhi.
2. Instrumentation and control, D Patranabis, PHI Learning Pvt. Limited, New Delhi, 2011.

Reference Books:

1. Electronics instrumentation by H. S. Kalsi, TMH.
2. Electrical & Electronics Measurements and Instrumentation by A. K. Shawhney, Dhanpat Rai & Sons.

Gaps in the Syllabus (to meet Industry/Profession requirements)

- Field applications of sensors.
- Concept of telemetering.
- Usage of LabVIEW, MATLAB and other modern tools.
- Interfacing of data for processing and analysis

POs met through Gaps in the Syllabus

3, 4, 5, 12, 15

Topics beyond syllabus/Advanced topics/Design

- Transmitters and receivers
- Tele-metering
- Usage of modern tools

POs met through Topics beyond syllabus/Advanced topics/Design

2, 3, 5, 12,15

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course outcome	**Program outcome**												**Program specific outcome**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	2	1	2	3	3	1	1			2	3	3	2
CO2	3	3	3	1	2	1	1	1	1			2	3	3	2
CO3	3	3	3	2	3	2	2	2	1	1	1	3	3	3	3
CO4	3	3	3	3	3	2	2	2	2	1	1	2	3	3	3
CO5	3	3	3	3	3	2	3	2	3	2	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	**Course Delivery Methods**	**Course Outcome**	**Course Delivery Method Used**
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: EE417

Course Title: Fundamentals of Communication System

Pre-requisite(s): Good understanding of mathematical tools like integration, differentiation etc.

Co- requisite(s):

Credits: L: 3 T: 0 P: 0 C:3

Class schedule per week: 03

Class: B. Tech.

Semester / Level:

Branch: Electronics & Electronics Engineering

Name of Teacher:

Course Objectives

This course enables the students:

A.	Explain communication systems and representation of signals.
B.	Explain different methods of analog modulation and demodulation schemes, their design, operation and applications.
C.	Explain different methods of digital modulation and demodulation schemes, their design, operation and applications.
D.	Evaluate the performance of communication system in the presence of noise.

Course Outcomes

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

1.	Demonstrate an understanding on communication system and representation of signals.
2.	Demonstrate an understanding on different methods of amplitude modulation and demodulation schemes, their design, operation and applications.
3.	Demonstrate an understanding on different methods of angle modulation and demodulation schemes, their design, operation and applications.
4.	Demonstrate an understanding on different methods of digital modulation, their design, operation and applications.
5.	Evaluate the performance of communication system in the presence of noise.

Syllabus

MODULE–I

Representation of Signals and Systems: Fourier series, Fourier Transform, Properties of Fourier Transform, Signal power and power spectral density, Signal energy and energy spectral density, Dirac delta function and its applications, Elements of a Communication system, Block diagram of digital communication system. [10]

MODULE–II

Amplitude Modulation Systems: Basics of Amplitude modulation, Square law modulator, Switching modulator Square law demodulator, Envelop Detector, Double side band suppressed carrier modulation. Balanced and Ring Modulators, Coherent modulator, Single side band modulation, Frequency Discrimination and phase discrimination modulators, Coherent detection of SSB, Introduction to Frequency Division Multiplexing and Time Division Multiplexing, Superheterodyne AM receiver and its characteristics. [7]

MODULE–III

Angle modulation-demodulation communication systems: Basic of Frequency and phase modulation, Singleton frequency modulation, NBFM, WBFM, Transmission band width of FM wave, Indirect and Direct methods of FM generation, Frequency Discriminator, phase locked Loop demodulator, Superheterodyne FM. receiver.
[7]

MODULE–IV

Digital Modulation Techniques: Sampling Quantization, PCM, DPCM, DM, ADM, Binary modulation, generation and detection of binary modulated wave, DPSK, QPSK, Matched filter, satellite Communication System, Transponder.
[10]

MODULE–V

Noise: Short Noise, Thermal noise, White Noise, Noise figure, Noise figure of an amplifier, Noise figure of amplifiers in cascade, Noise temperature, Noise Equivalent Bandwidth, Noise due to several amplifiers in cascade.
[6]

Textbooks:

1. Simon Haykin, “Communication Systems”, Wiley Eastern Limited, New Delhi, 2016, 2/e.
2. B. P. Lathi and Zhi Ding, “Modern Digital and Analog Communication Systems”, OxfordUniversityPress,2011,4/e, (Indian Edition)

Reference books:

1. John G. Proakis and Masoud Salehi, “Fundamentals of Communication Systems” Pearson Education, Inc., NewDelhi,2013.
2. Bruce Carlson and Paul B. Crilly, “Communication Systems: An Introduction to signals andNoise in Electrical Communication”, Tata McGraw Hills Education Pvt. Ltd., New Delhi,2011, 5/e.

Gaps in the syllabus (to meet Industry/Profession requirements): Nil

POs met through Gaps in the Syllabus: Nil

Topics beyond syllabus/Advanced topics/Design: Nil

POs met through Topics beyond syllabus/Advanced topics/Design: Nil

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects

Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Mid Semester Examination Marks	25
Quiz (s)	20 (10x2)
Teacher Assessment	05
End Semester Examination Marks	50

Indirect Assessment –

1. Student Feedback of Faculty
2. Student Feedback of Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	**Program Outcomes**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	3	2	2	1	-	-	-	-	-	-	-	2	-	3	2
2	3	3	3	3	2	-	-	-	-	-	-	1	-	3	2
3	3	3	3	3	2	-	-	-	-	-	-	1	-	3	2
4	3	3	3	3	2	-	-	-	-	-	-	1	-	3	2
5	3	3	3	3	3	-	-	-	-	-	-	1	-	3	2

CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1 and CD8
CD2	Tutorials/Assignments	CO2	CD1 and CD8
CD3	Seminars	CO3	CD1 and CD8
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

PROGRAM ELECTIVE - II

Course Code: EE 449

Course Title: Artificial Intelligence for Electrical Engineering

Pre-requisite(s): MA 103 (Mathematics I), MA 107 (Mathematics II)

Syllabus

Module - I

Introduction to Artificial Intelligence: Introduction, Definition of Artificial Intelligence, Importance of Soft Computing, Main Components of Soft Computing: Fuzzy Logic, Artificial Neural Networks, Introduction to Evolutionary Algorithms, Hybrid Intelligent Systems, Single and multi-objective optimization.

Module II

Artificial Neural Network and Supervised Learning: Introduction, Artificial Neuron Structure, ANN Learning; Back-Propagation Learning, Properties of Neural Networks, Generalized Neuron Models, Factors Affecting the Performance of Artificial Neural Network Models, Application of GN Models to Electrical Machine Modeling, Electrical Load Forecasting Problem: Short Term Load Forecasting Using Generalized Neuron Model, Aircraft Landing Control System Using GN Model.

Module III

Introduction to Fuzzy Set Theoretic Approach: Introduction, Uncertainty and Information, Types of Uncertainty, Introduction of Fuzzy Logic, Fuzzy Set, Operations on Fuzzy Sets, Fuzzy Intersection, Fuzzy Union, Fuzzy Complement, Fuzzy Concentration, Fuzzy Dilation, Fuzzy Intensification, α-Cuts, Characteristics of Fuzzy Sets, Demorgan’s Law, Fuzzy Cartesian Product, Various Shapes of Fuzzy Membership Functions, Methods of Defining of Membership Functions, Fuzzy Relation, Defuzzification Methods.

Module IV

Applications of Fuzzy Rule Based System: Introduction, System’s Modeling and Simulation Using Fuzzy Logic Approach, Selection of Variables, their Normalization Range and the Number of Linguistic Values, Selection of Shape of Membership Functions for Each Linguistic Value, Selection of Fuzzy Union and intersection Operators, Selection of Defuzzification Method, Steady State D.C. Machine Model, Transient Model of D.C. Machine, Fuzzy Control System, Power System Stabilizer Using Fuzzy Logic.

Module V

Genetic Algorithms: Introduction, Crossover, Mutation, Survival of Fittest, Population Size, Evaluation of Fitness Function, Applications of Artificial Neural Network, Genetic Algorithms and Fuzzy Systems for Power System Applications: voltage control, voltage stability, security assessment, feeder load balancing, AGC, Economic load dispatch, Unit commitment, Condition monitoring.

Reference Books:

1. S. Rajasekaran, G. A. Vijayalakshmi, Neural Networks, Fuzzy logic and Genetic algorithms, PHI publication.
2. Chaturvedi, Devendra K, Soft Computing Techniques and its Applications in Electrical Engineering, Hardcover ISBN:- 978-3-540-77480-8, Springer.
3. Kalyanmoy Deb, Optimization for Engineering Design, PHI publication
4. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, Willey Publication
5. Kevin Warwick, Arthur Ekwue, Rag HYPERLINK "https://www.amazon.in/s/ref=dp_byline_sr_book_3?ie=UTF8&field- author = Rag + Aggarwal & search-alias = strip books" Aggarwal, Artificial intelligence techniques in power systems. IEE Power Engineering Series-22.

COURSE INFORMATION SHEET

Course Code: EE447

Course Title: Machine Learning

Pre-requisite(s): MA 103 (Mathematics I), MA 107 (Mathematics II).

Co- requisite(s):

Credits: L 3; T 0; P 0

Class schedule per week: 04 Class: B. Tech.

Semester / Level: Fifth / Third

Branch: Electrical & Electronics Engineering

Name of Teacher:

Course Objectives:

The course objective is to provide students with ability to:

A.	Understand the principles, design and implementation of different machine learning algorithm grams that improve their performance on some set of tasks with experience.
B.	To illustrate and summarize the technique of machine learning algorithms for program synthesis.
C.	To Identify, formulate and solve machine learning problems for practical applications in power and control.
D.	To develop adaptive laws for hybridization of new model from the existing machine learning algorithms.

Course Outcomes:

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

1	Understand the current state of the art in machine learning and be able to begin to conduct original research in machine learning.
2	Comprehend of machine learning algorithms and their use in data-driven knowledge discovery and program synthesis.
3	Identify, formulate and solve machine learning problems that arise in practical applications.
4	Develop new hybrid model from the existing machine learning algorithms.

Syllabus

Module I

Introduction: Introduction to Machine Learning, The concept Learning task, General-to- specific ordering of hypotheses, Version spaces, Inductive bias, Over-fitting, Cross-Validation, Machine Learning Applications.
[10]

Module II

Probabilistic Models: Maximum Likelihood Estimation, MAP, Bayes Classifiers, Minimum description length principle, Bayesian Networks, Inference in Bayesian Networks, Bayes Net Structure Learning. [8]

Module III

Supervised learning: Decision Tree Learning, Instance-Based Learning: k-Nearest neighbor algorithm, Support Vector Machines, Support vector machines for classification and regression, Kernel methods, Basic of Artificial Neural Networks, Linear threshold units, Perceptron's, Multilayer networks and back-propagation. Ensemble learning: Boosting, Bagging, Random Forest.
[10]

Module IV

Unsupervised learning: K-means and Hierarchical Clustering, Fuzzy-C-means, Gaussian Mixture Models, EM algorithm, Hidden Markov Models.
[10]

Module V

Computational Learning Theory: Probably Approximately Correct (PAC) learning, Sample complexity, Computational complexity of training, Vapnik-Chervonenkis (VC) dimension, Reinforcement Learning. [8]

Reference Books:

1. Tom Mitchell. Machine Learning. McGraw Hill, 1997.
2. Christopher M. Bishop. Pattern Recognition and Machine Learning. Springer 2006.
3. Richard O. Duda, Peter E. Hart, David G. Stork. Pattern Classification. John Wiley & Sons, 2006.
4. E. Alpaydin, Introduction to Machine Learning, Prentice Hall of India, 2006.

Gaps in the Syllabus (to meet Industry/Profession requirements)

- Application of principles of machine learning in the area of electrical engineering.
- State-of-the-art Machine Learning techniques and how to apply them
- Emphasize how Machine Learning can be used to provide insights and create value from data.

POs met through Gaps in the Syllabus 3, 4, 12

Topics beyond syllabus/Advanced topics/Design

Recent trends in deep learning and representation learning

Natural language processing

POs met through Topics beyond syllabus/Advanced topics/Design: 2, 3, 4, 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10

Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2	3	2	3
CO2	3	3	3	1	3	1	1	1				2	3	2	3
CO3	3	3	3	3	3	1	2	2		1	1	2	3	2	3
CO4	3	3	3	1	3		1	1		1	1	2	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	**Course Delivery Methods**	**Course Outcome**	**Course Delivery Method Used**
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD3 and CD4
CD5	Laboratory Experiments/Teaching Aids		
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course code: EE365

Course Title: Introduction to Sustainable Energy

Pre-requisite(s): Mathematics, Basic Electrical Engineering, Physics

Syllabus

Module 1: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. [4]

Module 2: Introduction of PV cells, panels and their working. Performance of PV plants in different scenarios. [8]

Module 3: Introduction of wind energy, panels and their working. Working principle of different types of wind turbines and their operations. [10]

Module 4: Introduction of Energy storage (ESS), and their requirements. Working principle of different types of ESS and their operations. Introduction of Fuel cell and their working principle. [8]

Module 5: Integration of distributed generators to the existing system. Control and operation of various renewable energy resources. [8]

Textbook/References

1. Photovoltaics Fundamentals, Technology, and Practice, Konrad Mertens, Wiley, 2018, ISBN No. 13: 978-1119401049.
2. Bent Sørensen, Renewable Energy, AP , Fifth Edition
3. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, OXFORD , Third Edition

COURSE INFORMATION SHEET

Course Code: EE463

Course Title: Specifications & Estimation of Electrical Installations

Pre-requisite(s): Basic electrical

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: Fourth

Branch: Electrical & Electronics Engineering

Name of Teacher:

Course Objectives

This course envisions imparting to students the:

A.	Concept of electrical wiring
B.	Identification of the load distribution
C.	Familiarity with selection of conductors, switching and protection elements
D.	Estimation of electrification
E.	Knowledge, specification and planning of transmission and distribution lines.

Course Outcomes

After the completion of this course, students will be:

1.	Familiar with electrical wiring, planning and estimation.
2.	Able to analyze the electrical load distribution
3.	Able to estimate the costing of electrification for residential, commercial, and industrial.
4.	Capable of designing and implementation of electrical wiring.
5.	Able to understand the technical and commercial bid for transmission and distribution system.

SYLLABUS

MODULE – I

Interior Wiring System: Different wiring systems, Comparison of the various systems, Choice of wiring systems. Adequate lighting, Earthing, Materials used for the electrification, Estimation of wiring installations.

[10]

MODULE – II

Power Installation: Load calculations, Wire size selection, Power circuit wiring materials used and their specifications Estimation for motor installation, Pump-sets, Workshops, and theatre.
[12]

MODULE – III

Transmission and Distribution Lines: Planning and surveying, Applicable IE rules, Materials required for 400 kV, 11 kV, and 400 V lines. Estimates of 400 kV, 11 kV lines, and 400 Volts/230 Volts distribution system, Distribution transformer installation, and estimation.
[8]

MODULE – IV

Specification: Importance of specification, ISI specification of alternators, Transformers, Induction motors, Circuit breakers, Panels for transformers, Overhead line conductors, Insulators.
[7]

MODULE – V

Underground cables: types, ratings, testing, and applications. Storage batteries and earthing electrodes. [6]

Textbooks:

1. Surjit Singh, Electrical Estimating and Costing
2. Dharmpal Rai & K.R. Gangadhar Rao, Electrical Estimating & Energy Management

Gaps in the Syllabus (to meet Industry/Profession requirements)

- Coordination with civil work.
- Testing of electrical installation.
- Usage of software and other modern tools for optimized estimation of wiring.

POs met through Gaps in the Syllabus

3, 4, 5, 12, 15

Topics beyond syllabus/Advanced topics/Design

- Transmitters and receivers
- Tele-metering
- Usage of modern tools

POs met through Topics beyond syllabus/Advanced topics/Design

2, 3, 5, 12, 14, 15

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course outcome	Program outcome											Program specific outcome		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	2	1	2	3	3	1	1			2	3	1	2
CO2	3	3	3	1	2	1	1	1	1			2	3	1	2
CO3	3	3	3	2	3	2	2	2	1	1	1	3	3	1	3
CO4	3	3	3	3	3	2	2	2	2	1	1	2	3	1	3
CO5	3	3	3	3	3	2	3	2	3	2	2	2	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, and CD 8
CD2	Tutorials/Assignments	CO2	CD1, CD2, and CD9
CD3	Seminars	CO3	CD1, CD2, CD3, and CD7
CD4	Mini Projects/Projects	CO4	CD4, CD7, and CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, and CD6
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code: EE381

Course Title: Electrical Engineering Materials

Pre-requisite(s): Basic knowledge of Physics, Chemistry and Material science

Module 1:

Recapitulation of Atomic structure: Rutherford's and Bohr's Model of Hydrogen atom; Nuclear binding energy and mass defect. Review of wave nature of matter: Schrödinger equation, Wave mechanical theory of atomic structure; Different Energy states. Review of different types of Bonding: Stable interatomic distance; Ionic, covalent, metallic and Van der Waals Bonding. Crystal Structures: crystal defects. Electron energy levels Band theory of solids; Conductors, Insulators, and Semiconductors. [8]

Module 2:

Properties of Insulating materials: Mechanical, Chemical and Thermal; Electrical properties: Volume Resistivity, Surface resistivity, Dielectric constant, Dielectric dissipation factor, Breakdown voltage and Dielectric strength. Dielectric polarization: Polar and non-polar dielectrics; Electronic, Ionic and Dipole polarization; Classification of dielectrics by polarization mechanism; Dielectric polarization and relative permittivity. Relaxation models: Brief overview; Introduction to Electrets. [8]

Module 3:

Gaseous dielectrics: Pure and mixed gases, Applications. Liquid dielectrics: Natural and synthetic dielectrics; Transformer oil, Ester oils, Factors influencing dielectric properties of liquids. Solid insulating materials: Natural and synthetic resins; elastomers; fibrous materials; Ceramic materials; mica and micanites. Varnishes, compounds, oil-paper insulation, and impregnating process. Composite insulating materials: Advantages of using composite insulation; Concept of reinforced materials; Base and filler materials; Applications. Polymer Dielectrics and Applications, cross linked polyethylene [8]

Module 4:

Magnetic Materials: Atomic interpretation of ferromagnetic materials, Atomic exchange force, crystallographic forces, magnetic anisotropy, magnetostriction, Curie-Weiss law, Curie law, Curie temperature of ferromagnetic materials, soft magnetic material, CRGO, Ni-Fe alloy and applications, hard magnetic materials Alnico, Alcomax and application. Ferrite-ferromagnetic materials and their applications, Piezo-electric materials. [8]

Module 5:

Super Conductivity: Theory of super conductivities, critical field, critical current density, transition temperature normal and superconductivity steps, types of super conductor, high temperature superconductor and applications. [4]

Reference Books:

1. Electrical Engineering Material by A.J. Dekker.
2. Electrical Engineering Material by B.M. Tareev.
3. Dielectric Materials and applications by A. Von Hipple.
4. High voltage Engineering by Zaengl and Kuffel

COURSE INFORMATION SHEET

Course code: EE425

Course Title: Robotics

Pre-requisite(s): Engineering Mathematics, Signals and system, Control Theory, Basic programming knowledge.

