THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

COURSES SCHEME

&

SYLLABUS

FOR

B.E.

ELECTRICAL ENGINEERING

2017

Nature of Course	CODE
Core-Foundation Courses	CF
Core-Professional Courses	CP
Generic Electives	GE
Professional Electives	PE
Project Based Courses	PR

SEMESTER WISE CREDITS FOR BE: ELECTRICAL ENGINEERING

Nature of Course	Credits to be Earned (As per Choice Based Credit System)								
	Semesters								Total
	I	II	III	IV	V	VI	VII	VIII	
Core-Foundation (CF) Courses	23.5	22.0	16.0	9.0	4.5	3.0	--	--	78.0
Core-Professional (CP) Courses	--	--	7.0	16.5	21.5	13.0	16.0	--	74.0
Professional & Generic Electives (PE/GE)	--	--	--	--	--	6.0	3.5	--	9.5
Project Based (PR) Courses	--	5.0	6.0	--	--	--	8.0	20.0	39.0
								Total	200.5

SEMESTER – I

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UPH004	APPLIED PHYSICS	CF	3	1	2	4.5
2	UTA007	COMPUTER PROGRAMMING - I	CF	3	0	2	4.0
3	UEC001	ELECTRONIC ENGINEERING	CF	3	1	2	4.5
4	UTA015	ENGINEERING DRAWING	CF	2	4	0	4.0
5	UHU003	PROFESSIONAL COMMUNICATION	CF	2	0	2	3.0
6	UMA003	MATHEMATICS-I	CF	3	1	0	3.5
		TOTAL		**16**	**7**	**8**	**23.5**

SEMESTER – II

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UCB008	APPLIED CHEMISTRY	CF	3	1	2	4.5
2	UTA018	OBJECT ORIENTED PROGRAMMING	CF	3	0	2	4.0
3	UEE001	ELECTRICAL ENGINEERING	CF	3	1	2	4.5
4	UEN002	ENERGY AND ENVIRONMENT	CF	3	0	0	3.0
5	UTA013	ENGINEERING DESIGN PROJECT-I (Mangonel) (6 Self-Effort Hours)	PR	1	0	2	5.0
6	UMA004	MATHEMATICS-II	CF	3	1	0	3.5
7	UES009	MECHANICS *	CF	2	1	2*	2.5
		TOTAL		**18**	**4**	**8**	**27.0**

* Only one Lab session per semester

SEMESTER – III

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UTA014	ENGINEERING DESIGN PROJECT-II (Buggy) (6 Self-Effort Hours)	PR	1	0	4	6.0
2	UTA002	MANUFACTURING PROCESSES	CF	2	0	3	3.5
3	UMA031	OPTIMIZATION TECHNIQUES	CF	3	1	0	3.5
4	UES010	SOLIDS AND STRUCTURES *	CF	3	1	2	4.5
5	UES011	THERMO-FLUIDS *	CF	3	1	2	4.5
6	UEE305	ELECTROMAGNETIC FIELDS AND WAVES	CP	3	1	0	3.5
7	UEE304	TRANSMISSION AND DISTRIBUTION OF ELECTRIC POWER	CP	3	1	0	3.5
		TOTAL		**18**	**5**	**11**	**29.0**

* The lab sessions will be on every alternate week

SEMESTER – IV

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UES012	ENGINEERING MATERIALS	CF	3	1	2	4.5
2	UMA007	NUMERICAL ANALYSIS	CF	3	1	2	4.5
3	UEE505	ANALOG AND DIGITAL SYSTEMS	CP	3	1	2	4.5
4	UEE301	DIRECT CURRENT MACHINES AND TRANSFORMERS	CP	3	1	2	4.5
5	UEE407	NETWORK THEORY AND DESIGN	CP	3	1	2	4.5
6	UEE406	POWER SYSTEM PRACTICES	CP	3	0	0	3.0
		TOTAL		**18**	**5**	**10**	**25.5**

SEMESTER – V

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UEE401	ALTERNATING CURRENT MACHINES	CP	3	1	2	4.5
2	UEI501	CONTROL SYSTEMS	CP	3	1	2	4.5
3	UEI610	FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS	CP	3	0	2	4.0
4	UTA012	INNOVATION AND ENTREPRENEURSHIP (5 self-effort hour)	CF	1	0	2	4.5
5	UEE403	MEASUREMENT AND TRANSDUCERS	CP	3	0	2	4.0
6	UEE504	POWER ELECTRONICS	CP	3	1	2	4.5
		TOTAL		**16**	**3**	**12**	**26.0**

SEMESTER – VI

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UEE795	CAPSTONE PROJECT (START) (With 4 self-effort hour)	PR	0	0	2	0.0
2	UEE801	ELECTRIC DRIVES	CP	3	1	2	4.5
3	UHU005	HUMANITIES FOR ENGINEERS	CF	2	0	2	3.0
4	UEE605	POWER SYSTEM ANALYSIS AND STABILITY	CP	3	1	2	4.5
5	UEE603	SWITCHGEAR AND PROTECTION	CP	3	0	2	4.0
6		ELECTIVE-I		3	0	0	3.0
7		GENERIC ELECTIVE		3	0	0	3.0
		TOTAL		**17**	**2**	**10**	**22.0**

SEMESTER – VII

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UEE795	CAPSTONE PROJECT (COMPLETION) (With 8 self-effort hour)	PR	0	0	2	8.0
2	UEE604	FLEXIBLE AC TRANSMISSION SYSTEMS	CP	3	1	0	3.5
3	UEE502	HIGH VOLTAGE ENGINEERING	CP	3	0	2	4.0
4	UEE804	OPERATION AND CONTROL OF POWER SYSTEMS	CP	3	1	2	4.5
5	UEE608	SOFT COMPUTING IN ELECTRICAL ENGINEERING	CP	3	0	2	4.0
6		ELECTIVE-II		3	1	0	3.5
		TOTAL		**15**	**3**	**8**	**27.5**

SEMESTER – VIII

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UEE891	PROJECT	PR				**20.0**
		OR					
1	UEE806	ALTERNATE SOURCES OF ENERGY	CODE	3	0	2	4.0
2	UEE892	DESIGN PROJECT	PR				13.0
3	UEI805	ENVIRONMENTAL INSTRUMENTATION	CP	3	0	0	3.0
		TOTAL		6	0	2	**20.0**
		OR					
1	UEE893	START- UP SEMESTER	PR				**20.0**

Elective-I

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UEE633	GENERALIZED THEORY OF ELECTRICAL MACHINES	PE	3	0	0	3.0
2	UEE631	HVDC TRANSMISSION SYSTEMS	PE	3	0	0	3.0
3	UEE632	POWER GENERATION AND ECONOMICS	PE	3	0	0	3.0
4	UEE634	REAL TIME POWER SYSTEMS	PE	2	0	2	3.0
5	UCS049	DATA STRUCTURES AND ALGORITHMS	PE	2	0	2	3.0

Elective-II

S N	COURSE NO	COURSE TITLE	CODE	L	T	P	CR
1	UEI841	ADVANCED CONTROL SYSTEMS	PE	3	1	0	3.5
2	UEE521	ELECTRIC MACHINE DESIGN	PE	3	1	0	3.5
3	UEE841	INDUSTRIAL ELECTRONICS	PE	3	1	0	3.5
4	UEE524	POWER QUALITY MONITORING AND CONDITIONING	PE	3	1	0	3.5
5	UEE850	SMART GRID	PE	3	1	0	3.5
6	UEE714	DIGITAL SIGNAL PROCESSING FUNDAMENTALS	PE	2	1	2	3.5

GENERIC ELECTIVES

S.No	COURSE NO.	TITLE	CODE	L	T	P	Cr.
1	UHU007	EMPLOYABILITY DEVELOPMENT SKILLS	GE	0	3	3	3.0
2	UHU006	INTRODUCTORY COURSE IN FRENCH	GE	2	2	0	3.0
3	UHU009	INTRODUCTION TO COGNITIVE SCIENCE	GE	3	0	0	3.0
4	UHU008	INTRODUCTION TO CORPORATE FINANCE	GE	3	0	0	3.0
5	UCS001	INTRODUCTION TO CYBER SECURITY	GE	3	0	0	3.0
6	UPH063	NANOSCIENCE AND NANOMATERIALS	GE	3	0	0	3.0
7	UEN004	TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT	GE	3	0	0	3.0
8	UMA066	GRAPH THEORY AND APPLICATIONS	GE	3	0	0	3.0
9	UMA061	ADVANCED NUMERICAL METHODS	GE	3	0	0	3.0
10	UBT509	BIOLOGY FOR ENGINEERS	GE	3	0	0	3.0

TOTAL CREDITS: 200.5

SEMESTER I

UEC001: ELECTRONIC ENGINEERING

L	T	P	Cr
3	1	2	4.5

Course Objective: To enhance comprehension capabilities of students through understanding of electronic devices, various logic gates, SOP, POS and their minimization techniques, various logic families and information on different IC's and working of combinational circuits and their applications.