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: Third

Branch: Electrical and Electronics Engineering

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

A.	Outline fundamentals of robotics and discuss different types of sensors and basic programming languages used for robotics
B.	Describe direct and inverse kinematics of robots and to illustrate techniques used for planning robot motions in order to solve meaningful manipulation tasks.
C.	Explain different methods for control of robotic manipulators.
D.	Appraise the use of robotic vision in different field of robotics and compile all the techniques discussed.
E.	Upgrade themselves in the area of state-of-the-art techniques in the field of robotics.

Course Outcomes

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

1.	enumerate characteristics of robots, sensors used and basic programming languages
2.	visualize and associate direct and inverse kinematics to real life problems.
3.	to explain and analyse different techniques for planning robot motions and control of robotic manipulators
4.	assess the techniques of computer vision necessary in the field of robotics
5.	solve real life problems based on direct and inverse kinematics and simulate different controllers.

Syllabus

Module–I

Introduction of Robotics: Evolution of Robots and Robotics. What is and what is not a robot? Robot classification. Robot specifications. Robot applications. Direct Kinematics: Coordinate frames; Rotations; Homogeneous coordinates; D-H representation; The Arm Equation **Inverse Kinematics:** Inverse kinematics problem. General properties of solutions. Tool configuration. Robotic work cell.

Module–II

Workspace Trajectory and Trajectory Planning: Workspace analysis. Workspace envelop. Workspace fixtures. Pick and place operation. Continuous-path motion. Interpolated motion. Straight line motion.

Module–III

Sensing and Control of Robot Manipulators: Computed torque control; Near Minimum time control; Variable structure control; Non-Linear decoupled feedback control; Resolved motion and Adaptive control. **Robotic Sensors:** Different sensors in robotics: Range; Proximity; Touch; Torque; Force and others.

Module–IV

Robotic Vision: Image acquisition. Imaging geometry, Image processing: Pre-processing; Segmentation and Description of 3-D structures; Recognition and interpretation.

Module–V

Robot Programming Languages: Characteristics of Robot level languages. Task level languages: Task planning; Problem reduction; Use of predicate logic; Robot learning; Expert systems.

Textbooks:

1. Fundamental of Robotics: Analysis and Control- Robert J. Schilling.
2. Robotics: Control, Sensing, Vision and Intelligence- K. S. Fu, R. C. Gonzalez and Lee.

Reference books:

1. Robotics and Control–R. K. Mittal and I. J. Nagrath.

Gaps in the syllabus (to meet Industry/Profession requirements)

Simulation to meet real time implementation of techniques for control of robots.

POs met through Gaps in the Syllabus: 2, 3, 5, 12.

Topics beyond syllabus/Advanced topics/Design

Simulation given to students as assignments.

POs met through Topics beyond syllabus/Advanced topics/Design: 9, 10

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25

Second Quiz	10
Teacher’s Assessment	5
End Semester Examination	50

Indirect Assessment –

Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	2			2							3	3	2
CO2	3	3	3		2	1			2				3	3	2
CO3	3	2	3		2	2			3	3		2	3	3	3
CO4	2	2	2	3	2	3			3	3		3	3	3	3
CO5	2	2	2						2	2			3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors	CO1	CD1, CD6
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3, CD4, CD5
CD3	Seminars	CO3	CD1, CD6
CD4	Self- learning such as use of NPTEL materials and internets	CO4	CD1, CD2, CD3, CD4, CD5
CD5	Simulation	CO5	CD1, CD2, CD3, CD4, CD5

PROGRAM ELECTIVE - III

Course code: EE519

Course title: Computational Techniques in Electrical Engineering

Pre-requisite(s): Basics of signals and systems, Digital Signal Processing, Filter theory.

Syllabus

Module I

Introduction to Scientific Computing: Solution Of Non-Linear Equations, Numerical Solution Of Ordinary Differential Equation, Public-Domain Software Tools, Optimization Overview, Gradient-Based Methods, Linear Programming, Constrained Optimization Algorithm, Multi- Objective Optimization.

Module-II

Introduction to Computational Intelligent Techniques: Introduction, Definition and importance of Computational intelligent Techniques, Main Components of Computational intelligent Techniques: Fuzzy Logic Artificial Neural Networks, Swarm and Evolutionary Algorithms, Hybrid Intelligent Systems.

Module - III

Artificial Neural Network and Applications: Introduction, Artificial Neuron Structure, ANN Learning: Back-Propagation Learning, Unsupervised Learning, Radial Basic Function (RBF), Support Vector Machine (SVM), Recurrent Neural Network, Deep Neural Network.

Module IV

Fuzzy Logic, Evolutionary Algorithms and Applications: Introduction Of Fuzzy Logic, Fuzzy Cartesian Product, Fuzzy Relation, Defuzzification Methods, System's Modelling And Simulation Using Fuzzy Logic Approach, Selection of Defuzzification Method, Fuzzy Control System. Genetic Algorithm, Particle Swarm Optimization, Other Recent Heuristic Optimization Techniques. 8L

Module-V

Applications of Computational Techniques to Electrical Engineering: Applications of Artificial Neural Network, Genetic Algorithms, Fuzzy and Hybrid Systems In Power System Applications: Economic Load Dispatch, Unit Commitment, Condition Monitoring. Short Term Electrical Load Forecasting Applications of Soft Computing Techniques In Power Electronics And Control Applications. 8L

Textbooks:

l. Neural Networks: A Comprehensive Foundation - Simon Haykin, IEEE, Press, MacMillan, N.Y 1994.
2. S. Rajasekaran, G. A. Vijayalakshmi, Neural Networks, Fuzzy logic and Genetic algorithms, PHI publication.
3. Fuzzy logic with Engineering Applications – Timothy J. Ross, McGraw-Hill International Editions.
4. Fuzzy Sets and Fuzzy logic:- Theory and Applications - George J. Klir and Bo. Yuan, Prentice- Hall of India Private Limited.

Reference Books:

1. Chaturvedin Devendra K, Soft Computing Techniques and its Applications in Electrical Engineering, Hardcover ISBN:- 97-8-3-540-77480-8, Springer.
2. Kalyanmoy Deb, Optimization for Engineering Design, PHI publication
3. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, Willey Publication
4. Kevin Warwick, Arthur Ekwue, Rag Aggarwal, Artificial intelligence techniques in power systems. IEE Power Engineering Series-22.

COURSE INFORMATION SHEET

Course code: EE415

Course Title: Bioinstrumentation and concepts

Pre-requisite(s): Basic Electrical and Electronics measurement

Corequisite(s): Fundamental knowledge of the human physiological system

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. E.

Semester / Level: V

Branch: Electrical and Electronics Engineering

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

A.	To impart knowledge for interdisciplinary, applied engineering and technology.
B.	With respect to design consideration, to understand the standard structure of biomedical instrumentation systems.
C.	To learn the technicality associated with instrumentation and design of basic biosignal and imaging equipment.
D.	To understand the engineering aspects for safety and hazards associated with biomedical instruments.
E.	To make the students able to perform multidisciplinary research for development of healthcare systems.

Course Outcomes

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

1.	Understand the general physiology for man-machine interaction in medical environment.
2.	Understand the fundamentals of the concept and design of biomedical equipment.
3.	Understand the importance of medical data for better healthcare.
4.	Analyse the electrical hazards associated with medical equipment so that the safety equipment can be devised or suggested.
5.	Work in an interdisciplinary team.

SYLLABUS

Module-I

Physiology of cardiac system, pulmonary system, urinary system, nervous system and muscles. Generation and propagation of action potentials in muscle, heart and nervous system.
[8]

Module-II

Electrocardiograph; Electromyograph; Electroencephalograph; Phonocardiograph; Plethysmograph; Pulmonary function test devices; Non-Invasive and Invasive Blood Pressure measurement. [8]

Module-III

Pacemaker; Defibrillator; Anaesthesia machine; Ventilator; Heart-Lung machine; Haemodialysis machine; Audiometry and Hearing aids; Nerve and Muscle stimulators; Therapeutic and Surgical diathermies. [8]

Module-IV

Generation of X-ray; X-ray imaging device; Catheterization system; Computer Assisted Tomography; Generations of Computer Assisted Tomography System. [8]

Module-V

Ultrasound and Doppler equipment; Magnetic Resonance Imaging device; Functional Imaging with Gamma camera; Single Photon Emission Tomography; Positron Emission Tomography. [8]

Textbooks:

1. Textbook of Medical Physiology by A. C. Guyton, 8th edition, Prism Indian Publication, Bangalore, 1991.
2. Handbook for Biomedical instrumentation by R. S. Khandpur, 3rd edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2014.

Reference Books:

1. Medical instrumentation, Application &Design by J. G. Webstar, 4th edition, Wiley Student Edition, New Delhi, 2009.
2. Introduction to Biomedical Equipment Technology by J. J. Kar and J. M. Brown, 4th edition, Pearson India Education Services Pvt. Ltd., Noida, 2016.

Gaps in the Syllabus (to meet Industry/Profession requirements)

- Electrophysiological and metabolic understanding of the vital organs.
- Engineering design concept of biomedical equipment.
- Concepts of signal and image processing.

POs met through Gaps in the Syllabus: 3, 4, 12

Topics beyond syllabus/Advanced topics/Design

- Fundamentals of biochemistry.
- Protective measures in handling with medical equipment.
- Understanding of hospital organization for installation of medical devices.

POs met through Topics beyond syllabus/Advanced topics/Design: 2, 3, 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25

Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2	3	2	3
CO2	2	2	2	1	3	1	1	1				2	2	2	3
CO3	3	2	2	3	3	1	2	2		2	1	2	2	2	3
CO4	3	3	3	1	2		1	1		2	1	2	3	2	3
CO5	3	3	3	3	2	1	1	1	1	1	1	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code: EE465

Course Title: Electrical Machine Design

Pre-requisite(s): Electrical Machines

Module-1

Fundamental Aspects of Electrical Machine Design:

Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques.

Module-2

Design of DC Machines: Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.

Module-3

Design of Transformers: Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.

Module-4

Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No-Load Current and Leakage Reactance.

Module-5

Design of Three Phase Synchronous Machines: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non-salient Pole Rotors. Magnetic Circuit and Field Winding.

Textbooks:

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai & Sons

PROGRAM ELECTIVE - IV

COURSE INFORMATION SHEET

Course code: EE419

Course Title: Special Electrical Machines

Pre-requisite(s): Basic Electronics

Co-requisite(s): Circuit Theory, Basic electrical

Credits: L: 03 T: 0 P: 0

Class schedule per week: 03

Class: B.TECH.

Semester / Level: 6^{th} / 3

Branch: EEE

Name of Teacher:

Course Objectives:

This course envisions to impart to students to:

A.	Explain working principle of different type of special electrical machines such as PMBLDC, SRM, Stepper Motor etc
B.	Analyze the dynamic performance of electrical machines based on mathematical modeling.
C.	Compare dynamic performance in terms of speed response and torque response of different machine.
D.	Design power circuits and protection circuits for the drive system based on special electric machine.
E.	Evaluate design cost of closed loop control based electrical drive system in case of special electrical machine.

Course Outcomes:

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

1.	To describe method of electromagnetic torque generation in electrical machines such as PMBLDC, SRM, Stepper Motor etc
2.	Apply a knowledge of mathematical modeling to develop state space model of PMBLDC machine and SRM.
3.	Compare the transient behavior of different special electric machines.
4.	Design power converters and protection circuits for the drive system based on special electric machine.
5.	Optimize the cost of power converter based electrical drive system for special electrical machine.

Syllabus

MODULE–I

Permanent Magnet Brushless DC Motors: Fundamentals of permanent magnet types-principle of operation magnetic circuit analysis-emf and torque equations. [6]

MODULE–II

Permanent Magnet Synchronous Motor: Principle of operation–EMF and Torque equations, Power controllers, Torque speed characteristics, Digital controllers, Constructional features, operating principle and characteristics of synchronous reluctance motor. [10]

MODULE–III

Switched Reluctance Motors: Constructional features, Principle of operation, torque prediction Characteristics, Power controllers, Control of SRM drive-Sensor less operation of SRM–Applications. [7]

MODULE–IV

Stepper Motors: Constructional features, Principle of operation, Linear and Nonlinear analysis, Characteristics–Drive circuits–Closed loop control–Applications, High-Speed Operation of Stepper- Motors: Pull-out torque/speed, characteristics of Hybrid stepper motors. [10]

MODULE–V

Other Special Machines and Firing and Protection Circuits: Principle of operation and characteristics of Hysteresis motor, Linear motor –Applications. Necessity of isolation, pulse transformer, optocoupler–Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT.– Over voltage, over current and gate protections; Design of snubbers. [10]

Textbook:

1. Gopal Dubey, "Power semiconductor-controlled Drives", Prentice Hall Inc., New Jersey, 1989.
2. Krishnan R., “Electric Motor Drives-Modeling, Analysis and Control”, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
3. E. G. JANARDANAN, “SPECIAL ELECTRICAL MACHINES”, PHI Learning Pvt. Ltd., 01-Jan-2014

Reference Book:

1. Bimal K. Bose, “Modern power electronics and AC drives”, Pearson Education (Singapore) Ltd., New Delhi, 2005.
2. Sheperal, Wand Hully, L. N. "Power Electronic and Motor control" Cambridge University Press Cambridge, 1987.

Gaps in the syllabus: State Estimation methods,

POs met through Gaps in the Syllabus: PO (4)

Topics beyond syllabus/Advanced topics/Design:

Assignment: MRAC based state estimation for permanent synchronous motor.

POs met through Topics beyond syllabus/Advanced topics/Design: PO (4)

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	2	2	2	2	1	1	1	1	3	2	1
CO2	3	3	3	3	2	2	2	2	2	2	1	1	3	2	2
CO3	3	3	3	3	3	3	2	2	2	2	2	1	3	3	2
CO4	3	3	3	3	3	3	3	3	3	2	2	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9

CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE 443

Course Title: Utilisation of Electrical Power

Pre-requisite(s): Knowledge of kinematics, Power electronics, physics, Boolean algebra and Computer programming.

Co- requisite(s):

Credits: L: 3 T: 1 P: 0

Class schedule per week: 03

Class: B. Tech

Semester / Level: VII

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

A.	To explain the requirements of ideal traction supply system, train movement and energy consumption and the various methods of speed control of traction motors.
B.	To outline the knowledge of various methods of heating and welding and their applications.
C.	To list the laws of illumination, sources of illumination, flood lighting and street lighting and outline the knowledge of components of PLC and PLC programming
D.	Recall the knowledge of motor control circuits and their components, interlocking methods, different control methods and their applications.

Course Outcomes

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

1.	Explain the concept of the following: Duty cycle of a train speed control of traction motors
2.	Show a basic understanding of variety of tools and techniques (based on physics) used in heating, welding
3.	Design illumination schemes
4.	Reproduce the knowledge of various methods of motor control and PLC programming.
5.	Solve numerical problems on different engineering topics related to this subject

SYLLABUS

Module–I

Electric Traction: Introduction, Requirements of Ideal Traction System Supply system for electric traction, Train movement Energy consumption. Co-efficient of adhesion, the traction motors starting, Breaking of Traction motors.
[6]

Module–II

Speed Control of Traction Motor: Semiconductor converter-controlled drives of Traction Motor, Chopper controlled DC traction motor drives. PWM Voltage source inverter (VSI) Induction motor drives, load commutated inverter fed synchronous motor drivers, CSI squirrel Cage IM drive, PWM VSI Squirrel cage IM drive. Drives of Diesel Electric Traction Motors: Diesel Engine driven D.C Generator Feeding dc series motors. Diesel Engine driven three-phase alternator supplying dc motors. [8]

Module–III

Heating & Welding: Introduction, Different methods of heating, Temperature control of resistance furnace, Induction heating, Dielectric heating, Electric welding, Different welding methods, current control of welding transformer, Ultrasonic and laser welding. Illumination: Introduction, Nature of radiation, Definitions. Polar curve, Law of Illumination, Luminous Efficacy, Source of light, Incandescent, Vapor, Fluorescent Lighting calculations, Flood lighting, Street lighting.
[10]

Module–IV

PLC: Introduction, Ladder diagram fundamentals of PLC: Introduction, Basic components, and their symbol, Fundamentals of ladder diagram. PLC configurations. System Block Diagram, Update- solve the ladder Network. Fundamental PLC Programming: Physical components Vs. Program components, Internal Relays, Disagreement circuit. Ladder program, Execution sequence, Flip-Flop circuits, Mnemonic programming code: AND ladder rung, entering normally closed contracts, OR ladder rung, Simple branches, Complex branches.
[10]

Module–V

Motor Control Circuit Components, Interlocking methods for reversing control, Sequence control, Schematic and wiring diagram for motor control circuits, Remote control operation of an IM, Motor driven pump for a water tank, automatic water level control, Sequence operation of motors with interlocking arrangements.
[7]

Textbooks:

1. Generation, Distribution and Utilisation of Electric Power, C. L. Wadhwa, Revised Edition, Wiley–1993.
2. Electrical Design and Estimating and Costing, K. B. Raina and S. K. Bhattacharya, Reprint 2001, New Age International (P) Ltd., Publishers– 1991.
3. Fundamentals of Electrical Drives, G. K. Dubey, Second edition, Narosa Publication, New Delhi- 2001
4. Programmable Logic Controllers, John R. Hackworth and Frederick D. Hackworth Jr., Third edition, Pearson Education–2008.