Semiconductor Devices: p- n junction diode: Ideal diode, V-I characteristics of diode, Diode small signal model, Diode switching characteristics, Zener diode

Electronics Devices and Circuits: PN Diode as a rectifier, Clipper and clamper, Operation of Bipolar Junction Transistor and Transistor Biasing, CB, CE, CC (Relationship between α, β, γ) circuit configuration Input-output characteristics, Equivalent circuit of ideal and real amplifiers, Low frequency response of amplifiers, Introduction to Field Effect Transistor and its characteristics

Operational Amplifier Circuits: The ideal operational amplifier, The inverting, non-inverting amplifiers, Op-Amp Characteristics, Frequency response of op-amp, Application of op-amp

Digital Systems and Binary Numbers: Introduction to Digital signals and systems, Number systems, Positive and negative representation of numbers, Binary arithmetic, Definitions and basic theorems of boolean Algebra**,** Algebraic simplification, Sum of products and product of sums formulations (SOP and POS), Gate primitives, AND, OR, NOT and Universal Gate, Minimization of logic functions, Karnaugh maps.

Combinational and Sequential Logic: Code converters, multiplexors, decoders, Addition circuits and priority encoder,Master-slave and edge-triggered flip-flops,Synchronous and Asynchronous counters, Registers

Logic families: N and P channel MOS transistors, CMOS inverter, NAND and NOR gates, General CMOS Logic, TTL and CMOS logic families, and their interfacing.

Laboratory Work:

Familiarization with CRO, DSO and Electronic Components, Diodes characteristics - Input-Output and Switching, BJT and MOSFET Characteristics, Zener diode as voltage regulator,Rectifiers, Clippers and Clampers, adder circuit implementation, Multiplexer & its application, Latches/Flip-flops, up/down counters.

Course learning outcomes (CLOs):

The student will be able to:

1. Demonstrate the use of semiconductor diodes in various applications.
2. Discuss and explain the working of transistors and operational Amplifiers, their configurations and applications.
3. Recognize and apply the number systems and Boolean algebra.
4. Reduce Boolean expressions and implement them with Logic Gates.
5. Analyze, design and implement combinational and sequential circuits.
6. Analyze and differentiate logic families, TTL and CMOS.

Text Books:

1. Milliman, J. and Halkias, C.C., Electronic Devices and Circuits, Tata McGraw Hill, 2007.
2. M. M. Mano and M.D. Ciletti, Digital Design, Pearson, Prentice Hall, 2013.
3. Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason (2009).

Reference Books:

1. Donald D Givone, Digital Principles and Design, McGraw-Hill, 2003.
2. John F Wakerly, Digital Design: Principles and Practices, Pearson, (2000).
3. N Storey, Electronics: A Systems Approach, Pearson, Prentice Hall, (2009).

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessional (May include Assignments/Projects/Tutorials/Quiz(es)/Lab Evaluations)	40

UHU003: PROFESSIONAL COMMUNICATION

L	T	P	Cr
2	0	2	3.0

Course Objective: To introduce the students to effective professional communication. The student will be exposed to effective communication strategies and different modes of communication. The student will be able to analyze his/ her communication behavior and that of the others. By learning and adopting the right strategies, the student will be able to apply effective communication skills, professionally and socially.

Effective Communication: Meaning, Barriers, Types of communication and Essentials. Interpersonal Communication skills.
Effective Spoken Communication: Understanding essentials of spoken communication, Public speaking, Discussion Techniques, Presentation strategies.
Effective Professional and Technical writing: Paragraph development, Forms of writing, Abstraction and Summarization of a text; Technicalities of letter writing, internal and external organizational communication. Technical reports, proposals and papers.
Effective non-verbal communication: Knowledge and adoption of the right non verbal cues of body language, interpretation of the body language in professional context. Understanding Proxemics and other forms of non verbal communication.
Communicating for Employment: Designing Effective Job Application letter and resumes; Success strategies for Group discussions and Interviews.
Communication Networks in Organizations: Types, barriers and overcoming the barriers.

Laboratory Work:

1. Pre -assessment of spoken and written communication and feedback.
2. Training for Group Discussions through simulations and role plays.
3. Training for effective presentations.
4. Project based team presentations.
5. Proposals and papers-review and suggestions.

Minor Project (if any): Team projects on technical report writing and presentations.

Course Learning Outcomes (CLO):
On completion of the course, the student would be able to:

1. Apply communication concepts for effective interpersonal communication.
2. Select the most appropriate media of communication for a given situation.
3. Speak assertively and effectively.
4. Write objective organizational correspondence.
5. Design effective resumes, reports and proposals.

Text Books:

1. *Lesikar R.V and Flately M.E., Basic Business Communication Skills for the Empowering the Internet Generation. Tata Mc Graw Hill. New Delhi (2006).*

2. *Raman,M & Sharma, S., Technical Communication Principles and Practice, Oxford University Press New Delhi.(2011).*
3. *Mukherjee H.S., Business Communication-Connecting at Work, Oxford University Press New Delhi, (2013).*

Reference Books:

1. *Butterfield, Jeff.,Soft Skills for everyone,Cengage Learning New Delhi,(2013).*
2. *Robbins, S.P., & Hunsaker, P.L.,Training in Interpersonal Skills,Prentice Hall of India New Delhi,(2008).*
3. *DiSianza,J.J & Legge,N.J.,Business and Prfofessional Communication,Pearson Education India New Delhi,(2009).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	45
3	Sessionals (Group Discussions; professional presentations; panel discussions; public speaking; projects, quizzes)	30

UMA003: MATHEMATICS - I

L	T	P	Cr
3	1	0	3.5

Course Objectives: To provide students with skills and knowledge in sequence and series, advanced calculus and calculus of several variables which would enable them to devise solutions for given situations they may encounter in their engineering profession.

Applications of Derivatives: Mean value theorems and their geometrical interpretation, Cartesian graphing using first and second order derivatives, Asymptotes and dominant terms, Graphing of polar curves, applied minimum and maximum problems.
Sequences and Series: Introduction to sequences and Infinite series, Tests for convergence/divergence, Limit comparison test, Ratio test, Root test, Cauchy integral test, Alternating series, Absolute convergence and conditional convergence.
Series Expansions: Power series, Taylor series, Convergence of Taylor series, Error estimates, Term by term differentiation and integration.
Partial Differentiation: Functions of several variables, Limits and continuity, Chain rule, Change of variables, Partial differentiation of implicit functions, Directional derivatives and its properties, Maxima and minima by using second order derivatives.
Multiple Integrals: Change of order of integration, Change of variables, Applications of multiple integrals.

Course Learning Outcomes (CLO):
Upon completion of this course, the students will be able to

1) apply the knowledge of calculus to plot graphs of functions and solve the problem of maxima and minima.
2) determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.
3) evaluate multiple integrals and their applications to engineering problems.
4) examine functions of several variables, define and compute partial derivatives, directional derivatives and their use in finding maxima and minima.
5) analyze some mathematical problems encountered in engineering applications.

Text Books:

1. *Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007).*
2. *Stewart James, Essential Calculus; Thomson Publishers (2007).*

Reference Books:

1. *Wider David V, Advanced Calculus: Early Transcendentals, Cengage Learning (2007).*
2. *Apostol Tom M, Calculus, Vol I and II, John Wiley (2003).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessionals (May include assignments/quizzes)	25

UPH004: APPLIED PHYSICS

L	T	P	Cr
3	1	2	4.5

Course Objectives: Introduce the laws of oscillators, acoustics of buildings, ultrasonics, electromagnetic waves, wave optics, lasers, and quantum mechanics and demonstrate their applications in technology. Student will learn measurement principles and their applications in investigating physical phenomenon.

Oscillations and Waves: Oscillatory motion and damping, Applications - Electromagnetic damping – eddy current; ***Acoustics:*** Reverberation time, absorption coefficient, Sabine's and Eyring's formulae (Qualitative idea), Applications - Designing of hall for speech, concert, and opera; ***Ultrasonics:*** Production and Detection of Ultrasonic waves, Applications - green energy, sound signaling, dispersion of fog, remote sensing, Car's airbag sensor.

Electromagnetic Waves: Scalar and vector fields; Gradient, divergence, and curl; Stokes' and Green's theorems; Concept of Displacement current; Maxwell's equations; Electromagnetic wave equations in free space and conducting media, Application - skin depth.