Reference Books:

1. Utilisation of Electric Power, N. V. Suryanarayana, Reprint 2003, New Age International (P) Ltd., Publishers, New Delhi – 1994.

2. Utilisation of Electric Power, Taylor, London: English ersities Press, 1955.

Gaps in the Syllabus (to meet Industry/Profession requirements): Nil

POs met through Gaps in the Syllabus: Nil

Topics beyond syllabus/Advanced topics/Design: Nil

POs met through Topics beyond syllabus/Advanced topics/Design: Nil

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3		2	2	1	1	3	3	2	3	2	3	2
CO2	3	3	2		2	2			2	3	2	3	1	2	1
CO3	3	3	3	1	2	2	2	2	2	3	2	3	1	2	1
CO4	3	3	3		2	3			2	3	1	3	3	3	3
CO5	3	3	2	1	3	2			1	2	1	3	1	2	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1& CD8
CD2	Tutorials/Assignments	CO2	CD1 & CD8
CD3	Seminars	CO3	CD1, CD2 & CD8

CD4	Mini Projects/Projects	CO4	CD1& CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 & CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code: EE461

Course Title: Testing and Commissioning of Electrical Equipment

Pre-requisite(s): Electrical Machines and Switchgear and Protection.

MODULE – I

Transformers: Specification, Installation- Location and sites, Selection and design of foundation details (like bolts size, their number, etc.) code of practice for terminal plates, polarity and phase sequence, Oil tanks, drying of windings with & without oil, general inspection. Commissioning test such as volt ratio test, earth resistance oil strength, Bochholz & other relays, tap changing gear, fans & pumps, insulation test, impulse test, polarizing index, and load & temperature rise test. Determination of mechanical stress under normal & abnormal conditions, Maintenance Schedule.
[12]

MODULE – II

Induction Motors: Specifications for different types of motors, duty, protection. Installation of the motors (including the foundation details) & its control apparatus, Shaft & alignment for various coupling, fitting of pulleys & couplings, Drying of windings, Commissioning test - 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 and site tests (in accordance with ISI code). Specific Tests- Performance & temperature rise tests, stray load losses, re-rating & special duty capability. Maintenance Schedule. [12]

MODULE – III

Synchronous Machines: Specifications, Installation- Physical inspection, Rating nameplate details, Foundation details, Alignments, Excitation systems, Cooling & control gear, drying out. Commissioning Tests- Insulation, Resistance measurement of armature & field wings, Wave from & telephone interference factors, Line charging capacity.
[8]

MODULE –IV

Performance Tests: Various tests IP 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 rise tests, and Retardation tests. Factory Tests - Gap length, magnetic centrity balancing vibration, bearing performance.
[7]

MODULE – V

Switchgear & Protective Devices: Standards, types, Specification, Installation, Commissioning tests, Maintenance schedule, Type & routine tests. [6]

Textbooks:

1. S. Rao, Testing & Commissioning of electrical equipment, Khanna Publishers.
2. B.V.S. Rao, Testing & Commission of electrical equipment

Reference Books:

1. Relevant Bureau of Indian Standards.
2. Transformers – BHEL.

3. J & P transformer Handbook.
4. J & P Switchgear Hand Book

COURSE INFORMATION SHEET

Course code: EE573

Course Title: Embedded Systems and Applications

Pre-requisite(s): Microprocessor and Microcontroller

Co-requisite(s): Digital Electronics and C programming

Credits: L: 03 T: 0 P: 0

Class schedule per week: 03

Class: B.Tech.

Semester / Level: VII / IV

Branch: EEE

Name of Teacher:

Course Objectives:

This course envisions to impart to students to:

1.	Comprehend the basic functions, structure, concept and definition of embedded systems.
2.	Interpret ATMEGA8 microcontroller and TMS320C6713 processors in the development of embedded systems.
3.	Correlate different serial interfacing protocols (SPI, TWI, I2C, USART).
4.	Understand interfacing of different peripherals (ADC, DAC, LCD, motors).
5.	Evaluate design cost of any given embedded system application.

Course Outcomes:

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

CO1	Visualize the basic elements and functions of ATMEGA8 in building an embedded system.
CO2	Work with modern hardware/software tools for building prototypes of embedded systems.
CO3	Interface various sensors, ADC, DAC, LCD, stepper motors with ATMEGA8.
CO4	Employ various bus protocols like SPI, TWI, I2C for interfacing peripherals.
CO5	Apply design methodologies for embedded systems, while appreciating the considerations for embedded systems design: specification, technological choice, development process, technical, economic, environmental and manufacturing constraints, reliability, security and safety, power and performance.

SYLLABUS:

MODULE– I

Introduction & Basic Concepts of Computer Architecture: Embedded Systems Overview, Processor technology-General purpose processors (Software), Single purpose processors (Hardware), Application-Specific processors; IC Technology-Full-custom/VLSI, Semicustom ASIC (Gate Array and standard cell), PLD Computer Architecture Concepts Memory, Input/Output, DMA, Parallel and Distributed computers, Embedded Computer Architecture, Brief Introduction to FPGA processor.

MODULE– II

Embedded Processors & Systems: Atmel AVRATMEGA8 Micro-controller Introduction, Major features, Architecture, Application and programming, Timers/Counters, ADC, USART, SPI, TWI, Vectored Interrupts with emphasis on external interrupts.

MODULE– III

DSP-based controllers: Texas Instrument's TMS320C6713 DSP processor Introduction, Major features, Architecture, Application and programming, Brief Introduction to TMS320C28335.

MODULE–IV

Peripherals and Interfacing: Adding Peripherals and Interfacing-Serial Peripherals and Interfacing-Serial Peripheral Interface (SPI) Inter Integrated Circuit (I2C), Adding a Real-Time Clock with I2C, Adding a Small Display with I2C Serial Ports-UARTs, RS-232C & RS-422, Infrared Communication, USB, Networks- RS-485, Controller Area Network (CAN), Ethernet Analog Sensors - Interfacing External ADC, Temperature Sensor, Light Sensor, Accelerometer, Pressure Sensors, Magnetic-Field Sensor, DAC.

MODULE–V

Embedded System for Motor Control: PWM; Embedded System Applications-Motor Control, Motor Control, and Switching Big Loads

Textbooks:

1. Catsoulis, John, "Designing Embedded Hardware", First/Second Edition, Shroff Publishers & Distributors Pvt. Ltd., New Delhi, India.
2. Vahid, Frank and Givargis, Tony, "Embedded System Design-A Unified hardware/Software Introduction", John Wiley & Sons, (Asia) Pvt Ltd., Replika Press Pvt., Delhi-110040.
3. Mazidi & Mazidi, "AVR Microcontrollers & Embedded Systems using Assembly & C Pearson Education
4. Rulph Chassaing, "Digital Signal Processing and Applications with C6713 and C6416 DSK", John Wiley and Sonspublication

Reference books:

1. Stuart R. Ball, "Embedded Microprocessor Systems, Real World Design", Second Edition, Newnes publication.
2. Nasser Kehtarnavaz, "Real Time Digital Signal Processing based on the TMS320C6000", Elsevier publication.

Gaps in the syllabus:

Computation of algorithm complexity

POs met through Gaps in the Syllabus: PO (4)

Topics beyond syllabus/Advanced topics/Design:

Assignment: Compute number of clock cycles required for UART and RS232 Communication

POs met through Topics beyond syllabus/Advanced topics/Design: PO (4)

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	2	2	2	1	1	1	1	2	3	2	1
CO2	3	3	3	3	3	2	2	2	1	1	1	2	3	2	2
CO3	3	3	3	3	3	3	3	2	2	2	2	2	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used

CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: EE 531

Course Title: EHV AC Power Transmission

Pre-requisite(s): Knowledge of Physics, Mathematics, Principle of Electrical Engineering, Electromagnetic Theory, Power System Transmission and Distribution Switch Gear and Protection

Co-requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: VII/IV

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions imparting the following objectives to students:

A.	To provide the concept of calculation line resistance, inductance, capacitance and ground return parameters for N-conductor bundle
B.	To make the students understand the field of point charge, line charge and then surface voltage gradient for bundle conductor.
C.	To expose the effect of compensators in voltage dynamic of EHV buses.
D.	To expose the students about the calculation process of electrostatic and electromagnetic field for bundle conductor and their effects.
E.	To provide the core concept of HVDC system and the working principles of converters, harmonic generation and filtration.

Course Outcomes

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

1.	To determine the line parameters of bundle conductors.
2.	To formulate the mathematical equations for different factors that causes the operational limitations for EHV line like surface voltage gradients, electrostatic field.
3.	To determine the required size of compensators for EHV line.
4.	To understand the core concept involving the different components in schematic diagram of HVDC system and their performance.
5.	To understand the nature of harmonics generated by converters and to comprehend the importance of filter.

SYLLABUS:

Module– I

Maxwell's coefficients, Sequence inductance and capacitance, Charge Matrix, Effect of Ground wire.

Module– II

Surface Voltage-gradient on bundled conductors, Mangoldt's formula, Gradient factors & their use, Ground level electrostatic field of EHV lines.

Module– III

Power frequency over-voltage control, Series and shunt compensation, Generalised Constants of Compensated line, Static Var Compensators (SVC/SVS). Switching over-voltages in EHV Systems.

Module– IV

Six-pulse Bridge Circuit: waveforms and relevant equations, Twelve-pulse converter, Advantages of higher pulse number, Bipolar to monopolar operation, Converter performance with phase control, Commutation and effect of reactance

Module– V

Introduction to HVDC Transmission system, Economical advantages, Technical advantages, Critical distance, Submarine transmission. Inverter, Equivalent circuit of HVDC system, Schematic diagram, Reactive power consideration in HVDC system, Harmonics, Filters in HVDC system.

Textbooks:

1. Extra High Voltage AC Transmission Engineering (2nd Ed.)by R. D. Begamudre, Wiley Eastern Ltd.
2. HVDC Power Transmission Systems by K. Padiyar, Wiley Eastern Ltd.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

CO1	3	3	3	1	3	1	1	1				2	3	2	2
CO2	3	3	3	1	3	1	1	1				2	3	2	2
CO3	3	3	3	3	3	1	2	2		1	1	2	3	2	2
CO4	3	3	3	1	3		1	1		1	1	2	3	2	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	2	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE 593

Course Title: High Voltage Engineering

Pre-requisite(s): Fundamentals of Electrical and Electronics Engineering, Electromagnetics Field, Electrical Measurement, Electrical Insulating Material.

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 3

Class: B.Tech.

Semester / Level: VII/ IV

Branch: EEE

Name of Teacher:

Course Objectives:

This course enables the students to :

A.	To educate students about electric field stress
B.	To give an exposure about different types of electrical insulation
C.	To give information about conduction and breakdown in different types of electrical insulation
D.	To impart knowledge about the methods of generation and measurement of high voltage and current for testing
E.	To train the students for design of high voltage laboratory

Course Outcomes:

Student will be able to:

A.	gain skilful knowledge of controlling the electrical stress in electrical systems and proper use of electrical insulating media.
B.	perform experiments on generation and measurement of high voltage and current
C.	identify possible reasons for failure of electrical insulation
D.	explore remedial measure for failure of electrical insulation.
E.	design circuits for generation of high voltage and current, electrical insulation system and set up high voltage lab

Syllabus:

Module– I

Introduction: Electric Field Stresses, Gas/Vacuum as Insulator, Liquid Breakdown, Solid Breakdown, Estimation and Control of Electric Stress

Module– II

Conduction and Breakdown in Gases: Gases as Insulating Media, Ionization Processes, Townsend's Current Growth Equation, Townsend's Criterion for Breakdown, Breakdown in Electronegative Gases, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law, Breakdown in Non-Uniform Fields and Corona Discharges, Post-Breakdown Phenomena and Applications, Vacuum Insulation.

Module– III

Conduction and Breakdown in Liquid: Liquids as Insulators, Pure Liquids and Commercial Liquids, Conduction and Breakdown in Pure and Commercial Liquids Conduction and Breakdown Solid Dielectrics**:** Introduction, Intrinsic Breakdown, Electromechanical and Thermal Breakdown, Breakdown of Solid Dielectrics in Practice, Breakdown in Composite Dielectrics.

Module– IV

Generation High Voltage and Currents: Generation of High dc voltages, Generation of High alternating voltages, Generation of impulse voltages, Generation of impulse currents, Tripping and control of impulse generators.

Measurement of High Voltage and Currents: Measurement of High direct current voltages, Measurement of High ac and impulse voltages, Measurement of High impulse currents

Module– V

Design, Planning and Layout of High Voltage Laboratories: Introduction, Test Facilities provided in high voltage laboratories, Activities and studies in high voltage laboratories, Classification of high voltage laboratories, Size and Rating of large size high voltage laboratories, Grounding of impulse testing laboratories

Textbook:

1. High Voltage Engineering, M S Naidu and V. Kamaraju,4th edition, TMH New Delhi.
2. High Voltage Engineering Fundamentals, E. Kuffel and W S Zaengl, Pergamon Press, Oxford.

Reference Book:

1. High Voltage Engineering, C L Wadhwa, 2nd edition, New Age International (P) Limited, Publishers, New Delhi**.**
2. Electrical Break down of Gases, 2nd edition, J M, Meek and J D, Crages, John Wiley, New York.

Gaps in the syllabus (to meet Industry/Profession requirements):

HVDC and HVAC Power Transmission, Insulation Coordination

POs met through Gaps in the Syllabus: d, e, h

Topics beyond syllabus/Advanced topics/Design:

Insulation simulation and design using software, lightning.

POs met through Topics beyond syllabus/Advanced topics/Design: f

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
Quizzes	10 + 10
End Sem. Examination Marks	50
Assignment	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

Indirect Assessment –

Student Feedback

Mapping between Course Objectives and Course Outcomes:

Course Objectives	Course Outcomes				
	i	ii	iii	iv	v
1	√				
2	√		√	√	√
3			√	√	√
4		√			√
5	√	√			√

Mapping between CO and PO

Course Outcomes	Programme Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
1	H								M			

2					H							
3		H		M								M
4		H		M		L						H
5			H	M			M	M	M	L	M	M

H-High (3), M-Medium (2) and L-Low (1)

CD	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Industrial visits/in-plant training
CD5	Self- learning such as use of NPTEL materials and internets
CD6	Simulation

Mapping Between COs and Course Delivery (CD) methods

Course Outcome	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD5
CO2	CD1, CD2, CD4, CD5
CO3	CD1, CD2, CD5
CO4	CD1, CD5, CD6
CO5	CD1, CD5, CD6

COURSE INFORMATION SHEET

Course code: EE 535

Course Title: HVDC and FACTS

Pre-requisite(s): Knowledge of basic power system and control system courses.

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 3

Class: B. Tech.

Semester / Level: VII/IV

Branch: EEE

Name of Teacher:

Course Objectives

This course enables the students to:

A.	Identify the significance of HVDC System
B.	Understanding the AC/DC conversion and its components and Interpretation of reactive power harmonics in HVDC system.
C.	Define different types of FACTS devices and their need in emerging power system.
D.	Describe the operations of FACTS controller in a large-scale power system and to solve the power flow problems using efficient numerical methods suitable for computer simulation.

Course Outcomes

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

1.	To list significance/ importance/ advantages of HVDC systems over EHVAC systems, types and application of HVDC system
2.	To explain different converters and inverters for converting AC to DC & DC to AC conversion and to interpret the reactive power, harmonics in HVDC system, its effect and filtering.
3.	Explain the operating principles, modeling and control systems of different FACTS Controllers/Devices.
4	Solve and analyze power flow with FACTS devices using efficient numerical methods.
5.	Discuss the techniques of practical FACTS controller design for various applications, such as, enhancing power transfer, stability and damping; preventing voltage instability etc.

Syllabus

Module– I

Introduction to HVDC transmission: Comparison with EHV AC power transmission, HVDC system configuration and components.

Module– II

Principles of AC/DC conversion: Converter connections, Waveforms, Relevant Equations, Reactive Power requirements

Module– III

Harmonics and Filters: Waveforms of a-c bus currents in Star/Star, Star/delta&12-phase converters and their Fourier-series representations, non-characteristic harmonics, Harmful Effects of Harmonics, DC side harmonics, Filters and detuning, Cost considerations of filters.

Module– IV

FACTS Concept and THYRISTOR-BASED FACTS CONTROLLER:

Introduction to FACTS Devices: Need for FACTS in emerging power systems –Definitions–Types of FACTS– FACTS and High Voltage DC (HVDC) Transmission. Static Var Compensator (SVC)– Functional description and structures – Control components and Models – Concepts of voltage control –Controls and Applications, MATLAB Implementation.

Module– V

VOLTAGE SOURCE CONVERTER (VSC) BASED FACTS CONTROLLER:

Static Synchronous Compensator (STATCOM): Functional description and structure, Models, Controls and Applications, MATLAB Implementation

Textbooks:

1. HVDC Power Transmission Systems by K. Padiyar, Wiley Eastern Ltd.
2. Direct Current Transmission by E. W. Kimbark, Wiley Inter Science-New-York
3. R. M. Mathur and R. K. Varma, “Thyristor-Based FACTS Controllers for Electrical Transmission Systems”, IEEE Press and John Wiley & Sons, New York, USA, Feb. 2002, ISBN: 978-0-471-20643-9
4. Understanding of FACTS by N. G. Hingorani & L. Gyugyi, IEEE Press.