Optics: ***Interference:*** Parallel and wedge-shape thin films, Newton rings, Applications as Non-reflecting coatings, Measurement of wavelength and refractive index. ***Diffraction:*** Single and Double slit diffraction, and Diffraction grating, Applications - Dispersive and Resolving Powers. ***Polarization:*** Production, detection, Applications – Anti-glare automobile headlights, Adjustable tint windows. ***Lasers:*** Basic concepts, Laser properties, Ruby, HeNe, and Semiconductor lasers, Applications – Optical communication and Optical alignment.

Quantum Mechanics: Wave function, Steady State Schrodinger wave equation, Expectation value, Infinite potential well, Tunneling effect (Qualitative idea), Application - Quantum computing.

Laboratory Work:

1 Determination of damping effect on oscillatory motion due to various media.
2 Determination of velocity of ultrasonic waves in liquids by stationary wave method.
3 Determination of wavelength of sodium light using Newton's rings method.
4 Determination of dispersive power of sodium-D lines using diffraction grating.
5 Determination of specific rotation of cane sugar solution.
6 Study and proof of Malus' law in polarization.
7 Determination of beam divergence and beam intensity of a given laser.
8 Determination of displacement and conducting currents through a dielectric.
9 Determination of Planck's constant.

Micro Project: Students will be asked to solve physics based problems/assignments analytically or using computer simulations, etc.

Course Learning Outcomes (CLO):

Upon completion of this course, students will be able to:

1. Understand damped and simple harmonic motion, the role of reverberation in designing a hall and generation and detection of ultrasonic waves.
2. Use Maxwell's equations to describe propagation of EM waves in a medium.

3. Demonstrate interference, diffraction and polarization of light.
4. Explain the working principle of Lasers.
5. Use the concept of wave function to find probability of a particle confined in a box.
6. Perform an experiment, collect data, tabulate and report them and interpret the results with error analysis

Text Books:

1. *Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001).*
2. *Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007).*
3. *Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999).*

Reference Books:

1. *Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice Hall™ (2008).*
2. *Wehr, M.R, Richards, J.A., Adair, T.W., Physics of The Atom, Narosa Publishing House (1990).*
3. *Verma, N.K., Physics for Engineers, Prentice Hall of India (2014)*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessionals (May include assignments/quizzes)	25

UTA015 - ENGINEERING DRAWING

L	T	P	Cr
2	4	0	4.0

Course Objectives: This module is dedicated to graphics and includes two sections: manual drawing and AutoCAD. This course is aimed at to make the student understand dimensioned projections, learn how to create two-dimensional images of objects using first and third angle orthographic projection as well as isometric, perspective and auxiliary projection, to interpret the meaning and intent of toleranced dimensions and geometric tolerance symbolism and to create and edit drawings using drafting software AutoCAD.

Engineering Drawing

1. Introduction
2. Orthographic Projection: First angle and third angle projection system
3. Isometric Projections
4. Auxiliary Projections
5. Perspective Projections
6. Introduction to Mechanical Drawing
7. Sketching engineering objects
8. Sections, dimensions and tolerances

AutoCAD

1. Management of screen menus commands
2. Introduction to drawing entities
3. Co-ordinate systems: Cartesian, polar and relative coordinates
4. Drawing limits, units of measurement and scale
5. Layering: organizing and maintaining the integrity of drawings
6. Design of prototype drawings as templates.
7. Editing/modifying drawing entities: selection of objects, object snap modes, editing commands,
8. Dimensioning: use of annotations, dimension types, properties and placement, adding text to drawing

Micro Projects /Assignments:

1. Completing the views - Identification and drawing of missing lines in the projection of objects
2. Missing views – using two views to draw the projection of the object in the third view, primarily restricting to Elevation, Plan and Profile views
3. Projects related to orthographic and isometric projections
    a. Using wax blocks or soap bars to develop three dimensional object from given orthographic projections
    b. Using wax blocks or soap bars to develop three dimensional object, section it and color the section
    c. Use of AUTOCAD as a complementary tool for drawing the projections of the objects created in (1) and (2).

4. Develop the lateral surface of different objects involving individual or a combination of solids like Prism, Cone, Pyramid, Cylinder, Sphere etc.
5. To draw the detailed and assembly drawings of simple engineering objects/systems with due sectioning (where ever required) along with bill of materials.
   e.g. Rivet joints, simple bearing, wooden joints, Two plates connected with nut and bolt etc.

Course Learning Outcomes (CLO):

Upon completion of this module, students will be able to:

1. creatively comprehend geometrical details of common engineering objects
2. draw dimensioned orthographic and isometric projections of simple engineering objects
3. draw sectional views of simple engineering objects.
4. interpret the meaning and intent of toleranced dimensions and geometric tolerance symbolism
5. create and edit dimensioned drawings of simple engineering objects using AutoCAD
6. organize drawing objects using layers and setting up of templates in AutoCAD

Text Books:

1. *Jolhe, D.A., Engineering Drawing, Tata McGraw Hill, 2008*
2. *Davies, B. L., Yarwood, A., Engineering Drawing and Computer Graphics,* Van Nostrand Reinhold *(UK), 1986*

Reference Books:

1. *Gill, P.S., Geometrical Drawings, S.K. Kataria & Sons, Delhi (2008).*
2. *Gill, P.S., Machine Drawings, S.K. Kataria & Sons, Delhi (2013).*
3. *Mohan, K.R., Engineering Graphics, Dhanpat Rai Publishing Company (P) Ltd, Delhi (2002).*
4. *French, T. E., Vierck, C. J. and Foster, R. J., Fundamental of Engineering Drawing & Graphics Technology, McGraw Hill Book Company, New Delhi (1986).*
5. *Rowan, J. and Sidwell , E. H., Graphics for Engineers, Edward Arnold, London (1968).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	Mid semester test (formal written test)	25
2	End semester test (formal written test)	40

UTA017: COMPUTER PROGRAMMING-I

L	T	P	Cr
3	0	2	4.0

Course objective: This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs.

Computers Fundamentals: Classification of Computers, Application of Computers, Basic organization of computer, Input and Output Devices, Binary Number System, Computer memory, Computer Software.

Algorithms and Programming Languages: Algorithm, Flowcharts, Pseudocode, Generation of Programming Languages.

C Language: Structure of C Program, Life Cycle of Program from Source code to Executable, Compiling and Executing C Code, Keywords, Identifiers, Primitive Data types in C, variables, constants, input/output statements in C, operators, type conversion and type casting. Conditional branching statements, iterative statements, nested loops, break and continue statements.

Functions: Declaration, Definition, Call and return, Call by value, Call by reference, showcase stack usage with help of debugger, Scope of variables, Storage classes, Recursive functions, Recursion vs Iteration.

Arrays, Strings and Pointers: One-dimensional, Two-dimensional and Multi-dimensional arrays, operations on array: traversal, insertion, deletion, merging and searching, Inter-function communication via arrays: passing a row, passing the entire array, matrices. Reading, writing and manipulating Strings, Understanding computer memory, accessing via pointers, pointers to arrays, dynamic allocation, drawback of pointers.

Linear and Non-Linear Data Structures: Linked lists, stacks and queues.

Laboratory work:

To implement Programs for various kinds of programming constructs in C Language.

Course learning outcomes (CLOs):

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

1. Comprehend concepts related to computer hardware and software, draw flowcharts and write algorithm/pseudocode.
2. Write, compile and debug programs in C language, use different data types, operators and console I/O function in a computer program.
3. Design programs involving decision control statements, loop control statements, case control structures, arrays, strings, pointers, functions and implement the dynamics of memory by the use of pointers.
4. Comprehend the concepts of linear and Non-Linear data structures by implementing linked lists, stacks and queues.

Evaluation scheme

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	40
3.	Sessionals May include Assignments/Projects/ Tutorials/Quiz/Lab evaluations)	35

SEMESTER-II

UCB008: APPLIED CHEMISTRY

L	T	P	Cr
3	1	2	4.5

Course objective: The course aims at elucidating principles of applied chemistry in industrial systems, water treatment, engineering materials and analytical techniques.

Electrochemistry: Specific, equivalent and molar conductivity of electrolytic solutions, migration of ions, transference number and its determination by Hittorf's method, conductometric titrations, types of electrodes, concentration cells, liquid junction potential.

Phase Rule: States of matter, phase, component and degree of freedom, Gibb's phase rule, one component and two component systems.

Water Treatment and Analysis: Hardness and alkalinity of water: units and determination, external and internal methods of softening of water: carbonate, phosphate, calgon and colloidal conditioning, lime-soda process, zeolite process, ion exchange process, mixed bed deionizer, desalination of brackish water.