Reference Books:

1. HVDC Transmission by J. Arillaga, Peter Peregrinus Ltd; London U.K., 1983
2. Power Transmission by Direct Current by E. Uhlman, Springer Verlag, Berlin Helberg, 1985
3. N. G. Hingorani and L. Gyugyi, “Understanding FACTS”, IEEE Press, New York, USA, 1999.
4. Y. H. Song and A. T. Johns, eds, “Flexible AC Transmission Systems (FACTS)”, IEE Press, U. K., 1999
5. “FACTS Applications”, IEEE-PES Publication 96 TP 116-0, 1996.
6. “Modeling of Power Electronics Equipment (FACTS) in Load Flow and Stability Programs”, CIGRETF 38.01.08, Technical Brochure 145, August 1999.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
Quizzes	10 + 10
End Sem Examination Marks	50
Assignment / Quiz (s)	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping between Objectives and Outcomes

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
1												
2												
3												

4												
5												

Mapping Between COs and Course Delivery (CD) methods

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

Course Code: EE539

Course Title: Power System Dynamics

Pre-requisite(s): Electrical Power Transmission and Distribution, Power System Analysis

SYLLABUS

Module– I

Introduction to Power System Stability problem: Stability classification – Small signal & Transient stability, Rotor angle & Voltage stability, Hierarchy of controls in a Power System.

Module– II

Synchronous machine modelling: Basic equations, dqo transformation, equations of motion, generator operated as part of large power grid.

Module– III

Excitation System: Requirements of excitation system, Elements of excitation system, Types of excitation system, Modelling of excitation system. Power system loads: Static load models, Dynamic load models.

Module– IV

Small Signal (Steady State) Stability: Linearization, State matrix, modal analysis technique.

Module– V

Voltage Stability: Basic concepts related to voltage stability, Classification, Aspects of voltage stability analysis, Modelling requirements.

Textbooks:

1. Power System Stability and Control, P. Kundur.
2. Electric Energy System Theory – O. I. Elgerd
3. Power System Dynamics–K. R. Padiyar

COURSE INFORMATION SHEET

Course Code: EE629

Course Title: Hybrid Electric Vehicle

Pre-requisite(s): Electrical Machines, Power Electronics and Electric drives

Corequisite(s): Induction Motor, BLDC Motor, Battery, Power Converters

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B.Tech.

Semester / Level: VII/IV

Branch: EEE

Name of Teacher:

Course Objectives:

The course objective is to provide students with an ability to :

A.	Understand basic working principle of power converter controlled traction drive.
B.	Apply power converters in order to provide proper power modulation.
C.	Analyze transient performance of power converters for meeting traction load requirement.
D.	Design a suitable power converter for HEV.

Course Outcomes:

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

1.	Describe fundamental working principle of power converter controlled traction drive.
2.	Apply power converters in conjunction with IC engine for obtaining dynamic requirement of traction drive.
3.	Analyze mutual effect of power converter and IC engine for obtaining optimal performance of HEV.
4.	Evaluate cost effectiveness and optimize performance parameters.
5.	Design an HEV for a particular application with help of interdisciplinary team work.

SYLLABUS:

Module– I

Introduction

Hybrid and Electric Vehicles (HEV): History Overview and Modern Applications, Ground vehicles with mechanical power train and reasons for HEV development, HEV configurations and ground vehicle applications, Advantages and challenges in HEV design**.**

Module– II

Power Flow and Power Management Strategies in HEV

Mechanical power: generation, storage and transmission to the wheels, Vehicle motion and the dynamic equations for the vehicle., Vehicle power plant and transmission characteristics and vehicle performance including braking performance., Fuel economy characteristics of internal combustion engine, Basic architecture of hybrid drive train and analysis series drive train., Analysis of parallel, series parallel and complex drive trains and power flow in each case., Drive cycle implications and fuel efficiency estimations.

Module– III

Internal Combustion Engines

Operating Principles, Operation Parameters, Indicated Work per Cycles and Mean Effective Pressure, Mechanical Efficiency, Specific Fuel Consumption and Efficiency, Specific Emissions, Fuel/Air and Air/Fuel Ratio, Volumetric Efficiency.

Module– IV

Electric Vehicles

Traction Motor Characteristics, Tractive Effort and Transmission Requirement, Vehicle Performance, Tractive Effort in Normal Driving, Energy Consumption

Module– V

Hybrid Electric Vehicles

Concept of Hybrid Electric Drive Trains, Architectures of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains, Torque-Coupling Parallel Hybrid Electric Drive Trains, Speed-Coupling Parallel Hybrid Electric Drive Trains, Torque-Coupling and Speed- Coupling Parallel Hybrid Electric Drive Trains.

Textbook:

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles. Mehrdad Ehsani, CRC Press
2. Modern Electric Vehicle Technology, C. C. Chan and K. T. Chau, Oxford University Press

Reference Book:

1. R. Krishnan, 'Electric motor drives', Prentice hall of India, 2002
2. T. J. E. Miller, 'Brushless magnet and Reluctance motor drives.

Gaps in the syllabus:

POs met through Gaps in the Syllabus: PO (e)

Topics beyond syllabus/Advanced topics/Design: Regenerative Braking, Self Driven HEV

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Semester Examination Marks	25
Quizzes	10 + 10
End Semester Examination Marks	50
Assignment	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

MAPPING I: (Course Objectives & Outcomes)

Course Objectives /Outcomes	1.	2.	3.	4.	5.
A.	H	H	M	M	L
B.	H	H	H	M	M
C.	H	H	H	H	M
D.	H	H	H	H	H

MAPPING II: (CO vs PO)

TABLE NO.1

Course Outcomes/POs	a	b	c	d	e	f	g	h	i	j	k	l
1.	H	H	H	H	H	L	L	L	L	L	L	L
2.	H	H	H	H	H	M	M	L	L	L	L	L
3.	H	H	H	H	H	M	M	M	M	L	L	L
4.	H	H	H	H	H	H	H	M	M	M	M	M
5.	H	H	H	H	H	H	H	H	H	H	H	M

Mapping between COs and Course Delivery(CD) methods :

CD	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors/OHP
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training
CD8	Self- learning such as use of NPTEL materials
CD9	Simulation

Course Outcome	Course Delivery Method
CO1	CD1, CD8
CO2	CD1, CD8
CO3	CD1, CD8
CO4	CD1, CD2, CD8

CO5	CD1, CD2, CD8

COURSE INFORMATION SHEET

Course Code: EE605

Course Title: Micro-Grid Operation and Control

Pre-requisite(s): Electrical Power System Transmission and Distribution, Control System and Power Electronics, Control System and Power Electronics

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: VII/ IV

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions imparting the following objectives to the students:

A.	To enumerate the necessity of active distribution network and understand the principle of operation of microgrid.
B.	To expose the responsibility of controllers connected with DERs through IEEE standards 1547-2018.
C.	To feature the maximum power extraction from SPV and PMSG based wind turbine system and the working procedure of controllers.
D.	To assess different controllers for voltage and frequency restoration in microgrid.
E.	To outline the basic principles of protection of microgrids.

Course Outcomes

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

1.	Outline the significance of microgrid in big utility grid.
2.	Apply IEEE standard 1547-2018 while designing the controllers.
3.	Apply PWM based controllers to extract maximum power from SPV system
4.	Outline the steps and accordingly design primary controllers and evaluate their performance
5.	Explain the protection philosophy of islanding detection technique and the general microgrid protection.

Syllabus:

Module1:

Concept of Microgrid: Distributed generation and Microgrid concept: Introduction, Power System Structure, Traditional Grid, Microgrid definition and characteristics, typical microgrid configuration, distributed renewable energy technologies, non-renewable distributed generation technologies, interconnection of microgrids, technical and economic advantages of microgrid, key challenges

Module2:

DER integration-I: IEEE Standard for Interconnection (IEEE Std 1547™-2018): concept of area electric power system, point of common coupling, point of coupling, General interconnection technical specifications and performance Requirements, Reactive power capability and voltage/power control requirement, Voltage and Frequency disturbance ride-through requirements

Module3:

DER integration-II: Integration of solar sources: Modeling of the Entire PV Energy Conversion System, PV Controller, EES Controller, Grid Connection Control. Steps of control of the entire PV energy system.

Integration of wind power: Speed and power relations, Power extracted from the wind, Aerodynamic torque control, Control of a PMSG based wind energy generation system.

Module-4:

DER Integration –III: Hierarchical Microgrid Control, Local or primary Control: Droop Control, Droop Control in Inverter-based Distributed Generators, the performance of the primary controller, Secondary Control and Tertiary Control. Centralized and decentralized Energy Management System (EMS) in microgrids.

Module-5:

Microgrid Protection: Challenges in microgrid protection systems, Classification for microgrid protection: current limiter, centralized protection, distance protection. Islanding: Non-detection zone, Anti-islanding techniques, different islanding scenarios.

Gaps in the syllabus (to meet Industry/Profession requirements):

More focus on secondary and tertiary control in decentralized environment.

Detail in protection system for microgrid

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

The role of centralized and decentralized controller.

Relay coordination

POs met through Topics beyond syllabus/Advanced topics/Design:

4 and 5 with higher level of satisfaction.

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	1	2	1	1	1	1	2	2		1		1	3	2	
CO2	2	2	1	1	1	2	1	2		1		3	3	2	2
CO3	3	3	3	3	2	2	2	2	1	1	2	2	3	3	3
CO4	3	3	3	2	2	2	2	2	1	1	2	2	3	3	3
CO5	3	3	3	1	2	2	2	2	1	1	2	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

PROGRAM ELECTIVE V

COURSE INFORMATION SHEET

Course Code: EE437

Course Title: Industrial Drives and Control

Pre-requisite(s): Basic Electrical Engineering, Electrical Machines, Power Electronics

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: VII/IV

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

A.	explain the components of an electric drive system and understand their functions;
B.	describe the dynamics of an electromechanical system;
C.	choose an appropriate electric drive as per the application and requirements;
D.	select a proper size of the motor as per the load requirements and develop the closed loop control and asses the performance of the drive in terms of stability, capabilities of regeneration and flexibility in control.

Course Outcomes

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

1.	define an electric drive system and its component and determine the load parameters such as equivalent moment of inertia and load torque;
2.	develop dynamic model of an electric drive and carry out stability analysis and explain the necessity and different types of load equalization;
3.	use the information of different class of duty and thermal model to choose appropriate size of a motor for a given application;
4.	define the speed torque characteristics, different zone of operation, starting and braking of a dc-motor and ac-motor (viz. induction motor, squirrel cage induction motor, and synchronous motor) and develop the close loop control of a dc-motor/ac-motor drive and understand the mechanism of train movement and develop a controller for traction motor so that he/she can apply theoretical knowledge into practical system;
5.	aspire a career with specialization in field of electric drive more and recognize the need to learn engage and adopt in the world of constantly changing electric drive technology.

SYLLABUS:

Module– I

Electrical Drives: An Introduction, Parts of Electrical Drives; ac and dc Drives, fundamental torque equations, Speed torque conventions and multi-quadrant operation; calculation of equivalent drive parameters, Different load torques and their nature; steady-state stability; load equalization.

Module– II

Selection of Motor rating and its control: Introduction, thermal model of a motor, Classes of Motor Duty cycle, selection of motor and its rating, Closed-loop and open-loop control of drives, Modes of Operation; speed control & Drive classifications; closed-loop control of Drives; speed and current sensing; manual, semi-automatic & automatic control.

Module– III

D.C. Motor Drives: Introduction, Performance characteristics of DC Motors &their Modifications; Starting of DC motors & their Design, Electric Braking; Speed Control of DC motor; Converter controlled DC Drives; Single phase converter drives, three-phase converter drives, Dual converter drives, Chopper controlled dc drives, Closed-loop control of dc motor, selection of components and their specifications for DC drives.

Module– IV

Phase Controlled Induction Motor Drives: Introduction, Speed-torque characteristics, Starting & Braking of IM; effects of unbalancing and harmonics on IM, Speed Control techniques, Stator voltage control, Closed Loop schemes for phase-controlled IM drives, Rotor resistance control, Slip speed control, Slip power recovery schemes. Frequency Controlled Induction Motor Drives: Scalar control, Variable frequency control, constant volts/Hz control, Voltage source inverter (VSI) control using PWM techniques, Closed-Loop speed control of VSI drives, Control from a current source Inverter (CSI), Closed Loop speed control of CSI drives, Comparison of CSI and VSI drives. Selection of components and their specification for AC drives.

Module– V

Synchronous Motor Drives: Starting, Pull-in and Braking with Fixed Frequency Supply; Variable Speed Drives, Cyclo-converter based Synchronous motor control, control of Trapezoidal PMAC motor, Close loop speed control of Synchronous Machines.

Textbooks:

1. G. K. Dubey, Fundamentals of Electrical Drives, Narosa publication, New Delhi
2. R. Krishnan, Electric Motor Drives-modeling, analysis and control.

Reference Books:

1. S. K. Bhattacharya & Brijinder Singh, Control of Electrical Machines
2. Mukhtar Ahmad, Industrial Drives and Control
3. S. K. Pillai, A first course on Electrical Drives
4. M. Chilikin, Electric Drives.
5. C. L. Wadhwa, Genaration Distribution and Utilization of Electrical energy

Gaps in the Syllabus (to meet Industry/Profession requirements)

Simultaneous lab experiments should be in the same semester.

POs met through Gaps in the Syllabus: 3 and 4.

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	2	3	2	2	1	1	3	2	2	3	3	3	3	2
CO2	3	3	2	2	1	2	1	3	2	3	2	3	2	3	3
CO3	3	3	3	1	2	1	1	2	2	3	1	3	3	2	1
CO4	2	2	3	1	2	1	3	2	2	1	2	2	3	3	3
CO5	2	3	2	1	2	1	3	3	1	2	1	3	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2
CD3	Seminars	CO3	CD1, CD2, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE 439

Course Title: Applied Control Theory

Pre-requisite(s): Basic electrical, physic system theory and fundamentals of control system

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: VII/IV

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

A.	To acquaint students with concepts of state variables.
B.	To deliver comprehensive knowledge of mathematical modelling of linear/nonlinear system.
C.	To elucidate basics of designing the control problem.
D.	To brief them on theory of adaptive control theory.
E.	To acquaint students with concepts of nonlinearity in control problem.

Course Outcomes

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

1.	Find out the ABCD parameter of a system
2.	Able to solve the pole placement design
3.	Simulate the control problem and analyses
4.	Handle the nonlinearity in control system design
5.	Able to design and provide a control topology for given engineering system.

SYLLABUS

Module – I

Concepts of State, State Variables: Development of state-space models. State and state equations, State equations from transfer function from state equations. State transition matrix, Solution of State equation, Transfer Matrix, State variables and linear discrete-time systems.

Module – II

Controllability and Observability: Controllable and observable State models, Controllability and observability for discrete-time systems.

Module – III

State Variable Feedback: Asymptotic state observers. Control system design via pole placement

Module – IV

Optimal Control Systems: Introduction, Performance indices, Optimal control problems- Transfer function approach, State variable approach; Parameter optimization. Stability of Non-Linear Systems: Stability concepts. Stability analysis using Lyapunov's Direct method; Popov's stability criterion.

Module – V

Non-Linear Systems: Introduction. Common nonlinearities. Methods of studying non-linear systems: Linearization; Describing function analysis; Phase plane analysis. Adaptive Control Systems: Performance indices. Adaptive Controllers, Identification of dynamic characteristics of the plant.

Textbooks:

1. Control Systems Engineering-I. J. Nagrath & M. Gopal.

Reference books:

1. Modern Control System Theory-M. Gopal.
2. Modern Control Engineering-K. Ogata.
3. Control Systems-N. K. Sinha.

Gaps in the Syllabus (to meet Industry/Profession requirements)

Transducer and sensor mathematical model.

Real time simulation and analysis of control system.

Application of artificial intelligent topology for control system.

POs met through Gaps in the Syllabus: 3, 4, 12

Topics beyond syllabus/Advanced topics/Design

Digital signal processing.

Actuator and sensor moulding.

Neural network and AI system.

POs met through Topics beyond syllabus/Advanced topics/Design: 3, 4, 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher’s Assessment	5
End Semester Examination	50

Indirect Assessment

1. Students’ Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2	3	2	3
CO2	3	3	3	1	3	1	1	1				2	3	2	3
CO3	3	3	3	3	3	1	2	2		1	1	2	3	2	3
CO4	3	3	3	1	3		1	1		1	1	2	3	2	3
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: EE 441

Course Title: Computer-Aided Power System Analysis

Pre-requisite(s): Knowledge of basic principles of power system and its analysis

Co-requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: VII/IV

Branch: EEE

Name of Teacher:

Course Objectives:

This course envisions imparting the following objectives to students:

A.	To understand single-phase modeling of power system components and their input parameters for computer programming.
B.	To expose the students about efficient numerical methods suitable for computer simulation for the solution of the power flow problems.
C.	To make the students understand about fault current ad bus bar voltages under abnormal (fault) conditions utilizing bus impedance matrix.
D.	To understand the economic load dispatch and unit commitment problem and their solution techniques.
E.	To assess optimal system operation and infer about the dynamics of power systems for small and large disturbances.

Course Outcomes:

After completion of the course, the learners will be able :

1.	To identify and list input parameters to start with software-based solution.
2.	To solve the load flow problems by different techniques and their advantages.
3.	To identify and analyze the different abnormal (fault) conditions in power system utilizing efficient computer algorithm.
4.	To solve economic load dispatch problem with and without transmission losses and also to solve unit commitment problem by Dynamic programming method.
5.	To formulate different methods of improving the transient stability of a large practical power system.