Fuels: Classification of fuels, calorific value, cetane and octane number, fuel quality, comparison of solid liquid and gaseous fuels, properties of fuel, alternative fuels: biofuels, power alcohol, synthetic petrol.

Chemistry of Polymers: Overview of polymers, types of polymerization, molecular weight determination, tacticity of polymers, catalysis in polymerization, conducting, biodegradable and inorganic polymers.

Atomic spectroscopy: Introduction to spectroscopy, atomic absorption spectrophotometry and flame photometry, quantitative methods.

Molecular Spectroscopy: Beer-Lambert`s Law, molecular spectroscopy, principle, instrumentation and applications of UV-Vis and IR spectroscopy.

Laboratory Work

Electrochemical measurements: Experiments involving use of pH meter, conductivity meter, potentiometer.

Acid and Bases: Determination of mixture of bases.

Spectroscopic techniques: Colorimeter, UV-Vis spectrophotometer.

Water and its treatment: Determination of hardness, alkalinity, chloride, chromium, iron and copper in aqueous medium.

Course Learning Outcomes (CLO):

The students will be able to reflect on:

1. concepts of electrodes in electrochemical cells, migration of ions, liquid junction potential and conductometric titrations.
2. atomic and molecular spectroscopy fundamentals like Beer`s law, flame photometry, atomic absorption spectrophotometry, UV-Vis and IR.
3. water and its treatment methods like lime soda and ion exchange.
4. concept of phase rule, fuel quality parameters and alternative fuels.
5. polymerization, molecular weight determination and applications as biodegradable and conducting polymers.

6. laboratory techniques like pH metry, potentiometry, colourimetry, conductometry and volumetry.

Text Books

1. *Ramesh, S. and Vairam S. Engineering Chemistry, Wiley India (2012) 1st ed.*
2. *Puri, B.R., Sharma,L.R., and Pathania, M.S. Principles of Physical Chemistry, Vishal Publishing Co. (2008).*
3. *Aggarwal, S. Engineering Chemistry: Fundamentals and Applications, Cambridge University Press (2015).*

Reference Books

1. *Brown, H., Chemistry for Engineering Students, Thompson, 1st ed*
2. *Sivasankar, B., Engineering Chemistry, Tata McGraw-Hill Pub. Co. Ltd, New Delhi (2008).*
3. *Shulz, M.J. Engineering Chemistry, Cengage Learnings (2007) 1st ed.*

Evaluation scheme

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	40
3.	Sessionals May include Assignments/Projects/ Tutorials/Quiz/Lab evaluations)	35

UEE001: ELECTRICAL ENGINEERING

L	T	P	Cr.
3	1	2	4.5

Course Objective: To introduce concepts of DC and AC circuits and electromagnetism. To make the students understand the concepts and working of single-phase transformers, DC motor and generators.

DC Circuits: Kirchhoff's voltage and current laws; power dissipation; Voltage source and current source; Mesh and Nodal analysis; Star-delta transformation; Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum power transfer theorem; Millman's theorem and Reciprocity theorem; Transient response of series RL and RC circuits.

Steady state analysis of DC Circuits: The ideal capacitor, permittivity; the multi-plate capacitor, variable capacitor; capacitor charging and discharging, current-voltage relationship, time-constant, rise-time, fall-time; inductor energisation and de-energisation, inductance current-voltage relationship, time-constant; Transient response of RL, RC and RLC Circuits.

AC Circuits: Sinusoidal sources, RC, RL and RLC circuits, Concept of Phasors, Phasor representation of circuit elements, Complex notation representation, Single phase AC Series and parallel circuits, power dissipation in ac circuits, power factor correction, Resonance in series and parallel circuits, Balanced and unbalanced 3-phase circuit - voltage, current and power relations, 3-phase power measurement, Comparison of single phase and three phase supply systems.

Electromagnetism: Electromagnetic induction, Dot convention, Equivalent inductance, Analysis of Magnetic circuits, AC excitation of magnetic circuit, Iron Losses, Fringing and stacking, applications: solenoids and relays.

Single Phase Transformers: Constructional features of transformer, operating principle and applications, equivalent circuit, phasor analysis and calculation of performance indices.

Motors and Generators: DC motor operating principle, construction, energy transfer, speed-torque relationship, conversion efficiency, applications, DC generator operating principle, reversal of energy transfer, emf and speed relationship, applications.

Laboratory Work: Network laws and theorems, Measurement of R,L,C parameters, A.C. series and parallel circuits, Measurement of power in 3 phase circuits, Reactance calculation of variable reactance choke coil, open circuit and short circuit tests on single phase transformer, Starting of rotating machines.

Course Learning Outcome (CLO):

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

1. Apply networks laws and theorems to solve electric circuits.
2. Analyze transient and steady state response of DC circuits.
3. Signify AC quantities through phasor and compute AC system behaviour during steady state.
4. Explain and analyse the behaviour of transformer.
5. Elucidate the principle and characteristics of DC motor and DC generator.

Text Books:

1. *Hughes, E., Smith, I.M., Hiley, J. and Brown, K., Electrical and Electronic Technology, PHI (2008).*
2. *Nagrath, I.J. and Kothari, D.P., Basic Electrical Engineering, Tata McGraw Hill (2002).*
3. *Naidu, M.S. and Kamashaiah, S., Introduction to Electrical Engineering, Tata McGraw Hill (2007).*

Reference Books:

1. *Chakraborti, A., Basic Electrical Engineering, Tata McGraw–Hill (2008).*
2. *Del Toro, V., Electrical Engineering Fundamentals,* Prentice–Hall of India Private Limited *(2004)*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional (Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

UEN002: ENERGY AND ENVIRONMENT

L	T	P	Cr
3	0	0	3.0

Course Objectives: The exposure to this course would facilitate the students in understanding the terms, definitions and scope of environmental and energy issues pertaining to current global scenario; understanding the value of regional and global natural and energy resources; and emphasize on need for conservation of energy and environment.

Natural Resources: Human settlements and resource consumption; Biological, mineral and energy resources; Land, water and air; Natural resources vis-à-vis human resources and technological resources; Concept of sustainability; Sustainable use of natural resources

Ecology, Structure and Functioning of Natural Ecosystems: Ecology, ecosystems and their structure, functioning and dynamics; Energy flow in ecosystems; Biogeochemical cycles and climate; Population and communities

Agricultural, Industrial Systems and Environment: Agricultural and industrial systems vis-à-vis natural ecosystems; Agricultural systems, and environment and natural resources; Industrial systems and environment

Environment Pollution, Global Warming and Climate Change: Air pollution (local, regional and global); Water pollution problems; Land pollution and food chain contaminations; Carbon cycle, greenhouse gases and global warming; Climate change – causes and consequences; Carbon footprint; Management of greenhouse gases at the source and at the sinks

Energy Technologies and Environment: Electrical energy and steam energy; Fossil fuels, hydropower and nuclear energy; Solar energy, wind energy and biofuels; Wave, ocean thermal, tidal energy and ocean currents; Geothermal energy; Future energy sources; Hydrogen fuels; Sustainable energy

Group Assignments: Assignments related to Sanitary landfill systems; e-waste management; Municipal solid waste management; Biodiversity and biopiracy; Air pollution control systems; Water treatment systems; Wastewater treatment plants; Solar heating systems; Solar power plants; Thermal power plants; Hydroelectric power plants; Biofuels; Environmental status assessments; Energy status assessments, etc.

Course Learning Outcomes (CLO):

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

1. outline the scenario of natural resources and their status
2. calculate the flow of energy and mass balance in ecosystems
3. analyse environmental status of human settlements
4. monitor the energy performance of systems

Text Books:

1. *Bharucha, E., Textbook of Environmental Studies, Universities Press (2005).*
2. *Chapman, J.L. and Reiss, M.J., Ecology- Principles and Application, Cambridge University Press (LPE) (1999).*
3. *Joseph, B., Environmental Studies, Tata McGraw-Hill (2006).*

4. *Eastop, T.P. and Croft, D.R. Energy Efficiency for Engineers and Technologists,Longman and Harow (2006).*

Reference Books:

1. *Miller, G.T., Environmental Science- Working with Earth, Thomson (2006).*
2. *Wright, R.T., Environmental Science-Towards a sustainable Future, Prentice Hall (2008).*
3. *O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).*

Evaluation Scheme:

-Sr. No.	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	50
3.	Sessionals (Quizzes/assignments/group presentations)	20

UES009: MECHANICS

L	T	P	Cr
2	1	2*	2.5

(Two hours Lab Once In Semester)

Course Objectives: The objective of this module is to help students develop the techniques needed to solve general engineering mechanics problems. Students will learn to describe physical systems mathematically so that their behaviour can be predicted.

Review of Newton's law of motion and vector algebra:
Equilibrium of Bodies: Free-body diagrams, conditions of equilibrium, torque due to a force, statical determinacy.
Plane Trusses: Forces in members of a truss by method of joints and method of sections.
Friction: Sliding, belt, screw and rolling.
Properties of Plane Surfaces: First moment of area, centroid, second moment of area etc.
Virtual Work: Principle of virtual work, calculation of virtual displacement and virtual work.
Work and Energy: Work and energy, work-energy theorem, principle of conservation of energy, collisions, principles of momentum etc.
Dynamics of Rigid Bodies: Newton's Laws, D'Alembert's Principle, Energy Principles.
Experimental Project Assignment/ Micro Project: Students in groups of 4/5 will do project on Model Bridge Experiment: This will involve construction of a model bridge using steel wire and wood.

Course Learning Outcomes (CLO):
The students will be able to:

1. Determine resultants in plane force systems
2. Identify and quantify all forces associated with a static framework
3. Solve problems in kinematic and dynamic systems

Text Books:

1. *Shames, I. H. Engineering Mechanics: Dynamics, Pearson Education India (2006).*
2. *Beer, Johnston, Clausen and Staab, Vector Mechanics for Engineers, Dynamics, McGraw-Hill Higher Education (2003).*

Reference Books:

1. *Hibler, T.A., Engineering Mechanics: Statics and Dynamics, Prentice Hall (2012).*
2. *Timoshenko and Young, Engineering Mechanics, Tata McGraw Hill Education Private Limited, (2006).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Tutorials/Quiz	25

UMA004: MATHEMATICS – II

L	T	P	Cr
3	1	0	3.5

Course Objectives: To introduce students the theory and concepts of differential equations, linear algebra, Laplace transformations and Fourier series which will equip them with adequate knowledge of mathematics to formulate and solve problems analytically.

Linear Algebra: Row reduced echelon form, Solution of system of linear equations, Matrix inversion, Linear spaces, Subspaces, Basis and dimension, Linear transformation and its matrix representation, Eigen-values, Eigen-vectors and Diagonalisation, Inner product spaces and Gram-Schmidt orthogonalisation process.

Ordinary Differential Equations: Review of first order differential equations, Exact differential equations, Second and higher order differential equations, Solution techniques using one known solution, Cauchy - Euler equation, Method of undetermined coefficients, Variation of parameters method, Engineering applications of differential equations.

Laplace Transform: Definition and existence of Laplace transforms and its inverse, Properties of the Laplace transforms, Unit step function, Impulse function, Applications to solve initial and boundary value problems.

Fourier Series: Introduction, Fourier series on arbitrary intervals, Half range expansions, Applications of Fourier series to solve wave equation and heat equation.

Course Learning Outcomes (CLO):

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

1. solve the differential equations of first and 2nd order and basic application problems described by these equations.
2. find the Laplace transformations and inverse Laplace transformations for various functions. Using the concept of Laplace transform students will be able to solve the initial value and boundary value problems.
3. find the Fourier series expansions of periodic functions and subsequently will be able to solve heat and wave equations.
4. solve systems of linear equations by using elementary row operations.
5. identify the vector spaces/subspaces and to compute their bases/orthonormal bases. Further, students will be able to express linear transformation in terms of matrix and find the eigen values and eigen vectors.

Text Books:

1. *Simmons, G.F., Differential Equations (With Applications and Historical Notes), Tata McGraw Hill (2009).*
2. *Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, Affiliated East West Press (1976).*

Reference Books:

1. *Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006).*
2. *Jain, R.K. and Iyenger, S.R.K, Advanced Engineering Mathematics, Narosa Publishing House(2011).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessionals (May include assignments/quizzes)	25

UTA013: ENGINEERING DESIGN PROJECT-I

L	T	P	Cr
1	0	2	5.0

Course Objectives: To develop design skills according to a Conceive-Design-Implement-Operate (CDIO) compliant methodology. To apply engineering sciences through learning-by-doing project work. To provide a framework to encourage creativity and innovation. To develop team work and communication skills through group-based activity. To foster self-directed learning and critical evaluation.

To provide a basis for the technical aspects of the project a small number of lectures are incorporated into the module. As the students would have received little in the way of formal engineering instruction at this early stage in the degree course, the level of the lectures is to be introductory with an emphasis on the physical aspects of the subject matter as applied to the 'Mangonel' project. The lecture series include subject areas such as Materials, Structures, Dynamics and Digital Electronics delivered by experts in the field.

This module is delivered using a combination of introductory lectures and participation by the students in 15 "activities". The activities are executed to support the syllabus of the course and might take place in specialised laboratories or on the open ground used for firing the Mangonel. Students work in groups throughout the semester to encourage teamwork, cooperation and to avail of the different skills of its members. In the end the students work in sub-groups to do the Mangonel throwing arm redesign project. They assemble and operate a Mangonel, based on the lectures and tutorials assignments of mechanical engineering they experiment with the working, critically analyse the effect of design changes and implement the final project in a competition. Presentation of the group assembly, redesign and individual reflection of the project is assessed in the end.

Breakup of lecture details to be taken up by MED:

Lec No.	Topic	Contents
Lec 1	Introduction	The Mangonel Project. History. Spreadsheet.
Lec 2	PROJECTILE MOTION	no DRAG, Design spread sheet simulator for it.
Lec 3	PROJECTILE MOTION	with DRAG, Design spread sheet simulator for it.
Lec 4	STRUCTURES FAILURE	STATIC LOADS
Lec 5	STRUCTURES FAILURE	DYNAMIC LOADS
Lec 6	REDESIGNING THE MANGONEL	Design constraints and limitations of materials for redesigning the Mangonel for competition as a group.
Lec 7	MANUFACTURING	Manufacturing and assembling the Mangonel.

Lec 8	SIMULATION IN ENGINEERING DESIGN	Simulation as an Analysis Tool in Engineering Design.
Lec 9	ROLE OF MODELLING & PROTOTYPING	The Role of Modelling in Engineering Design.

Breakup of lecture details to be taken up by ECED:

Lec No.	Topic	Contents
Lec 1-5	Digital Electronics	Prototype, Architecture, Using the Integrated Development Environment (IDE) to Prepare an Arduino Sketch, structuring an Arduino Program, Using Simple Primitive Types (Variables), Simple programming examples. Definition of a sensor and actuator.

Tutorial Assignment / Laboratory Work:

Associated Laboratory/Project Program: T- Mechanical Tutorial, L- Electronics Laboratory, W- Mechanical Workshop of "Mangonel" assembly, redesign, operation and reflection.

Title for the weekly work in 15 weeks	Code
Using a spread sheet to develop a simulator	T1
Dynamics of projectile launched by a Mangonel - No Drag	T2
Dynamics of projectile launched by a Mangonel - With Drag	T3
Design against failure under static actions	T4
Design against failure under dynamic actions	T5
Electronics hardware and Arduino controller	L1
Electronics hardware and Arduino controller	L2
Programming the Arduino Controller	L3
Programming the Arduino Controller	L4
Final project of sensors, electronics hardware and programmed Arduino controller based measurement of angular velocity of the "Mangonel" throwing arm.	L5
Assembly of the Mangonel by group	W1
Assembly of the Mangonel by group	W2
Innovative redesign of the Mangonel and its testing by group	W3
Innovative redesign of the Mangonel and its testing by group	W4
Final inter group competition to assess best redesign and understanding of the "Mangonel".	W5

Project: The Project will facilitate the design, construction and analysis of a "Mangonel". In addition to some introductory lectures, the content of the students' work during the semester will consist of:

1. the assembly of a Mangonel from a Bill Of Materials (BOM), detailed engineering drawings of parts, assembly instructions, and few prefabricated parts ;

2. the development of a software tool to allow the trajectory of a "missile" to be studied as a function of various operating parameters in conditions of no-drag and drag due to air;

3. a structural analysis of certain key components of the Mangonel for static and dynamic stresses using values of material properties which will be experimentally determined;
4. the development of a micro-electronic system to allow the angular velocity of the throwing arm to be determined;
5. testing the Mangonel;
6. redesigning the throwing arm of the Mangonel to optimise for distance without compromising its structural integrity;
7. an inter-group competition at the end of the semester with evaluation of the group redesign strategies.