Syllabus:

Module– I

Introduction: The new computer environment, Basic single-phase modeling- Generator, Transmission lines, Transformer- Off nominal transfer tap representation, Phase shifting representation.

Module– II

Load Flow Analysis: Introduction, Nature of load flow equations, Computational steps and flow chart of Gauss-Seidel Techniques, Newton-Raphson method: Formulation for load buses and voltage-controlled buses in rectangular and polar co-ordinates, Computational steps and flow chart. **Computational Aspects of Large-Scale System:** Sparsity of Y_{bus} and Jacobian matrix, Sparsity oriented computer programming, Reducing storage requirement, Decoupled power flow algorithm.

Module– III

Optimal System Operation: Introduction, Characteristic of steam and hydro units, Economic dispatch of thermal units, Equal incremental cost operation, Computational steps, Transmission loss and incremental transmission loss (ITL), Computational aspects.

Unit Commitment: Introduction, Objective function, Constraints, Dynamic programming method.

Module– IV

Short Circuit Analysis: Introduction, Bus impedance matrix and its building algorithm through modifications, Symmetrical and unsymmetrical fault calculation using Z_{bus} and its computational steps.

Module– V

Power System Stability: Stability problem, swing equation and its numerical solution, Determination of initial state in a multi-machine system, Base case Y-BUS and modified Y-BUS, Computational algorithm, Improvement of stability.

TEXTBOOKS:

1. Power system Analysis—Grainger and Stevension—Tata-McGraw Hill, New Delhi.
2. Advanced Power System Analysis and Dynamics-L. P. Singh, New Age International, 4th edition, 2006.

Reference Books:

1. Computer Modelling of Electrical Power Systems - J. Arrillaga, N.R. Watson, Wiley, 2ndedition, 2001.
2. Power Generation Operation and Control - A.J. Wood, B.F. Wollenberg, 2nd edition Wiley Inderscience publication.
3. Computer Techniques in Power System Analysis –M. A. Pai, Mc Graw Hill, New Delhi, 2nd edition, 2003.

Gaps in the syllabus (to meet Industry/Profession requirements)

Impact of Deregulation in Power Industry

Computer Simulation incorporating impact of Renewable Sources in Power System.

POs met through Gaps in the Syllabus: 3, 4 and 5

Topics beyond syllabus/Advanced topics/Design: Load flow considering RES, MATLAB Simulation of power system network.

POs met through Topics beyond syllabus/Advanced topics/Design: 3,4 and 5

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	-	-	-	1	-	2	1	1	-	-	2	2	1
CO2	3	3	2	2	3	2	1	1	1	1	-	1	3	2	2
CO3	3	2	2	2	2	2	3	1	1	1	-	1	3	2	2
CO4	3	3	3	2	2	2	2	1	1	1	3	1	3	2	2
CO5	3	3	2	2	2	2	2	1	1	1	3	1	3	2	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: EE507

Course Title: Advanced Power Electronics

Pre-requisite(s): Power Electronics, Operating Principle of Semiconductor Devices

Co-requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: VII/IV

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

A.	Recognize of different type of modern semiconductor-based switching devices and their operating characteristics
B.	Explain working principle of power converters and relate them with different area of application
C.	Capable to analyze closed loop control of electrical drives based on power converters.
D.	Differentiate between different control strategy of electrical drives in terms of dynamic parameters of system and overall efficiency.
E.	Evaluate performance evaluation, plan and design procedure for a complex power electronics-based system.

Course Outcomes

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

1.	List different types of semiconductor devices and remember their operating characteristics. Explain working principle of different semiconductor devices
2.	Classify different types of power converters. Show suitability of a power converter for a particular application. Solve power management related problems with application of power electronics-based topologies.
3.	Outline shortcomings of each class of power converters and solve them using proper modifications. Identify potential area for power electronics applications.
4.	Estimate the cost and long-term impact of power electronics technology on a large scale project of socio-economic importance.
5.	Modify existing power electronics-based installations. Design new power converter topologies and

	Plan to develop a power processing unit for a particular requirement in industrial plants as well as domestic applications. Lead or support a team of skilled professionals.

SYLLABUS:

Module– I

Power Electronic Devices: (Diodes, Thyristors), Transistors, MOSFET, IGBT, IGCT, etc. - operating principle, Static & dynamic characteristics, Data sheet ratings; Thermal characteristics of power devices; Sample Gate drive circuits.

Module– II

Switched Mode Power Supply: Forward and flyback converter circuits: operation of flyback converter and waveforms analysis, operation of forward converter and waveforms analysis, Double-ended forward converter, Push-Pull converter, Half Bridge isolated converter, Full bridge isolated converter, Bidirectional power supplies, small-signal analysis of DC-DC converters and closed-loop control.

Module– III

PWM inverter modulation strategies & dual bridge: Sine wave with third harmonic, space vector modulation and predictive current control techniques; PWM rectifier; Input side bidirectional power flow requirement for regeneration & Dual Thyristor Bridge.

Multi-level inverter: Basic topology and waveform, Diode clamped multi-level inverter, Flying capacitor multilevel inverter, cascaded multilevel inverter improvement in harmonics and high voltage application, comparison of different multilevel inverters, application of multilevel inverters;

Module– IV

Resonant Inverters: Operating principle of series resonant inverter, wave forms analysis, switching trajectory, losses and control, Operating principle of series resonant inverter with bidirectional switches, Frequency response of resonant series loaded, parallel loaded, and series parallel- loaded inverter, Parallel resonant inverter, ZCS resonant converter, ZVS resonant converter.

Module– V

Introduction to application-oriented chips: Industrial PWM driver chips for power supplies such as UC 3843, 3825 or equivalent; Industrial gate driver chips for PWM voltage source inverters with isolation and protection circuits. Intelligent power modules.

Textbook

1. M. H. Rashid, “Power Electronics: Circuits, Device and Applications”, 2^{nd} Edn, PHI, New Jersey, 1993.
2. Mohan, Underl and, Robbins; Power Electronics Converters, Applications and Design, 3^{rd} Edn.,2003, John Wiley & Sons Pte. Ltd.
3. M. D. Singh, K. B. Khanchandani, “Power Electronics”, 2^{nd} Edn., Tata McGraw-Hill, 2007.

Reference Book

1. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, 1^{st} Edn., Prentice Hall, 2001.
2. B. K. Bose, “Modern Power Electronics & AC Drives”,1^{st} Edn., Prentice Hall, 2001.
3. L. Umanand, “Power Electronics: Essentials & Applications”, 1^{st} Edn. Wiley India Private Limited, 2009.
4. Jeremy Rifkin, “Third Industrial Revolution: How Lateral Power Is Transforming

Energy, the Economy, and the World", 1st Edn.,St. Martin's, Press,2011.

Gaps in the syllabus (to meet Industry/Profession requirements):

Cost Evaluation of Power Electronics based installation based on reliability.

Application of artificial intelligence in power electronics.

Study of impact of power electronics on society and environment.

POs met through Gaps in the Syllabus: PO6

Topics beyond syllabus/Advanced topics/Design:

Reliability analysis in power electronics topologies

Application of adaptive algorithms in power electronics-based systems.

POs met through Topics beyond syllabus/Advanced topics/Design: PO3 & PO6

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	3	1	1	1	1	1	1	1	2	1	1
CO2	3	3	3	3	3	2	2	1	1	1	1	1	3	2	1
CO3	3	3	3	3	3	2	2	2	2	1	1	1	3	3	1
CO4	3	3	3	3	3	3	2	2	2	2	2	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1 and CD9
CD3	Seminars	CO3	CD1, CD2 and CD3
CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Minor course offered by EEE Departments

Semester of Study (Recommended)	Pre-requisites	Course Code	Subjects	Credits
FIFTH (Any two courses, total of 8 credits)	Mathematics, Basic Electrical Engineering	EE205	Circuit Theory (For all branches except ECE)	4
	Mathematics	EE305	Digital Signal Processing (For all branches except ECE)	4
		EE379	Sustainable Energy Sources (For all branches)	4
	Mathematics, Basic Electrical Engineering	EE351	Control Theory (For all branches except ECE)	4
	Basic Electrical Engineering	EE261	Principles of Electrical Machines (For all branches)	4
SIXTH (Any two courses, total of 8 credits)	Basic Electrical Engineering Mathematics	EE353	Power Electronics (For all branches)	4
	Basic Electrical Engineering Mathematics	EE421	Power System (For all branches)	4
	Control Theory	EE475	Non-linear and Adaptive Control (For all branches)	4
SEVENTH (Mandatory, 2 credits)	Basic Electrical Engineering	EE452	Advanced Electrical Engineering Lab (For all branches)	2
18 credits				

COURSE INFORMATION SHEET

Course code: EE205

Course Title: Circuit Theory

Pre-requisite(s): Basic Electrical Engineering

Co- requisite(s): Mathematics

Credits: 4 L:3 T:1 P:0

Class schedule per week: 04

Class: B. Tech

Semester / Level: 02

Branch: EEE

Name of Teacher:

Course Objectives:

This course enables the students to:

A.	list the Properties and discuss the concepts of graph theory
B.	solve problems related to network theorems
C.	illustrate and outline the Multi- terminal network in engineering
D.	select and design of filters

Course Outcomes:

After the completion of this course, students will:

1.	be able to solve problems related to DC and AC circuits
2.	become adept at interpreting network analysis techniques
3.	be able to determine response of circuits consisting of dependent sources
4.	analyse linear and non-linear circuits
5.	be able to design the filters with help of electrical element

Syllabus

Module – I

Network Topology: Definition and properties, Matrices of Graph, Network Equations &Solutions: Node and Mesh transformation; Generalized element; Source transformation; Formulation of network equations; Network with controlled sources; Transform networks; Properties of network matrices; Solution of equations; Linear time-invariant networks; Evaluation of initial conditions; Frequency and impedance scaling.

Module – II

Network Theorem: Substitution theorem, Tellegen's theorem, Reciprocity theorem; State space concept and State variable modelling.

Module – III

Multi-terminal Networks: Network function, transform networks, natural frequency (OCNF and SCNF); Two-port parameters, Equivalent networks.

Module – IV

Elements of Network Synthesis: Positive real function, Reactance functions, RC functions, RL Network, Two-port functions, Minimum phase networks.

Module – V

Approximation: Filter specifications; Butterworth approximation; Chebyshev approximation; Frequency transformation; High pass; Band pass; all pass and notch filter approximation.

Textbooks:

1. V.K. Aatre, Network Theory & Filter Design, New Age International Pvt. Ltd., New Delhi. (T1)
2. M.S. Sukhija, T.K.Nagsarkar, Circuits and Networks, Oxford University Press, 2nd ed., New Delhi.(T2)

Reference Books:

1. M.E. Van Valkenberg, Introduction to Modern Network Synthesis, John Wiley & Sons (1 January 1966) (R1)
2. Balabanian, N. and T.A. Bickart, "Electric Network Theory", John Wiley & Sons, New York, 1969. (R2)
3. C. L. Wadhwa, Network Analysis and Synthesis, New Age International Pvt. Ltd., New Delhi(R2)

Gaps in the syllabus (to meet Industry/Profession requirements):

Practical aspects and demonstration of electrical and non-electrical systems

POs met through Gaps in the Syllabus:

Demonstrate appropriate inter-personal skills to function effectively as an individual, as a member or as a leader of a team and in a multi-disciplinary setting (POi)

Be able to comprehend and write effective reports and design documentations; give and receive clear instructions; make effective presentations and communicate effectively and convincingly on complex engineering issues with engineering community and with society at large. (POj)

Be conscious of financial aspects of all professional activities and shall be able to undertake projects with appropriate management control and control on cost and time. (POk)

Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all- round development throughout the professional career. (POl)

Topics beyond syllabus/Advanced topics/Design:

Design of filter using operational amplifier

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery methods
Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Industrial visits/in-plant training
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure:

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem. Examination Marks	50
Assignment	05
Quiz (s)	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Quiz I					
Mid Semester Examination					
Quiz 2					
Assignment					
End Semester Examination					

Indirect Assessment –

Student Feedback on Faculty

Student Feedback on Course Outcome

Mapping between Objectives and Outcomes:

Mapping of Course Outcomes onto Program Outcomes

Course Outcome #	Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
1	3	3	2							1	1	1
2	3	3	3	2	1					1	1	1
3	3	3	3	3	2	2				1	1	1

4	3	3	3	3	3	3				2	2	2
5	3	3	3	2	2	3	3	3	3	1	3	3

CD	**Course Delivery methods**	**Course Outcome**	**Course Delivery Method**
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: EE 305

Course title: DIGITAL SIGNAL PROCESSING

Pre-requisite(s): Fundamentals of transform methods, Signals and Systems, Filter theory.

Credits: 04

L	T	P
3	1	0

Class schedule per week: 4 lectures

Class: B.Tech.

Semester: 4th

Course Coordinator:

Course Objectives:

This course enables the students to:

A.	Enumerate the basic concepts of signals and systems and their interconnections in a simple and easy-to-understand manner by summarizing different mathematical operations like folding, shifting, scaling, convolutions, Z-transform etc.
B.	Sub-divide and construct different realization structures.
C.	Determine transfer function and predict frequency response of discrete-time systems by applying various techniques like Z-transform, DFT and FFT.
D.	Design digital IIR and FIR filters using filter approximation theory, frequency transformation techniques and window techniques.
E.	Apply DSP processor in processing of 1D and 2D signals.

Course Outcomes:

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

1.	State sampling theorem and reproduce a discrete-time signal from an analog signal;
2.	Classify systems based on linearity, causality, shift-variance, stability criteria and represent transfer function of the selected system;
3.	Evaluate system response of the system using convolution methods, frequency transformation technique, DFT, DIF-FFT or DIT-FFT algorithm, window techniques;
4.	Design FIR and IIR filters for real time application.
5.	Construct (structure) and recommend environment-friendly filter for real- time applications.

Syllabus

MODULE – I

Introduction: Classification of Signals and systems, Fourier analysis of periodic and a periodic continuous time signal, Application of Laplace Transform to system analysis, Discrete-Time Signals,

Shanon's sampling theorem, difference equation description, properties of discrete time system (linearity, time-variance, convolution), BIBO stability, structure for realization of LTI discrete time systems, direct form I&II, cascade, parallel.
[7]

MODULE – II

Frequency Domain Analysis: Z-transform definition, region of convergence (ROC), Relationship between Laplace and Z-transforms. Discrete Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT), Periodic convolution, Direct evaluation of DFT, FFT algorithms decimation in time and frequency, Relationship between Fourier and Z-transforms
[8]

MODULE – III

Filter Function Approximations and Transformations. Review of approximations of ideal analog filter response, Butterworth filter, Chebyshev Type I & II. Frequency Transformations: Frequency transformation in analog domain, frequency transformation in digital domain. Design of IIR Filter based on Impulse invariance method and Bilinear transformation.
[7]

MODULE – IV

Design of FIR Filters: Characteristic of FIR filters with linear phase, Symmetric and anti-symmetric FIR filters, design of linear phase FIR filters using windows and frequency sampling methods, comparison of FIR and IIR filters.
[7]

MODULE-V

Application of DSP: Introduction to DSP processors, Types of architectures, DSP support tools, code composer studio, compiler, assembler and linker, Introduction TMS320 C6x architecture, Digital signal processing application in the area of biomedical signal, speech, and image.
[7]

Books:

1. John G. Proakis, Dimitris G. Mamalakis, Digital Signal Processing, Principles, Algorithms and Applications, Third edition, Pearson International Edition.
2. Alan V. Oppenheim Ronald W. Schafer, Digital Signal Processing, PHI, India.

Reference Book:

1. S. Salivahanan C Gnanapriya, Digital Signal Processing, Tata McGraw Hill Education Private Limited.
2. Antonious, Digital Filter Design, Mc-Graw-Hill International Editions

Mapping between Course Outcomes and Program Outcomes:

CO	Program Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	3	3	3	2	2	2	2	2	1	1	1	1			
2	3	3	3	3	3	3	2	2	2	2	2	1			
3	1	2	1	2	3	3	3	2	2	2	1	1			
4	1	1	1	3	3	2	2	2	2	1	1	1			
5	1	1	1	1	1	2	2	2	3	3	3	3			

3. *3: High, 2: Medium, 1: Low

Mapping between Course Objective and Course Outcomes:

Course Objectives	Course Outcomes				
	1	**2**	**3**	**4**	**5**
A	3	3	2	2	1
B	3	3	2	2	1
C	2	2	2	3	2
D	1	2	2	3	3
E	1	1	2	3	3

Gaps in the syllabus (to meet Industry/Profession requirements)

Examine different signal processing techniques such as STFT, Wavelet Transform etc. in real time applications.
Implementation of 1D, 2D digital filters in many important applications such as image compression, video processing etc.

POs met through Gaps in the Syllabus: 1, 2, 3, 7

Topics beyond syllabus/Advanced topics/Design:

Adaptive Signal Processing, Image Processing, Application of TMS kit.