Course Learning Outcomes (CLO):

Upon completion of this module, students will be able to:

1. simulate trajectories of a mass with and without aerodynamic drag using a spreadsheet based software tool to allow trajectories be optimized;
2. perform a test to acquire an engineering material property of strength in bending and analyze the throwing arm of the "Mangonel" under conditions of static and dynamic loading;
3. develop and test software code to process sensor data;
4. design, construct and test an electronic hardware solution to process sensor data;
5. construct and operate a Roman catapult "Mangonel" using tools, materials and assembly instructions, in a group, for a competition;
6. operate and evaluate the innovative redesign of elements of the "Mangonel" for functional and structural performance

Text Books:

1. *Michael Mc Roberts, Beginning Arduino, Technology in action publications.*
2. *Alan G. Smith, Introduction to Arduino: A piece of cake, Create Space Independent Publishing Platform (2011)*

Reference Book:

1. *John Boxall, Arduino Workshop - A Hands-On Introduction with 65 Projects, No Starch Press (2013)*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	-
2	EST	-
3	Sessional: (may include the following) Mechanical Tutorial Assignments Electronics Hardware and software Practical work in Laboratory Assessment of Mechanical contents in Lectures and Tutorials and Electronics contents in Lectures and Practical. Project (Assembly of the "Mangonel", innovative	30 30 10 30

	redesign with reflection, prototype competition, Final Presentation and viva-voce	

UTA018 - OBJECT ORIENTED PROGRAMMING

L	T	P	Cr
3	0	2	4.0

Course Objectives: Understand fundamentals as well as advanced topics of object-oriented programming in C++. To help students understand basics of programming such as variables, conditional and iterative execution, methods, I/O and exception handling.

Object Oriented Programming with C++: Class declaration, creating objects, accessing objects members, nested member functions, memory allocation for class, objects, static data members and functions. Array of objects, dynamic memory allocation, this pointer, nested classes, friend functions, constructors and destructors, constructor overloading, copy constructors, operator overloading and type conversions.

Inheritance and Polymorphism: Single inheritance, multi-level, multiple inheritance, runtime polymorphism, virtual constructors and destructors.

File handling: Stream in C++, Files modes, File pointer and manipulators, type of files, accepting command line arguments.

Templates and Exception Handling: Use of templates, function templates, class templates, handling exceptions.

Introduction to Windows Programming in C++: Writing program for Windows, using COM in Windows Program, Windows Graphics, User Input

Laboratory work: To implement Programs for various kinds of programming constructs in C++ Language.

Course learning outcomes (CLOs):

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

1. Write, compile and debug programs in C++, use different data types, operators and I/O function in a computerprogram.
2. Comprehend the concepts of classes, objects and apply basics of object oriented programming, polymorphism andinheritance.
3. Demonstrate use of filehandling.
4. Demonstrate use of templates and exceptionhandling.
5. Demonstrate use of windows programming concepts usingC++

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1	MST	20
2	EST	45
3	Sessionals (Assignments/Projects/ Tutorials/Quizzes/Lab Evaluations)	35

SEMESTER III

UEE304: TRANSMISSION AND DISTRIBUTION OF ELECTRIC POWER

L	T	P	Cr.
3	1	0	3.5

Course objective: To introduce the concepts of transmission lines, line insulators, cables. To get familiarize with distribution, EHV and HVDC transmission system.

Introduction: Structure of power systems, Growth of power systems – Indian overview, Interconnections and their advantages, per unit system and its advantages.
Transmission Line Parameters: Choice of voltage and frequency, Types of conductor, Size of conductor, Resistance, Inductance and capacitance of single phase and three phase transmission lines, Effect of ground on capacitance.
Mechanical design of overhead transmission lines: Tension and sag calculations, Factors affecting Sag, Sag template, Stringing charts, Vibrations and vibration damper.
Insulators: Insulator types, String efficiency, Improvement of String Efficiency Grading rings, Insulator Failure, Arcing horns, Armored rods and Bushing.
Transmission Line Performance: Characteristics and performance of power transmission lines: Short, Medium, Long lines, Generalized constants, Power flow, Regulation, Power circle diagrams, Series and shunt compensation, Corona visual and disruptive, Critical voltage, Phenomenon of Corona, Corona loss, Factors affecting Corona, Ferranti Effect, Electrostatic and Electromagnetic interference with communication lines.
Insulated Cables: Constructional features, Parameters, Grading of cables, Cable laying procedures, Fault location Methods, High voltage cables, Thermal characteristics, Ratings of Cables, Introduction to XLPE cables.
Distribution Systems: Power supply systems and their comparison, Classification of distribution system, Primary and secondary distribution, Ring main and radial systems, Systematic design of distribution systems.
EHV transmission and HVDC transmission: Need of EHV transmission system, types of DC links, advantages of DC transmission, EHVAC and HVDC systems in India and trends.
Standards: Indian Electricity Rules 1956 amended in 2000.

Course learning Outcomes (CLOs):
After the completion of the course the students will be able to:

1. Analyse the transmission line models and evaluate its performance parameters.
2. Design the transmission lines under various working conditions.
3. Describe and select the configurations of different line insulators and evaluate their performance.
4. Supervise the laying of cables and fault detection in cables.
5. Design the distribution system network.

Text Books:

1. *Chakrabarti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., A Text Book on Power System Engineering, Dhanpat Rai (2008).*

2. *Wadhwa, C.L., Electrical Power Systems, New Age International (P) Limited, Publishers (2008).*

Reference Books:

1. *Gupta, B.R., Power System Analysis and Design, S. Chand (2009).*
2. *Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw−Hill (2007).*
3. *Pabla, A.S., Electric Power Distribution, McGraw Hill (2008).*
4. *Stevenson, W.D., Power System Analysis, McGraw−Hill (2007).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	25

UEE305: ELECTROMAGNETIC FIELDS AND WAVES

L	T	P	Cr.
3	1	0	3.5

Course objective: To provide the basic skills required to understand, develop and design various engineering applications involving electromagnetic fields.

Vector Analysis: Review of vector algebra, Review of Cartesian, Cylindrical and Spherical coordinate systems, Introduction to del ∇ (operator, Use of del operator as gradient, divergence, curl).

Electrostatic fields: Introduction to coulomb's law, Gaussian law and it's applications in determination of field of spherical and cylindrical geometries, Laplace's and poission's equation in various coordinate systems. Effect of dielectric on capacitance, Boundary conditions at electric interfaces, Method of images and its applications.

Magnetostatics: Introduction to Ampere's law, Magnetic vector potential, Magnetic forces, Boundary conditions at magnetic interfaces.

Time Varying Fields and Maxwell's Equations: Continuity of charge, Concept of displacement current, Maxwell's equation in integral and differential form: For static fields, For time varying fields, For free space, For good conductors, For harmonically varying fields, Poynting theorem, Energy stored and radiated power, Complex poynting vector, Properties of conductor and dielectrics, Wave equations for free space, Wave equations for conductors.

Uniform Plane Waves: Introduction, Uniform plane wave propagation: Wave equations, Transverse nature of uniform plane waves, Perpendicular relation between E and H, EM waves in charge free, Current free dielectric, Reflection by ideal conductor: Normal incidence, reflection and transmission with normal incidence at another dielectric, Plane wave in lossy dielectric, Wave impedance and propagation constant, Depth of penetration, Surface impedance and surface resistance, Application of EM propagation through Transmission Lines, Wave characteristics on an infinite and finite transmission lines, Rectangular Waveguides, TE and TM waves in rectangular waveguide, mode cut off frequencies and dominant mode, wave impedances.

Course learning Outcomes (CLOs):

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

1. Appraise need analysis for different coordinate systems in electromagnetics and their interrelations
2. Apply vector calculus to solve field theory problems
3. Calculate electric and magnetic fields in different coordinates for various charge and current configurations
4. Exhibit the concept of time varying fields
5. Demonstrate different aspects of plane wave in dielectric and conducting media
6. Realize the analogy of wave with transmission line and determine the transmission line performance

Text Books:

1. *Hayt, W.H., Engineering Electromagnetics, Tata McGraw−Hill (2008).*
2. *Kraus, J.D., Electromagnetics, McGraw−Hill (2006).*
3. *Sadiku, M.N.O, Elements of Electromagnetics, Oxford University Press (2009).*

Reference Books:

1. *Jordan, E.C. and Balmain K.G., Electromagnetic Waves and Radiating Systems, Prentice Hall of India (2008).*
2. *Paramanik, A, Electromagnetism: Theory and Applications, Prentice−Hall of India (2006).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	25

UES010: SOLID AND STRUCTURES

L	T	P	Cr
3	1	2	4.5

Course Objectives: This subject aims to develop an understanding of the stresses and strainsthat develop in solid materials when they are subjected to different types of loading and to develop an understanding of the conditions at failure of such materials. Further to this subject aims at to introduce the fundamental concepts of structural mechanics.