POs met through Topics beyond syllabus/Advanced topics/Design: NA

Course Delivery Methods	
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Laboratory experiments/teaching aids
CD4	Self- learning such as use of NPTEL materials and internets
CD5	Simulation

Mapping between COs and Course Delivery (CD) methods

Course Outcome	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD5
CO2	CD1, CD2, CD4, CD5
CO3	CD1, CD2, CD4, CD5
CO4	CD1, CD2, CD4, CD5
CO5	CD1, CD2, 3, CD4, CD5

Course code: EE379

Course Title: Sustainable Energy Sources

Pre-requisite(s): Mathematics, Basic Electrical Engineering, Physics

Syllabus

Module 1:

Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Introduction to wave energy, small hydro-based plants, Hybrid power plants. [**5**]

Module 2:

Introduction of PV cells, panels and their working. Performance of PV plants in different scenarios. Maximum power point methods, Grid-connected single-phase/three-phase PV inverter schemes and control, types of grid interface. Grid codes standards for grid-connected PV systems. [**10**]

Module 3:

Introduction of wind energy, panels, and their working. Power estimation in wind, Wind energy conversion principles, Components of wind energy Conversion Systems. Working principle of different types of wind turbines and their operations. Wind power Conversion Technologies and applications. Integration and control of the different types of wind turbines. [**10**]

Module 4:

Introduction of Energy storage (ESS), and their requirements. Need of energy storage; Different modes of Energy Storage, Working principle of different types of ESS and their operations. Introduction of Fuel cell and their working principle. Electric Vehicle integration (V2G, G2V). [**10**]

Module 5:

Integration of distributed generators to the existing system. Effects on the grid by RE systems integration. Control and operation of various renewable energy resources. Introduction of microgrid. [**10**]

Textbook/References

1. Photovoltaics Fundamentals, Technology, and Practice, Konrad Mertens, Wiley, 2018, ISBN No. 13: 978-1119401049.
2. Bent Sørensen, Renewable Energy, AP , Fifth Edition
3. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, OXFORD , Third Edition

COURSE INFORMATION SHEET

Course Code: EE351

Course Title: Control Theory

Pre-requisite(s): Applied Mathematics, Introduction to System Theory

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 03

Class: B. Tech.

Semester / Level: VI/Third

Branch: EEE

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

A.	State basic concepts of control systems and various methods to represent a system.
B.	Illustrate and interpret a system using time and frequency domain techniques.
C.	Classify different types of systems, solve different control problems and construct root locus, Bode plot and Nyquist plots for different systems.
D.	Examine the time and frequency domain techniques and analyze stability of control systems.
E.	Summarize and design controllers and compensators for systems.

Course Outcomes

After the completion of this course, students will be:

1.	Identify a closed loop system and represent system in terms of block diagram, signal flow graph, state diagrams and state model.
2.	Describe techniques such as root locus, Bode plot and Nyquist plot for a system.
3.	Solve problems and analyze performance and stability of system using time and frequency domain techniques.
4.	Evaluate and judge different controllers for a system
5.	Design compensators for the control system.

Syllabus

Module–I

Introduction: Examples of control systems and applications, Basic components of control systems, Open-loop and closed-loop control systems, Effect of feedback, Classification of the control system. Linearization of nonlinear systems using Taylors series. Modeling. Laplace transform method. Analogous systems. Block diagrams representation of control systems, Block diagram reduction, Signal Flow Graph (SFG)- Basic properties of SFG, SFG algebra, Gain formula to SGP, Application of gain formula to block diagrams. 8

Module–II

Time Domain Analysis of Control Systems: Transient and steady-state response, Time response specifications, Typical test signals, Steady-state error, and error constant, Stability-Absolute, relative and conditional stability, Dominant poles of a transfer function, Root locus concept, Properties and construction of root locus, Determination of relative stability from root locus, Root sensitivity to parameter variation, Root contours, Systems with transportation lag and effect of adding poles or zeros. 8

Module–III

Frequency Domain Analysis of Control Systems: Frequency response specifications, Correlation between time and frequency domain, bode plot, Determination of stability using Bode plot, Nyquist stability criterion, Nyquist Plot, Polar Plot, Theory of Magnitude phase plot, Constant M, constant N circle and Nichols chart. 8

Module–IV

Control System Components and Basic Control Actions: Sensors and encoders in control system, Potentiometer, Tachometers, incremental encoders, Synchros, Operational Amplifiers, Basic control actions: on-off control, P, PI, PD and PID. Introduction to design, lead, lag & lead-lag compensation. 8

Module–V

Concepts of State, State Variables: Development of state-space models. State and state equations, State equations from transfer function Transfer function from state equations, State transition matrix. 8

Textbooks:

- I. J. Nagrath & Gopal, "Control Systems Engineering", 4th Edition New Age International Publication.
- K. Ogata, "Modern Control Engineering",3rd Edition, Pearson Education.

Reference books:

- Norman Nise, "Control System Engineering, 4th Edition, Wiley.
- Graham C. Goodwin, "Control System Design", PHI.
- B. C. Kuo, "Automatic Control System", 7th Edition, PHI.

Gaps in the syllabus (to meet Industry/Profession requirements)

Solving real time problems of industrial applications

POs met through Gaps in the Syllabus: 2, 5, 6

Topics beyond syllabus/Advanced topics/Design:

Controllability and Observability of a system
Response of different types of systems with different inputs using simulation

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment

First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	2	1	2	2	1	1	1	1	1	2	3	3	2
CO2	3	3	3	2	2	1	2	1	1	1		2	3	3	2
CO3	3	3	3	2	2	2	1	1	2	1	2	1	3	3	2
CO4	3	3	3	3	3	2	1	1	1	1	2	2	3	3	3
CO5	3	3	3	1	3	3	2	2	1	1	2	1	3	3	3

Correlation Levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD5
CD2	Tutorials/Assignments	CO2	CD1, CD5, CD8
CD3	Seminars	CO3	CD1, CD2, CD8, CD9
CD4	Mini projects/Projects	CO4	CD1, CD2, CD5, CD8, CD9
CD5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD5, CD8, CD9
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

Course code: EE261

Course Title: Principle of Electrical Machines

Pre-requisite(s): Basic Electrical Engineering

Syllabus

Module I: Electromechanical Energy Conversion: Introduction, flow of energy in electromechanical devices, energy in magnetic systems, singly excited system, determination of mechanical force, mechanical energy, torque equation, doubly excited system, energy stored in magnetic field, electromagnetic torque, generated EMF in machines, torque in machines with cylindrical airgap, general classifications of electrical machines.

Module II: Transformers: construction and principle, types & classification, operation at no load and on load, vector diagrams, equivalent circuit, losses, efficiency and regulation, determination of regulation and efficiency by direct load test and indirect test methods, sumpner's test, parallel operation, autotransformer, condition for maximum efficiency, all-day efficiency. star/star, star/delta, delta/delta, delta/Star, delta/zigzag, vector diagram, phase groups, parallel operation of 3-phase transformer.

Module III: DC Generator: Parts of generator, armature winding, coil pitch, back pitch, front pitch, resultant pitch, commutator pitch, single-layer winding, two-layer winding, multiplex winding, lap & wave winding, dummy coils, types of generators, equalizer connections, EMF & torque equation, total losses and efficiency, armature reaction, compensating winding commutation, methods for improving commutation, inter-poles, performance characteristics of DC generators.

Module IV: DC Motor: Principle of motor, comparison of generator and motor action, back Emf, power & torque, shaft torque, performance characteristics of DC motors, losses & efficiency, power stages, speed control of DC motors, electric braking, necessity of a starter, three point & four point starters, starting of DC motors.

Module V: Alternators : construction of alternators, operation, armature winding, winding factor, EMF equation, phaser diagram, voltage regulation, ampere-turn method, power/power angle characteristics, effect of change of excitation and mechanical input, hunting.

Text books:

1. Principles of electrical machines- v k mehta
2. Electrical Machinery Fundamental – Stephen J. Chapman

Reference books:

1. Electrical Machines – DP Kothari and IJ Nagrath

COURSE INFORMATION SHEET

Course code: EE 353

Course title: Power Electronics

Pre-requisite(s): Analog Electronics, Digital Electronics

Co- requisite(s): Semiconductor devices, Frequency analysis

Credits:	04	L:	T:	P:
		3	1	0

Class schedule per week: 04

Class: B.TECH.

Semester / Level:5

Branch: EEE

Name of Teacher:

Course Objectives:

The course objective is to provide students with an ability to:

A.	Describe various type of high power switches and their switching technique.
B.	Explain operating principle of power electronic converters with voltage and current waveforms and illustrate their applications in electrical technology.
C.	Apply different converters for energy management
D.	Analysis and performance evaluation of power electronics based technology.
E.	Planning and design procedure for a power electronics based system.

Course Outcomes:

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

1.	List different types of high power semiconductor switches and interpret their operating characteristics.
2.	Classify various kinds of power converters. Explain the working principle of power converters. Solve problems of voltage regulation with the help of power converters.
3.	Analysis of power electronic converters using fourier series technique in order to Identify design parameters for high performance converters.
4.	Estimate the cost and long term impact of power based installations.
5.	Reorganize existing power electronics based installations. Develop new power converters and Plan to design a power processing unit. Play the role of a dynamic leader or supporter in a team of skilled professionals.

SYLLABUS

Module–I

Scope of power electronics, Overview of high-power semiconductor switches, two transistor analogy of SCR terminal characteristics, Rating and protection of SCR, Dynamic and static characteristics of MOSFET, IGBT and IGCT, Industrial firing circuit. [10]

Module–II

Dynamic characteristics of SCR, Gate characteristics, series and parallel operation of SCR, power diodes, diode circuits, commutation circuits.
[10]

Module–III

Single phase controlled, Half-wave, Full-wave rectifier with R, RL and RLE loads, Single phase semi-converter, Effect of Source impedance performance, Evaluation of converter using Fourier series analysis, Three phase uncontrolled rectifier with resistive load, Three phase half wave, Full wave rectifiers with R-load,3-phasesemi-converter, RMS, Average value, Fourier analysis, THD, HF and PF of converter. [10]

Module–IV

Chopper, Introduction, Principle of operation control, Strategies, Step-up and step-down chopper, Chopper configuration, Type A, B, C, D & E chopper uses.
[7]

Module–V

Single phase inverter, VSI and CSI, Analysis with R, RL, and RLC loads, 180^o and 120^o mode of operation of 3-phase VSI, SPM, MPM and Sinusoidal PWM techniques, Series inverters, Overview of Electric drive.
[5]

Textbook:

3. M.D. Singh, K. B. Khanchandani, Power Electronics, TMH, New Delhi 2008.
4. P. S. Bimbhra, Power Electronics, Khanna Publications, 5th Edition, New Delhi, 2012.

Reference Book:

1. M.H. Rashid, Power Electronics: Circuits, Device and Applications, 2nd Edn, PHI, New Jersey, 2003.

2. Mohan, Underland, Robbins; Power Electronics Converters, Applications and Design, 3rd Edn. 2003, John Wiley & Sons.

3. R.S. Ramshaw, Power Electronics Semiconductor Switches, Chapman & Hall 2nd Edition, 1993, Chennai.

Gaps in the syllabus:

Role of converters for renewable energy integration

POs met through Gaps in the Syllabus: PO 5

Topics beyond syllabus/Advanced topics/Design:

Assignment: Simulation of grid connected SPV system

POs met through Topics beyond syllabus/Advanced topics/Design: PO 5

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

Students' Feedback on Course Outcome.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	3	3	1	1	1	1	1	1	1	2	2	1
CO2	3	3	3	3	3	2	2	1	1	1	1	1	3	2	2
CO3	3	3	3	3	3	2	2	2	2	1	1	1	3	3	2
CO4	3	3	3	3	3	3	2	2	2	2	2	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

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CD4	Mini Projects/Projects	CO4	CD1 and CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1 and CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code: EEE 421

Title of the course: Power System

Pre-Requisite: - Knowledge of Physics, Mathematics, Principle of Electrical Engineering

Syllabus:

MODULE I

Introduction: Power system structure, Single line diagram, Overview of power generation scenario from thermal, hydro and nuclear and non-conventional sources. Basic component and principle of operation [7]

MODULE II

Introduction: Structure of a power system, Effect of transmission voltage, Different curves: load curves, Load duration curve, Different factors for Power plant operation: Demand factor, Load factor, diversity factor, plant capacity factor, plant utilisation factor, cost of electrical energy, different types of tariff: simple type, flat rate types, bulk rate, two part, three-part tariff, availability based tariff. [12]

MODULE III

O/H lines: Types of conductors, bundle conductor, resistance calculation, skin effect, inductance and capacitance of overhead lines: Inductance and capacitance of single-phase line, Overhead line insulators: Types of insulators, potential distribution over a string of suspension insulators, Underground cable: types, extra high voltage cables: electrostatic stresses [10]

Module IV

Transmission System: Performance of transmission line, representation of short, medium and long transmission lines, Ferranti effect, SIL, Tuned Power Line, Power flow through transmission lines. [7]

Module V

Distribution Systems: Feeders, distributors, and service mains, redial and ring main system, different types of DC and AC distribution systems, calculation, Voltage control: Dependency on reactive power, method of reactive power injection at load end. [9]

Textbooks:

1. Power System Analysis – Hadi Saadat, Tata McGraw-Hill Edition.
2. Power System Engineering – A. Chakrabarti, M. L. Soni, P. V. Gupta, U. S. Bhatnagar

Reference Books:

1. Modern Power System Analysis – D. P. Kothari, I. J. Nagrath, Tata-McGraw Hill.
2. Electric Energy Systems Theory - An Introduction – O. I. Elgerd, TMH Edition.
3. Electric Power System – C. L. Wadhwa, New Age International Publishing.
4. Principles of Power System - V.K.Mehta and Rohit Mehta, S.Chand

Course code: EE 475

Course Title: Nonlinear and Adaptive Control

Pre-requisite(s): Control Theory

Syllabus:

Module – 1

Introduction to nonlinear systems, Types of nonlinearities and their characteristics, nonlinear properties, Limit cycle, Singular points, Linear approximation of nonlinear systems. [6]

Module – 2

Phase plane analysis: Phase plane representation, Phase portrait, graphical method to obtain phase trajectory, describing function analysis: Definition, Derivation of Describing functions for common nonlinear elements, Determination of amplitude and frequency of limit cycle using describing function technique. [9]

Module - 3.

Direct method of Lyapunov: Introduction, Basic concepts, Stability definitions, Stability theorems, Lyapunov functions for nonlinear systems, Feedback Linearization: Motivation, Input-output linearization, Full state linearization, State feedback control. [9]

Module – 4.

Introduction to Adaptive Control, On-line Parameter Estimation, Spectral estimation, Optimum (Wiener and Kalman) linear estimation, Parameter Identifiers and Adaptive Observers. [8]

Module – 5

Model Reference Adaptive Control (MRAC): Direct MRAC Schemes, MRAC for SISO Plants, Direct MRAC with Unnormalized Adaptive Laws, Direct MRAC with Normalized Adaptive Laws. [8]

Textbooks:

1. M. Gopal, “Digital Control & State Variable Method”, TMH
2. B.C.Kuo, “Automatic Control System”7th Edition PHI

Reference books:

1. Slotine and Li, “Nonlinear Control Systems”
2. Hassan K.Khalil, “Non Linear Systems”.

Shankar Sastry, Marc Bodson, “Adaptive Control”, Prentice Hall Information and System Science Series.

In-depth course for EEE Departments

Semester of Study (Recommended)	Category of course	Course Code	Subjects	Credits
FIFTH	Group-I (POWER SYSTEM)	EE377	Industrial Instrumentation	4
SIXTH		EE379	Sustainable Energy Sources	4
SIXTH		EE481	Advanced Power System Analysis and Control	4
SEVENTH		EE479	Smart Power System	4
SEVENTH		EE452	Advanced Electrical Engineering Laboratory	2
FIFTH	Group-II (POWER ELECTRONICS)	EE377	Industrial Instrumentation	4
SIXTH		EE379	Sustainable Energy Sources	4
SIXTH		EE477	Power Conversion Techniques	4
SEVENTH		EE557	Power Electronics Applications	4
SEVENTH		EE452	Advanced Electrical Engineering Laboratory	2
FIFTH	Group-III (CONTROL SYSTEM)	EE377	Industrial Instrumentation	4
SIXTH		EE379	Sustainable Energy Sources	4
SIXTH		EE475	Non-linear and Adaptive Control	4
SEVENTH		EE375	Sensing Technology and Applications	4
SEVENTH		EE452	Advanced Electrical Engineering Laboratory	2

Course code: EE377

Course Title: Industrial Instrumentation

Pre-requisites: Electrical Measurement and Instrumentation

Co-requisites:

Syllabus

Module I

Introduction to Instrumentation system: Characteristics of Instrument. Actuators, Transducers, Transmitters, Final control elements. Introduction to electronic, pneumatic, digital, and electrical transmitters. Hardware/software sensor linearization techniques.

[9]

Module II

Signal conditioning: Introduction, Interfacing circuits, Amplifiers, Modulation, Demodulation, Filtering. Basics of Data transmission: IEEE-488 bus, RS 232, and RS 485 interface. Pneumatic and Hydraulic Instrumentation system. Smart transmitters. HART protocol. Overview of sensor-actuator networks, field bus. [9]

Module III

Measurement of velocity and acceleration: Actuation, Transduction, Transmission and Control for tachometers, stroboscopes, gyroscope, accelerometers. Proximity Sensors. Flow measurement: Fluid properties. Flowmeters. Criteria for selection of flowmeters.

[9]

Module IV

Measurement of Pressure: Elastic pressure sensors. Pressure gauge. Pressure switch. Actuator and Electronic pressure transmitters. Calibration and installation of pressure measuring devices. Measurement accessories. Vacuum measurement. Level measurement: Point level measurement, Continuous level measurement. [9]

Module V

Force and Torque measurement systems: Strain gauge signal processing. Load cells. Introduction to industrial weighing systems and belt conveyor weighing systems. Weigh feeders. Principle of torque measurement in rotating shafts. Introduction to vibration measurement and monitoring.

[9]

Textbooks

1. Principles of Industrial Instrumentation, D. Patranabis, Tata McGraw Hill.
2. Measurement Systems Application and Design, E.O. Doebelin, Tata McGraw Hill.
3. Fundamentals of Industrial Instrumentation, Alok Barua, Wiley.
4. Measurement & Instrumentation: Trends & Applications, M.K. Ghosh, S. Sen, and S. Mukhopadhyay.

Reference books

1. Liptak B.G, Instrumentation Engineers Handbook (Measurement), Chilton Book Co.,
2. John G Webster, Measurement, Instrumentation and Sensors, Handbook, CRC Press.
3. Principles of Measurement, John Bentley, Pearson.