Axial Stress and Strain: Concept of stress, strain, elasticity and plasticity; one-dimensional stress-strain relationships; Young's modulus of elasticity, shear modulus and Poisson's ratio; two-dimensional elasticity; isotropic and homogeneous materials; ductile and brittle materials; statically determinate and indeterminate problems, compound and composite bars; thermal stresses. Torsion of shafts; buckling of struts, concept of factor of safety.

Shear Force and Bending Moment Diagrams: Types of load on beams, classification ofbeams; axial, shear force and bending moment diagrams: simply supported, overhung and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment, equation of condition, load function equation, qualitative analysis for two-dimensional frames.

Bending & Shear Stresses in beams: Derivation of flexural formula for straight beams, conceptof second moment of area, bending stress calculation for beams of simple and built up sections, Flitched beams. Shear stress formula for beams, shear stress distribution in beams

Transformation of Stress and Strain: Transformation equations for plane stress and planestrain, Mohr's stress circle, relation between elastic constants, strain measurements, strain rosettes.

Deformations: Governing differential equation for deflection of straight beams having constantflexural rigidity, double integration and Macaulay's methods for slopes and deflection, unit load method for deflection of trusses

Laboratory Work

Experimental project assignment: Students in groups of 4/5 will do projects:

1. Calculation of tensile strength using UTM
2. Buckling of struts
3. Experimental verification of Theory of bending (Calculation of bending stress and deflections at various points in the beam theoretically and verifying the same experimentally) and indirect evaluation of the modulus of elasticity.
4. Torsion: Study the behavior of circular shafts under torsion and analysis of failure and indirect evaluation of the modulus of rigidity.

Micro Project:

Model Bridge Experiment: This will involve construction of a model bridge using steel wire and wood.

Course Learning Outcomes (CLOs):

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

1. Evaluate axial stresses and strains in various determinate and indeterminate structural systems

2. Draw Shear Force Diagram and Bending Moment Diagram in various kinds of beams subjected to different kinds of load
3. Calculate load carrying capacity of columns and sturts and their buckling strength.
4. Evaluate various kinds of stresses (axial, bending, torsional and shearing) in various structural elements due to different type of external loads.
5. Determine deformations and deflections in various kinds of beams and trusses

Text Books :

1. *Popov, E.P. and Balan, T.A., Engineering Mechanics of Solids, Prentice Hall of India (2012).*
2. *Singh, D.K., Mechanics of Solids, Pearson Education (2008).*

Reference Books :

1. *Shames, I. H. and Pitarresi, J. M., Solid Mechanics, Prentice Hall of India (1996).*
2. *Crandall, S.H., Dahl, N.C. and Lardner, T.J., An Introduction to Mechanics of Solids, McGraw Hill International, Tokyo(1969).*

Evaluation Scheme

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include Assignments/Projects/Tutorials/Quiz/Lab evaluations)	40

UES011:THERMO-FLUIDS

L	T	P	Cr
3	1	2	4.5

Course Objective: To understand basic concepts of fluid flow and thermodynamics and their applications in solving engineering problems

Fluid Mechanics

- **Introduction**: Definition of a fluid and its properties
- **Hydrostatics**: Measurement of pressure, thrust on submerged surfaces
- **Principles of Fluid Motion**: Description of fluid flow; continuity equation; Euler and Bernoulli equations; Pitot total head and static tubes, venturi-meter, orifice-meter, rotameter; Momentum equation and its applications
- **Pipe Flow**: Fully developed flow; laminar pipe flow; turbulent pipe flow, major and minor losses; Hydraulic gradient line (HGL) and total energy line (TEL)
- **Boundary Layer**: Boundary layer profile; displacement, momentum and energy thickness

Thermodynamics

- **Introduction**: Properties of matter, the state postulate, energy, processes and thermodynamic systems;
- **Properties of Pure Substances**: property tables, property diagrams, phase change, equations of state (ideal gas);
- **Energy**: Energy transfer by heat, work and mass;
- **First Law of Thermodynamics**: Closed system, open system, steady-flow engineering devices;
- **Second Law of Thermodynamics**: Statements of the Second Law, heat engines, refrigeration devices, reversible versus irreversible processes, the Carnot cycle.

Laboratory/Project programme

List of Experiments

1. Verification of Bernoulli's theorem
2. Determination of hydrostatic force and its location on a vertically immersed surface
3. Determination of friction factor for pipes of different materials
4. Determination of loss coefficients for various pipe fittings
5. Verification of momentum equation
6. Visualization of laminar and turbulent flow, and rotameter
7. Calibration of a venturi-meter
8. Boundary layer over a flat plate

Sample List of Micro-Projects

Students in a group of 4/5 members will be assigned a micro project.

1. Design a physical system to demonstrate the applicability of Bernoulli's equation
2. Determine the pressure distribution around the airfoil body with the help of wind tunnel
3. Demonstrate the first law of thermodynamics for an open system, for example: a ordinary hair dryer
4. Develop a computer program for solving pipe flow network.

Course Learning Outcomes (CLO):

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

1. analyze and solve problems of simple fluid based engineering systems including pressures and forces on submerged surfaces
2. analyze fluid flow problems with the application of the mass, momentum and energy equations
3. evaluate practical problems associated with pipe flow systems
4. conceptualize and describe practical flow systems such as boundary layers and their importance in engineering analysis
5. estimate fluid properties and solve basic problems using property tables, property diagrams and equations of state
6. analyze and solve problems related to closed systems and steady-flow devices by applying the conservation of energy principle
7. analyze the second law of thermodynamics for various systems and to evaluate the performance of heat engines, refrigerators and heat pumps.

Textbooks

1. *Kumar, D. S, Fluid Mechanics and Fluid Power Engineering, S. K. Kataria (2009)*
2. *Cengel and Boles, Thermodynamics: an Engineering Approach, McGraw-Hill (2011)*

Reference Books

1. *Jain, A. K. , Fluid Mechanics: including Hydraulic Machines, Khanna Publishers (2003)*
2. *Rao, Y.V. C, An Introduction to Thermodynamics, Universities Press (2004)*

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	40
3	Sessional (may be tutorials/ quizzes/ assignments/lab/ project)	35

UTA002 MANUFACTURING PROCESSES

L	T	P	Cr
2	0	3	3.5

Course Objectives: This course introduces the basic concepts of manufacturing via machining, forming, joining, casting and assembly, enabling the students to develop a basic knowledge of the mechanics, operation and limitations of basic machining tools. The course also introduces the concept of metrology and measurement of parts.

Machining Processes: Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, Introduction to multi-point machining processes – milling, drilling and grinding, Tool Life, Introduction to computerized numerical control (CNC) machines, G and M code programming for simple turning and milling operations, introduction of canned cycles.
Metal Casting: Principles of metal casting, Introduction to sand casting, Requisites of a sound casting, Permanent mold casting processes.
Metal Forming: Forging, Rolling, Drawing, Extrusion, Sheet Metal operations.
Joining Processes: Electric arc, Resistance welding, Soldering, Brazing.

Laboratory Work:
Relevant shop floor exercises involving practices in Sand casting, Machining, Welding, Sheet metal fabrication techniques, CNC turning and milling exercises, Experiments on basic engineering metrology and measurements to include measurements for circularity, ovality, linear dimensions, profiles, radius, angular measurements, measurement of threads, surface roughness.
Basic knowledge and derivations related to above measurements, uncertainties, statistical approaches to estimate uncertainties, Line fitting, static and dynamic characteristics of instruments will be discussed in laboratory classes.
Assignments: Assignments for this course will include the topics: Manufacturing of micro-chips used in IT and electronics industry and use of touch screens. Another assignment will be given to practice numerical exercises on topics listed in the syllabus.
Micro Project: Fabrication of multi-operational jobs using the above processes as per requirement by teams consisting of 4-6 members. The use of CNC machines must be part of micro project. Quality check should be using the equipment available in metrology lab.

Course Learning Outcomes (CLO):
After the completion of this module, students will be able to:

1. develop simple CNC code, and use it to produce components while working in groups.
2. analyse various machining processes and calculate relevant quantities such as velocities, forces.
3. recognise cutting tool wear and identify possible causes and solutions.
4. understand the basic principle of bulk and sheet metal forming operations for analysis of forces.
5. analyse various shearing operations for tooling design.
6. apply the knowledge of metal casting for different requirements.

7. analyse and understand the requirements to achieve sound welded joint while welding different similar and dissimilar engineering materials.