4. Measurement and Instrumentation Principles, A. S. Morris, Butterworth-Heinemann.

Course code:EE379

Course Title: Sustainable Energy Sources

Pre-requisite(s): Mathematics, Basic Electrical Engineering, Physics

Syllabus

Module 1:

Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Introduction to wave energy, small hydro-based plants, Hybrid power plants.
[**5**]

Module 2:

Introduction of PV cells, panels and their working. Performance of PV plants in different scenarios. Maximum power point methods, Grid-connected single-phase/three-phase PV inverter schemes and control, types of grid interface. Grid codes standards for grid-connected PV systems.
[**10**]

Module 3:

Introduction of wind energy, panels, and their working. Power estimation in wind, Wind energy conversion principles, Components of wind energy Conversion Systems. Working principle of different types of wind turbines and their operations. Wind power Conversion Technologies and applications. Integration and control of the different types of wind turbines.
[**10**]

Module 4:

Introduction of Energy storage (ESS), and their requirements. Need of energy storage; Different modes of Energy Storage, Working principle of different types of ESS and their operations. Introduction of Fuel cell and their working principle. Electric Vehicle integration (V2G, G2V).
[**10**]

Module 5:

Integration of distributed generators to the existing system. Effects on the grid by RE systems integration. Control and operation of various renewable energy resources. Introduction of microgrid.
[**10**]

Textbook/References

4. Photovoltaics Fundamentals, Technology, and Practice, Konrad Mertens, Wiley, 2018, ISBN No. 13: 978-1119401049.
5. Bent Sørensen, Renewable Energy, AP , Fifth Edition
6. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, OXFORD , Third Edition

Course Code: EE481

Course Title: Advanced Power System Analysis and Control

SYLLABUS

Module I

Introduction: Modelling of power system component, Basic single-phase modeling, Generation, Transmission line, transformer, Shunt elements. [8]

Module II

Load Flow Analysis: Introduction, Nature of load flow equations, Newton Raphson method: Formulation for load buses and voltage-controlled buses in rectangular and polar coordinates, Computational steps and flowchart, Computational Aspects of Large-Scale System-Introduction, Sparsity oriented technique for reducing storage requirements, Factorization. [8]

Module III

Short Circuit Analysis: Introduction, Bus impedance matrix, and its building algorithm through modifications, Fault calculation uses Zbus and its computational steps. Symmetrical and Unsymmetrical faults. [8]

Module IV

Contingency Analysis: Introduction to power system security, Factors affecting power system security, Analysis of single contingencies, Linear sensitivity factors, Analysis of multiple contingencies, Contingency ranking. State Estimation: Introduction, weighted least square technique, Statistics, Errors and estimates. [8]

Module V

Load Frequency Control - Introduction, Types of speed governing system and modeling, Mechanical, Electro-hydraulic, Digital electro-hydraulic governing system, Turbine modeling, Generator-load modeling, Steady-state and dynamic response of ALFC loop, the secondary ALFC loop, Integral control. [8]

Textbooks:

1. Power System Analysis - John J. Grainger, William D. Stevenson,Jr.
2. Power System Analysis - L. P.Singh
3. Power Generation Operation and Control - A.J. Wood, B.F. Wollenberg, John Wiley 7 Sons, 2nd Edition

Reference Books:

1. Electric Energy Systems Theory - An Introduction, O.L.Elgerd.
2. Computer Modelling of Electrical Power Systems - J. Arrillaga, N.R.Watson
3. Power System harmonic Analysis, J. Arrillage, B.C. Smith, etal.

Course code: EE479

Course Title: Smart Power System

Pre-requisite(s): Power system courses, power electronics.

Syllabus

Module-1

Introduction: Basics about Power Grid operation, Smart Grid: The Definitions, Characteristics of Smart Grid, Traditional Grid Versus Smart Grid, Evolution of Smart Grid, Components of Smart Grid, smart grid operation and control architecture, The key challenges, Case studies: 2012 blackout and requirement of new technology.

[10]

Module-2

Smart Grid and Generation: Active Distribution network and Micro-grid, Micro-Grid Structure, Basic Concepts of Solar and Wind Generation, Different issues of Grid-tied inverter, Grid following and grid forming issues in islanding., Different disadvantages: Managing renewable intermittency in smart grid, Energy storage system for smart grid application, stability issues.

[10]

Model-3

Smart Grid and transmission system: Introduction, Wide-area monitoring system, Phasor measurement units (PMUs) smart meters, multi-agent system technology, phasor measurement techniques: introduction, phasor estimation of nominal frequency signals, phasor updations using non-recursive and recursive updates, phasor estimation at off-nominal frequency input, hierarchy of phasor measurement systems, communication options for PMUs, functional requirements of PMUs and phasor data concentrators (PDCs). [8]

Module 4

Smart Grid and Communication system: Introduction, Role of communication in smart grids, Bluetooth-IEEE 802.15.1, ZigBee Technology, Ultra Wideband- IEEE 802.15.3a, TCP over wireless network: Overview of traditional TCP, Impact on the performance of TCP over wireless environment, Link Layer scheme (Snoop Protocol), The I-TCP protocol, The mobile TCP Protocol, IPv4 vs IPv6 : IPv4 and IPv6 addressing IPv4 and IPv6 header format, IPv4 option, IPv6 extension header, IPv5 routing architecture, QoS capabilities, IPv6 transition mechanism.

[10]

Module 5

Smart Grid and Demand Response: Introduction, demand response, Types of demand Response Programmes, Benefits of demand response programs, Advanced metering infrastructure, quantification of financial benefit of generation utility and distribution utility, Basic concept of big-data analysis. [8]

Test Book:

1. Smart Grids: opportunities, developments and trends by A.B.M Shawkat Ali, publisher : Springer, ISBN: 978-1-4471-5209-5
2. A.G. Phadke J.S. Thorp, “Synchronized Phasor Measurements and their Applications”, springer 2008
3. Wireless Communication & Networking by Vijay K. Garg, Elsevier.

Course code: EE 475

Course Title: Nonlinear and Adaptive Control

Pre-requisite(s): Control Theory

Syllabus:

Module – 1

Introduction to nonlinear systems, Types of nonlinearities and their characteristics, nonlinear properties, Limit cycle, Singular points, Linear approximation of nonlinear systems. [6]

Module – 2

Phase plane analysis: Phase plane representation, Phase portrait, graphical method to obtain phase trajectory, describing function analysis: Definition, Derivation of Describing functions for common nonlinear elements, Determination of amplitude and frequency of limit cycle using describing function technique. [9]

Module - 3.

Direct method of Lyapunov: Introduction, Basic concepts, Stability definitions, Stability theorems, Lyapunov functions for nonlinear systems, Feedback Linearization: Motivation, Input-output linearization, Full state linearization, State feedback control. [9]

Module – 4.

Introduction to Adaptive Control, On-line Parameter Estimation, Spectral estimation, Optimum (Wiener and Kalman) linear estimation, Parameter Identifiers and Adaptive Observers. [8]

Module – 5

Model Reference Adaptive Control (MRAC): Direct MRAC Schemes, MRAC for SISO Plants, Direct MRAC with Unnormalized Adaptive Laws, Direct MRAC with Normalized Adaptive Laws. [8]

Textbooks:

3. M. Gopal, "Digital Control & State Variable Method", TMH
4. B.C.Kuo, "Automatic Control System"7th Edition PHI

Reference books:

3. Slotine and Li, "Nonlinear Control Systems"
4. Hassan K.Khalil, "Non Linear Systems".
5. Shankar Sastry, Marc Bodson, "Adaptive Control", Prentice Hall Information and System Science Series.

Course code: EE477

Course Title: Power Conversion Techniques

Prerequisite (s): Power electronics

Corequisite (s): Network Theory

Syllabus

Module 1:

Introduction: Basic concept of gate drivers (Triggering techniques, optical isolators, protection circuits, and isolation transformers), snubber design and protection schemes of power devices, Analysis of switched circuits- thyristor controlled half-wave rectifier – R, L, RL, RC load circuits, classification, and analysis of commutation.
[10]

Module 2:

AC-DC Conversion: Single-phase and three-phase AC to DC converters- operating domains of three-phase full converters and semi-converters, Reactive power considerations, Pulse width modulation techniques for converters, PWM rectifiers, Design and control of front-end converter.
[8]

Module 3:

DC-DC Conversion: Analysis and design of DC-DC converters- Control of DC-DC converters, Steady-state analysis of Buck, Boost, Buck-Boost, and Cuk converter. Advanced DC-DC converter topologies. [10]

Module 4:

DC-AC Conversion: Single phase and three-phase inverters, Voltage source and current source inverters, Voltage control and harmonic minimization in inverters, Applications of voltage source converters, Improved power quality converters (non-isolated and isolated) for reduction of harmonics at AC mains. [10]

Module 5:

AC-AC Conversion: AC to AC power conversion using voltage regulators, AC to AC Converters with a DC Link, Matrix Converters, and Different type of cyclo-converters, consideration of harmonics, Applications of AC-AC converters.
[7]

Textbooks (T):

1. Umanand, L., 2009. *Power Electronics: Essentials and Applications*. Wiley India Pvt. Limited.
2. Krein, P.T., 1998. *Elements of power electronics* (Vol. 126). New York: Oxford University Press.

Reference Books (R):

1. Batarseh, I., 2004. *Power electronic circuits*. John Wiley.
2. Wu, K.C., 2005. *Switch-mode power converters: Design and analysis*. Elsevier.

Course code: EE459

Course Title: Introduction to Power Electronics

Pre-requisite(s): Basic Electronics

Corequisite(s): Circuit Theory, Basic electrical

Syllabus

MODULE – I

Introduction to Power electronics: Difference between small signal electronics and power electronics, qualitative analysis of different types of power supplies, linear power regulator, switched mode power regulator.
[8]

MODULE – II

Specification of Power Electronic Devices:

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy.
[10]

MODULE – III

Current Controlled Devices: BJT's – Construction, static characteristics, switching characteristics; Negative temperature coefficient and second breakdown; – Thyristors – Physical construction and operating principle, Two transistor analogy – concept of latching.
[8]

MODULE – IV

Voltage Controlled Devices: Power MOSFETs and IGBTs – Principle of voltage-controlled devices, construction, types, static and switching characteristics, steady-state and dynamic models of MOSFET and IGBTs – and IGCT.
[8]

MODULE – V

Firing and Protection Circuits: Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. – Over voltage, over current and gate protections; Design of snubbers.
[6]

Text Book:

1. Power Electronics by Md.Rashid
2. Gopal Dubey, "Power semiconductor controlled Drives", Prentice Hall Inc., NewJersey, 1989.
3. Krishnan R., "Electric Motor Drives- Modeling, Analysis and Control", PrenticeHall of India Pvt. Ltd., New Delhi, 2007.
4. Werner Leonhard, "Control of Electrical Drives", 3rd Edition, Springer, Sept.,2001

Reference Book:

1. Bimal K.Bose, "Modern power electronics and AC drives", Pearson Education(Singapore) Ltd., New Delhi, 2005.
2. Murphy J.M.D, Turnbull, F.G, "Thyristor control of AC motor", Pergamon press, Oxford, 1988

3. Sheperal, Wand Hully, L.N. "Power Electronic and Motor control" Cambridge University Press Cambridge, 1987.

4. Dewan, S. Slemon B., Straughen, A. G.R., "Power Semiconductor drives", John Wiley and Sons, NewYork, 1984.

Course code: EE375

Course Title: Sensing Technology and Applications

Pre-requisites: Electrical Measurement and Instrumentation

Syllabus

Module I

Sensing principles, sensor architecture, sensor types and classification, characteristics, Sensor modeling in time and frequency domain. [5]

Module II

Micro machining techniques- bulk, surface and other micromachining methods, Photolithography, Wet and Dry Etching, Thin Film Deposition and Growth Electroplating, Molding, Bonding and Sacrificial Processes, Polymer Processing and Rapid Prototyping. Microelectronics compatible sensors technology; principles of design, fabrication, and characterization of miniature sensors. [10]

Module III

Sensors for physical measurands: Strain, force, pressure, acceleration, flow, volume, temperature, bio-potentials. Sensors for chemical analytes: Amperometric sensors, Potentiometric sensors, Conductometric sensors, Impedimetric sensors, Ion-selective electrodes, ISFETs, Clark electrode. [10]

Module IV

Optical sensors, Absorbance based sensors, Fluorescence based sensors, Nanotechnology and Nanoparticle based sensors. μ-TAS: Fluid Control Components, Sample Handling, Separation Components and Detection. [10]

Module V

Biosensors: Introduction, Classification, Immunosensors, Catalytic sensors. Miniature Biosensors, Biosensor Arrays and Implantable Devices Smart/Intelligent sensors, sensor arrays and networks. [10]

<u>Reference books</u>

1. Microsystem Technology in Chemistry and Life Sciences, A. Manz and H. Becker, Eds., Springer-Verlag, New York, 1999.
2. Fundamentals of Microfabrication: The Science of Miniaturization, Marc J. Madou, Second Edition, CRC Press; 2nd edition, 2002.
3. John G. Webster (ed.): Medical Instrumentation - Application and Design; Houghton Mifflin Co., Boston, 1992.
4. Richard Aston: Principles of Biomedical Instrumentation and Measurement, Merril Publishing Co., Columbus, 1990.
5. Richard S.C. Cobbold: Transducers for Biomedical Measurements: Principles and Applications, John Wiley & Sons, 1974.
6. Ernest O. Doeblin: Measurement Systems, Application and Design, McGraw-Hill, 1985.
7. A.P.F. Turner, I. Karube& G.S. Wilson: Biosensors: Fundamentals & Applications, Oxford University Press, Oxford, 1987.

Open Elective courses offered by EEE Departments

	Course Code	Subjects	Credits
OE-I	EE203	Electric Energy Generation & Control	3
	EE255	Signals and Systems	3
	EE257	Solar Photovoltaics: Photons to Farms	3
OE-II	EE361R1	Linear Control Theory	3
	EE363	Sensors: Fabrication and Applications	3
	EE365	Introduction to Sustainable Energy	3
OE-III	EE457	Fundamentals of Power System	3
	EE459	Introduction to Power Electronics	3
	EE425	Robotics	3
OE-IV	EE453	Machine Electronics	3
	EE519	Computational Techniques in Electrical Engineering	3

Course code: EE203

Course Title: Electric Energy Generation and Control

Pre-requisite(s): Basic knowledge about working of alternator and electric power systems

Syllabus

Module – I:

Overview of Power Generation Scenario and Thermal Power Stations Overview of power generation scenario from thermal, hydro and nuclear and non-conventional sources. Selection of site for a thermal station, layout, main components, boiler, economizer, air preheater, super heater, reheater, condenser, feed heater, cooling powers, FD and ID fans, Coal handling plant, water treatment plant, Ash handling plant, Types of boilers and theirs characteristics, Steam turbines, and their characteristics, governing system for thermal stations.

Module – II:

Hydro Electric Stations Selection of site, layout, classification of hydro plants, general arrangement and operation of a hydro - plant, governing system for hydel plant, types of turbines.

Module – III:

Nuclear Power Station Nuclear reaction for nuclear power, nuclear fuels, feasibility of a nuclear power station, layout, main part of a nuclear station, nuclear reactor classification, control system for nuclear power station, Safety of nuclear power reactor.

Module – IV:

Diesel Electric Station Site selection, layout, main components, choice and characteristics of diesel engines, diesel engines, diesel plant efficiency and heat balance, maintenance.

Module – V:

Non-conventional Sources of Energy Solar: Operating principles. Photovoltaic cell concepts. Cell, module, array. Series and parallel connections. Maximum power point tracking, Wind: Operating principles, types of wind turbines, Bio-Mass, Tidal.

Textbooks:

1. Power Plant Engineering - PK Nag TMH publications, 2nd Edition.
2. A Textbook on Power System Engg. – A Chakravarti, ML Soni, PV Gupta and U.S. Bhatnagar, Dhanpat Rai & Co., New Delhi, 2nd Edition.

Reference Books:

1. Elements of Electrical Power Station Design-MV Deshpande, Pitman and Sons Ltd.
2. Electric Power Generation, Transmission and Distribution - S.M. Singh, Prentice Hall of India, Delhi.
3. Generation, Distribution and Utilization of Electrical Power – C.L. Wadhwa, New Age Publications.

Course code: EE255

Course title: **Signals and Systems**

Pre-requisite(s): Physics, Mathematics and Basics of Electrical Engineering

SYLLABUS

MODULE I: Objectives and overview: Signals and systems: Definition, Basis of classification, Representation of common signals and their detailed properties, System modeling. Analogous System: Introduction, D Alembert's Principle, Force – voltage and Force – Current analogies, Electrical analogue of mechanical, hydraulic and Thermal systems.

MODULE II: Mathematical Tools: Laplace Transform Method: Introduction, Laplace transform pair, Laplace transformation of common functions, Gate function, Step function and impulse function, Laplace theorems shifting, initial value, final value and convolution theorems. Inverse Laplace transform by partial fraction expansion and convolution integral method. Fourier Transform Method: Introduction, Fourier transform pair, Amplitude spectrum and phase spectrum of signals, Sinusoidal transfer function.

MODULE III: Application of Mathematical tools for System Analysis: System Analysis by Laplace Transform Method, Natural, forced transient and steady-state responses, Transfer function and characteristic equation, Concept of poles and zeros, System response for first and second-order systems, nature of system response from poles and zeros. Analysis of electrical and mechanical systems.

MODULE IV: System Stability: Concept of stability for analog and digital systems, Types of stability, Necessary and sufficient conditions, Routh Hurwitz stability criterion, Limitations, and its applications to closed-loop systems, relative stability using Routh Hurwitz stability criterion, Jury's stability criterion.

MODULE – V State-Space Analysis: Introduction, Definition: State, State variable, State vector and state space, State-space representation, Derivation of State model from transfer function, Bush form and diagonal canonical form of state model, non-uniqueness of state model, Derivation of the transfer function from state model, Transition matrix and its properties, Solution of time-invariant state equation.

Textbooks:

1. Analysis of Linear Systems – D. K. Cheng, Narosa Publishing House, Indian Student Edition
2. Control System Engineering – Nagrath & Gopal , New Age International Publication

Reference books:

1. Modern Control Engineering- K Ogata, Pearson Education.
2. Automatic Control System- B C Kuo,, PHI.
3. An Introduction to Analog and Digital Communication Systems-Simon Haykin, John Wile & Sons, 1989.
4. Modern Digital and Analog Communication Systems-Lathi B.P, 3rd Edition, Oxford University Press, 1998.

Course code: EE257

Course Title: Solar Photovoltaics: Photons to Farms

Pre-requisite(s): Mathematics, Electrostatics, Physics

Syllabus

Module 1:

Introduction: Need and prospects of photovoltaics, solar PV cells basics, important optoelectronic properties of materials, fundamental limits: single junction, multi-junction. tandem device configurations for efficient collection of photo-generated carriers: PN (c-Si), PIN (Organic, perovskite), Carrier-selective tandem. [**8L**]

Module 2:

From cell to Module, Equivalent circuits, small area to large area device, large area device to module, series vs. parallel connections, bifacial modules, module in practical conditions, degradation mechanisms, monitoring, performance assessment considering environmental factors, predictive modeling. [**8L**]

Module 3:

Basics of solar energy conversion, modeling of photovoltaic power plants, DC Side modeling (cells, modules, arrays, generation of module file), AC side modeling (inverters, transformers, grid connection), algorithms for modeling solar irradiance, module temperature, shading, soiling. [**8L**]

Module 4:

System level concerns for grid connected PV and standalone PV, levelized cost of electricity (panel vs. balance of systems), power systems aspects, variability, storage, solar farms. [**8L**]

Module 5:

Modeling and simulation of grid connected and standalone PV systems using software tools such as MATLAB, PSIM, PSpice etc. [**5L**]

Textbook/References

1. Photovoltaics Fundamentals, Technology, and Practice, Konrad Mertens, Wiley, 2018, ISBN No. 13: 978-1119401049.
2. Solar Cells: Operating Principles, Technology and System Applications, Martin A. Green, Prentice-Hall, 1986, ISBN No. 13: 978-0138222703.
3. Solar Energy Fundamentals, Technology, and Systems, Smets Arno et al., UIT Cambridge, ISBN: 9781906860325, 9781906860325

Course code: EE361R1

Course Title: Linear Control Theory

Pre-requisite(s): Principles of Electrical Engineering, Basic knowledge of mechanics, Basic knowledge of mathematics

Syllabus

MODULE – I:

Systems: Definition, Basis of classification, Representation of common signals and their properties, Laplace Transform concept and application. General Control System: Introduction, Open loop and closed loop control system modelling. (8)

MODULE – II:

Analogous System: Introduction, Mathematical modelling, D Alembert's Principle, Force –voltage and Force – Current analogies, Transfer function, Mathematical modelling of various physical system Electrical analogue of mechanical, hydraulic and Thermal systems. etc. feedback and feed-forward control system control system a) Block diagram reduction Technique b) signal flow graph (8)

MODULE – III:

Time domain Analysis: Steady state and transient analysis of first and second order systems, steady state errors, error constants, Performance specification in Time domain, Type of feedback control system. Proportional, Integral and derivative Control, PID controller. (8)

MODULE – IV:

Root Locus Method: Root locus Concept, Properties and construction of root locus, Determination of relative stability from root locus, Stability, Frequency domain analysis: Frequency domain specification, Bode Plot, Stability in frequency domain. (8)

MODULE – V:

Introduction, Definition: State, State variable, State vector and state space, State and state space representation, Derivation of State model from transfer function, Derivation of transfer function from state model, Transition Matrix and its properties, Solution of time-invariant state equation. (8)

Textbooks:

1. Control System Engineering – Nagrath& Gopal, New Age International Pvt. Ltd., New Delhi, 4nd edition.
2. Modern Control Theory- K. Ogata, Pearson Education, 4nd edition

Reference Books:

1. Control System Engineering, Norman Nise , 4th Edition , wiley
2. Control System Design, Graham C.Goodwin, PHI

Course code: EE363

Course title: Sensors: Fabrication and Applications

Pre-requisites: Basics of Electrical Engineering, Chemistry, Biological Sciences

Syllabus

Module I

Sensing principles, sensor architecture, sensor types and classification, characteristics, Sensor modeling in time and frequency domain. [4]

Module II

Micromachining techniques- bulk, surface and other micro machining methods, Photolithography, Wet and Dry Etching, Thin Film Deposition and Growth Electroplating, Molding, Bonding and Sacrificial Processes, Polymer Processing and Rapid Prototyping. [6]

Module III

Sensors for physical measurands: Strain, pressure, acceleration, flow, volume, temperature, bio-potentials. Sensors for chemical analytes: Amperometric sensors, Potentiometric sensors, Impedimetric sensors, Ion-selective electrodes, ISFETs, Clark electrode. [10]

Module IV

Optical sensors, Absorbance based sensors, Fluorescence based sensors, Nanoparticle based sensors. μ-TAS: Fluid Control Components, Sample Handling, Separation Components and Detection. [9]

Module V

Biosensors: Introduction, Classification, Immunosensors, Catalytic sensors. Miniature Biosensors, Biosensor Arrays and Implantable Devices Smart/Intelligent sensors, sensor arrays and networks. [9]

Reference books

1. Microsystem Technology in Chemistry and Life Sciences, A. Manz and H. Becker, Eds., Springer-Verlag, New York, 1999.
2. Fundamentals of Microfabrication: The Science of Miniaturization, Marc J. Madou, Second Edition, CRC Press; 2nd edition, 2002.
3. John G. Webster (ed.): Medical Instrumentation - Application and Design; Houghton Mifflin Co., Boston, 1992.
4. Richard Aston: Principles of Biomedical Instrumentation and Measurement, Merril Publishing Co., Columbus, 1990.
5. Richard S.C. Cobbold: Transducers for Biomedical Measurements: Principles and Applications, John Wiley & Sons, 1974.
6. Ernest O. Doeblin: Measurement Systems, Application and Design, McGraw-Hill, 1985.
7. A.P.F. Turner, I. Karube& G.S. Wilson: Biosensors: Fundamentals & Applications, Oxford University Press, Oxford, 1987.

Course code: EE365

Course Title: Introduction to Sustainable Energy

Pre-requisite(s): Mathematics, Basic Electrical Engineering, Physics

Syllabus

Module 1: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. [**4L**]

Module 2: Introduction of PV cells, panels and their working. Performance of PV plants in different scenarios. [**8L**]

Module 3: Introduction of wind energy, panels and their working. Working principle of different types of wind turbines and their operations. [**10L**]

Module 4: Introduction of Energy storage (ESS), and their requirements. Working principle of different types of ESS and their operations. Introduction of Fuel cell and their working principle. [**8L**]

Module 5: Integration of distributed generators to the existing system. Control and operation of various renewable energy resources. [**8L**]

Textbook/References

1. Photovoltaics Fundamentals, Technology, and Practice, Konrad Mertens, Wiley, 2018, ISBN No. 13: 978-1119401049.
2. Bent Sørensen, Renewable Energy, AP , Fifth Edition
3. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, OXFORD , Third Edition

Course Code: EE 457

Course Title: Fundamentals of Power System

Pre-requisite(s): EE101 Basics of Electrical Engineering, MA 107 Mathematics-I

Syllabus

Module – I

Introduction: Importance of Power System, Power system supply structure, Single line diagram, Overview of power generation scenario from conventional and non-conventional sources. Basic component and principle of operation. **8**

Module – II

Factors for the operation of Power plant: Demand factor, Load factor, diversity factor, plant capacity factor, plant utilization factor, economic factor, Tariffs, and its needs, different types of tariffs: simple type, flat rate types, bulk rate, two-part, three-part tariff, availability based tariff. Load Characteristics: load curves, Load duration curve. **8**

Module – III

Transmission System: Performance of transmission line, representation of short, medium and long transmission lines, Ferranti effect, SIL, Tuned Power Line, Power flow through transmission lines, O/H lines: Types of conductors, bundle conductor, resistance calculation, skin effect, inductance and capacitance of single-phase lines, Underground cable: types, extra-high voltage cables: electrostatic stress. Concepts of Overhead line insulators. **8**

Module – IV

Distribution Systems: Feeders, distributors, and service mains, radial and ring main system, different types of DC and AC distribution systems, calculation, Voltage control: Dependency on reactive power, method of reactive power injection at load end. **8**

Module – V

Introduction to power system protection: Need for protection, basic structure of protection, types, application in different parts of power system. **8**

Textbooks:

1. Power System Analysis – Hadi Saadat, Tata McGraw-Hill Edition.
2. Power System Engineering – A. Chakrabarti, M. L. Soni, P. V. Gupta, U. S. Bhatnagar

Reference Books:

1. Modern Power System Analysis – D. P. Kothari, I. J. Nagrath, Tata-McGraw Hill.
2. Electric Energy Systems Theory - An Introduction – O. I. Elgerd, TMH Edition.
3. Electric Power System – C. L. Wadhwa, New Age International Publishing.
4. Principles of Power System - V.K.Mehta and Rohit Mehta, S.Chand

Course code: EE459

Course Title: Introduction to Power Electronics

Pre-requisite(s): Basic Electronics

Corequisite(s): Circuit Theory, Basic electrical

Syllabus

MODULE – I

Introduction to Power electronics: Difference between small signal electronics and power electronics, qualitative analysis of different types of power supplies, linear power regulator, switched mode power regulator. [8]

MODULE – II

Specification of Power Electronic Devices:

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy. [10]

MODULE – III

Current Controlled Devices: BJT's – Construction, static characteristics, switching characteristics; Negative temperature coefficient and second breakdown; – Thyristors – Physical construction and operating principle, Two transistor analogy – concept of latching. [8]

MODULE – IV

Voltage Controlled Devices: Power MOSFETs and IGBTs – Principle of voltage-controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs – and IGCT. [8]

MODULE – V

Firing and Protection Circuits: Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. – Over voltage, over current and gate protections; Design of snubbers. [6]

Text Book:

5. Power Electronics by Md.Rashid
6. Gopal Dubey, "Power semiconductor controlled Drives", Prentice Hall Inc., NewJersey, 1989.
7. Krishnan R., "Electric Motor Drives- Modeling, Analysis and Control", PrenticeHall of India Pvt. Ltd., New Delhi, 2007.
8. Werner Leonhard, "Control of Electrical Drives", 3rd Edition, Springer, Sept.,2001

Reference Book:

5. Bimal K.Bose, "Modern power electronics and AC drives", Pearson Education(Singapore) Ltd., New Delhi, 2005.
6. Murphy J.M.D, Turnbull, F.G, "Thyristor control of AC motor", Pergamon press, Oxford, 1988
7. Sheperal, Wand Hully, L.N. "Power Electronic and Motor control" Cambridge University Press Cambridge, 1987.
8. Dewan, S. Slemon B., Straughen, A. G.R., "Power Semiconductor drives", John Wiley and Sons, NewYork, 1984.

Coursecode:EE425

Course Title: Robotics

Pre-requisite(s): Engineering Mathematics, Signals and systems, Control Theory, Basic programming knowledge.

Corequisite(s):

Syllabus

Module–I

Introduction of Robotics: Evolution of Robots and Robotics. What is and what is not a robot. Robot classification. Robot specifications. Robot applications. Direct Kinematics: Coordinate frames; Rotations; Homogeneous coordinates; D-H representation; The Arm Equation **Inverse Kinematics:** Inverse kinematics problem. General properties of solutions. Tool configuration. Robotic work cell.

Module–II

Workspace Trajectory and Trajectory Planning: Workspace analysis. Workspace envelope. Workspace fixtures. Pick and place operation. Continuous-path motion. Interpolated motion. Straight line motion.

Module–III

Sensing and Control of Robot Manipulators: Computed torque control; Near Minimum time control; Variable structure control; Non-Linear decoupled feed-back control; Resolved motion and Adaptive control. **Robotic Sensors:** Different sensors in robotics: Range; Proximity; Touch; Torque; Force and others.

Module–IV

Robotic Vision: Image acquisition. Imaging geometry, Image processing: Pre-processing; Segmentation and Description of 3-D structures; Recognition and interpretation.

Module–V

Robot Programming Languages: Characteristics of Robot level languages. Task level languages: Task planning; Problem reduction; Use of predicate logic; Robot learning; Expert systems.

Textbooks:

3. Fundamental of Robotics: Analysis and Control-Robert J. Schilling.
4. Robotics: Control, Sensing, Vision and Intelligence-K. S. Fu, R. C. Gonzalezand Lee.

Reference books:

2. Robotics and Control–R. K. Mittal and I. J. Nagrath.

Course code: EE4033

Course Title: Machine Electronics

Pre-requisite(s): Power electronics

Corequisite(s): Basic electrical circuit analysis, DC-DC converters, AC-DC converters

Syllabus

MODULE – I

Introduction to Power electronics: Characteristics of semiconductor power devices-Silicon Controlled Rectifier (SCR), Gate Turn-off Thyristor (GTO), Power Bipolar Transistor, Power MOSFET, Insulated Gate Bipolar Transistor (IGBT). SCR firing circuit and commutation circuits.

MODULE – II

Different types of chopper-based DC drives:

Introduction to time ratio control and frequency modulation; class A, B, C, D, and E chopper-controlled DC motor – performance analysis, multi-quadrant control –chopper-based implementation of braking schemes. Modeling of drive elements – Equivalent circuit, the transfer function of the self, separately DC motors

MODULE – III

DC-AC (inverter fed AC drives): Mathematical analysis and modelling of Current Source Inverter, Voltage Source Inverter,3-Phase Induction Motor Drives: Starting, Breaking and Transient Analysis. Calculation of energy losses. Speed Control, Staler Voltage control. Variable Frequency control from voltage and current sources.

MODULE – IV

Dual Converter based DC Drives: Principle of Dual Converter, direction and speed control of DC Motor using dual converter

MODULE – V

Rectifier based DC Drive: Single phase controlled, Half wave, Full wave rectifier with motor, Single phase semi converter, Effect of Source impedance performance, Evaluation of converter using Fourier series analysis, Extinction Angle Control

Textbook:

1. Power Electronics by Md. Rashid
2. Gopal Dubey, "Power semiconductor-controlled Drives", Prentice Hall Inc., New Jersey, 1989.
3. Krishnan R., "Electric Motor Drives- Modeling, Analysis and Control", Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
4. Werner Leonhard, "Control of Electrical Drives", 3rd Edition, Springer, Sept.,2001

Reference Book:

1. BimalK.Bose, "Modern power electronics and AC drives", Pearson Education(Singapore) Ltd., New Delhi, 2005.
2. Murphy J.M.D, Turnbull, F.G, "Thyristor control of AC motor", Pergamon press, Oxford, 1988.
3. Sheperal, Wand Hully, L.N. "Power Electronic and Motor control" Cambridge University Press Cambridge, 1987.
4. Dewan, S. Slemon B., Straughen, A. G.R., "Power Semiconductor drives", John Wiley and Sons, NewYork, 1984.

Course code: EE519

Course Title: Computational Techniques in Electrical Engineering

Pre-requisite(s): Basics of signals and systems, Digital Signal Processing, Filter theory.

SYLLABUS

Module I

Introduction to Scientific Computing: Solution of Non-Linear Equations, Numerical Solution Of Ordinary Differential Equation, Public-Domain Software Tools, Optimization Overview, Gradient-Based Methods, Linear Programming, Constrained Optimization Algorithm, Multi- Objective Optimization.

Module-II

Introduction to Computational Intelligent Techniques: Introduction, Definition and importance of Computational intelligent Techniques, Main Components of Computational intelligent Techniques: Fuzzy Logic Artificial Neural Networks, Swarm and Evolutionary Algorithms, Hybrid Intelligent Systems.

Module - III

Artificial Neural Network and Applications: Introduction, Artificial Neuron Structure, ANN Learning: Back-Propagation Learning, Unsupervised Learning, Radial Basic Function (RBF), Support Vector Machine (SVM), Recurrent Neural Network, Deep Neural Network.

Module IV

Fuzzy Logic, Evolutionary Algorithms and Applications: Introduction of Fuzzy Logic, Fuzzy Cartesian Product, Fuzzy Relation, Defuzzification Methods, System's Modelling and Simulation Using Fuzzy Logic Approach, Selection of Defuzzification Method, Fuzzy Control System. Genetic Algorithm, Particle Swarm Optimization, Other Recent Heuristic Optimization Techniques. 8L

Module-V

Applications of Computational Techniques to Electrical Engineering: Applications of Artificial Neural Network, Genetic Algorithms, Fuzzy and Hybrid Systems in Power System Applications: Economic Load Dispatch, Unit Commitment, Condition Monitoring. Short Term Electrical Load Forecasting Applications of Soft Computing Techniques in Power Electronics and Control Applications. 8L

Textbooks:

l. Neural Networks: A Comprehensive Foundation - Simon Haykin, IEEE, Press, MacMillan, N.Y 1994.
2. S. Rajasekaran, G. A. Vijayalakshmi, Neural Networks, Fuzzy logic and Genetic algorithms, PHI publication.
3. Fuzzy logic with Engineering Applications – Timothy J. Ross, McGraw-Hill International Editions.
4. Fuzzy Sets and Fuzzy logic:- Theory and Applications - George J. Klir and Bo. Yuan, Prentice- Hall of India Private Limited.

Reference Books:

1. Chaturvedin Devendra K, Soft Computing Techniques and its Applications in Electrical Engineering, Hardcover ISBN:- 97-8-3-540-77480-8, Springer.
2. Kalyanmoy Deb, Optimization for Engineering Design, PHI publication
3. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, Willey Publication
4. Kevin Warwick, Arthur Ekwue, Rag Aggarwal, Artificial intelligence techniques in power systems. IEE Power Engineering Series-22.