Text books:

1. *Degarmo, E. P., Kohser, Ronald A. and Black, J. T., Materials and Processes in Manufacturing, Prentice Hall of India (2008) 8thed.*
2. *Kalpakjian, S. and Schmid, S. R., Manufacturing Processes for Engineering Materials, Dorling Kingsley (2006) 4thed.*

Reference Books:

1. *Martin, S.I., Chapman, W.A.J. , Workshop Technology, Vol.1 & II, Viva Books (2006) 4 th ed.*
2. *Zimmer, E.W. and Groover, M.P., CAD/CAM - Computer Aided Designing and Manufacturing, Dorling Kingsley (2008).*
3. *Pandey, P.C. and Shan, H. S., Modern Machining Processes, Tata McGraw Hill (2008).*
4. *Mishra, P. K., Non-Conventional Machining, Narosa Publications (2006).*
5. *Campbell, J.S., Principles of Manufacturing, Materials and Processes, Tata McGraw Hill Company (1999).*
6. *Lindberg, Roy A., Processes and Materials of Manufacture, Prentice Hall of India (2008) 4 thed.*

Evaluation Scheme:

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25
2	EST	40
3	Sessional: (May include the following) Assignment, Sessional (Includes Regular Lab assessment and Quizzes Project (Including report, presentation etc.)	35

UMA031 OPTIMIZATION TECHNIQUES

L	T	P	Cr
3	1	0	3.5

Course Objective: The main objective of the course is to formulate mathematical models and to understand solution methods for real life optimal decision problems. The emphasis will be on basic study of linear programming problem, Integer programming problem, Transportation problem, Two person zero sum games with economic applications and project management techniques using PERT and CPM.

Scope of Operations Research: Introduction to linear and non-linear programming formulation of different models.

Linear Programming: Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex method, Exceptional cases in LP, Duality theory, Dual simplex method, Sensitivity analysis.

Integer Programming: Branch and bound technique.

Transportation and Assignment Problem: Initial basic feasible solutions of balanced and unbalanced transportation/assignment problems, Optimal solutions.

Project Management: Construction of networks, Network computations, Floats (free floats and total floats), Critical path method (CPM), Crashing.

Game Theory: Two person zero-sum game, Game with mixed strategies, Graphical method and solution by linear programming.

Course Learning Outcomes (CLO):

Upon completion of this course, the students would be able to:

1) formulate and solve linear programming problems.
2) solve the transportation and assignment problems
3) solve the Project Management problems using CPM
4) to solve two person zero-sum games

Text Books:

1) Chandra, S., Jayadeva, Mehra, A., Numerical Optimization and Applications, Narosa Publishing House, (2013).
2) Taha H.A., Operations Research-An Introduction, PHI (2007).

Recommended Books:

1) Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004)
2) Bazaarra Mokhtar S., Jarvis John J. and Shirali Hanif D., Linear Programming and Network flows, John Wiley and Sons (1990)
3) Swarup, K., Gupta, P. K., Mammohan, Operations Research, Sultan Chand & Sons, (2010).

Evaluation Scheme:

Sr.No.	Evaluation Elements	Weight age (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May includeassignments/quizzes)	25

UTA014 ENGINEERING DESIGN PROJECT-II (BUGGY LAB)

L	T	P	Cr
1	0	4	6.0

Course objective: The project will introduce students to the challenge of electronic systems design & integration. The project is an example of '*hardware and software co-design'* and the scale of the task is such that it will require teamwork as a co-ordinated effort.

Hardware overview of Arduino:

- Introduction to Arduino Board: Technical specifications, accessories and applications.
- Introduction to Eagle (PCB layout tool) software.

Sensors and selection criterion:

- Concepts of sensors, their technical specifications, selection criterion, working principle and applications such as IR sensors, ultrasonic sensors.

Active and passive components:

- Familiarization with hardware components, input and output devices, their technical specifications, selection criterion, working principle and applications such as-
  - Active and passive components: Transistor (MOSFET), diode (LED), LCD, potentiometer, capacitors, DC motor, Breadboard, general PCB etc.
  - Instruments: CRO, multimeter, Logic probe, solder iron, desolder iron
  - Serial communication: Concept of RS232 communication , Xbee
- Introduction of ATtiny microcontroller based PWM circuit programming.

Programming of Arduino:

- Introduction to Arduino: Setting up the programming environment and basic introduction to the Arduino micro-controller
- Programming Concepts: Understanding and Using Variables, If-Else Statement, Comparison Operators and Conditions, For Loop Iteration, Arrays, Switch Case Statement and Using a Keyboard for Data Collection, While Statement, Using Buttons, Reading Analog and Digital Pins, Serial Port Communication, Introduction programming of different type of sensors and communication modules, DC Motors controlling.

Basics of C#:

- Introduction: MS.NET Framework Introduction, Visual Studio Overview and Installation
- Programming Basics: Console programming, Variables and Expressions, Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Assignment Operators, Expressions, Control Structures, Characters, Strings, String Input, serial port communication: Read and write data using serial port.
- Software code optimization, software version control

Laboratory Work:

Schematic circuit drawing and PCB layout design on CAD tools, implementing hardware module of IR sensor, Transmitter and Receiver circuit on PCB.

Bronze Challenge: Single buggy around track twice in clockwise direction, under full supervisory control. Able to detect an obstacle. Parks safely. Able to communicate state of the track and buggy at each gantry stop to the console.

Silver Challenge: Two buggies, both one loop around, track in opposite directions under full supervisory, control. Able to detect an obstacle. Both park safely. Able to communicate state of the track and buggy at each gantry stop with console.

Gold Challenge: Same as silver but user must be able to enter the number of loops around the track beforehand to make the code generalized.

Course learning outcome (CLO):

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

1. Recognize issues to be addressed in a combined hardware and software system design.
2. Draw the schematic diagram of an electronic circuit and design its PCB layout using CAD Tools.
3. Apply hands-on experience in electronic circuit implementation and its testing.
4. Demonstrate programming skills by integrating coding, optimization and debugging for different challenges.
5. Develop group working, including task sub-division and integration of individual contributions from the team.

Text Books:

1. *Michael McRoberts, Beginning Arduino, Technology in action publications, 2nd Edition.*
2. *Alan G. Smith, Introduction to Arduino: A piece of cake, CreateSpace Independent Publishing Platform (2011).*

Reference Books:

1. *John Boxall, Arduino Workshop - a Hands-On Introduction with 65 Projects, No Starch Press; 1 edition (2013).*

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1.	Evaluation-1 (ECE lab)	20
2.	Evaluation-2 (CSE lab)	20
3.	Quiz	10
4.	Evaluation-3 (ECE+CSE lab)	50

SEMESTER IV

UEE301: DIRECT CURRENT MACHINES AND TRANSFORMERS

L	T	P	Cr.
3	1	2	4.5

Course Objective: To introduce the fundamentals of dc machines, transformer, 3-phase transformer and special purpose transformer.

General Concepts of Rotating Electrical Machines: Electromagnetic torque, Reluctance torque, Constructional features of rotating electrical machines, Classifications of rotating electrical machines, Construction of DC machines.

DC Generators: Classification of DC generator, Armature reaction, Compensating windings, Commutation, Methods of improving commutation, Characteristic of DC generators, Voltage buildup of shunt generators, Voltage regulation, Parallel operation of DC generators, Condition for maximum efficiency, Applications of DC generators.

DC Motors: Characteristic of DC motors, Speed control of DC motors, Ward – Leonard control (Voltage control), Three-point starter, four-point starter, DC shunt motor starter design, Electric breakings of DC shunt and series motors, Condition for maximum mechanical power, Testing of DC machines: Brake test, Swinburne's test, Hopkinson's test or back to back test, Retardation test or Running test, Field's test, Applications of DC motors.

Single Phase Transformers: Introduction, Basic principle, Types of transformer, Construction, Equivalent circuit, Open circuit and short circuit, Separation of core losses, Per unit representation, Voltage regulation of a transformer, Losses in a transformer, Efficiency of a transformer, Condition for maximum efficiency, All day efficiency, Polarity test of a single–phase transformer, Sumpner's test, Parallel operation, Auto transformer.

Three-Phase Transformer: Advantages of three phase transformer, Principle of operation, Construction, Three – phase transformer connections, Open delta or V – V connection, Scott connection or T–T connection, Three–phase to two–phase conversion, Three–phase to six–phase conversion, Three–winding transformer, Parallel operation of transformers.

Special Purpose Transformers: Instrument transformers (CT and PT), Earthing transformer, Pulse transformer, High frequency transformer, Converter transformer.

Laboratory Work: DC Machines: Characteristics of generators and motors, Speed control, Efficiency, DC generators in parallel. Transformers: Open and short circuit tests, Parallel operation, Harmonics in no-load current, Three-phase connections, 3 – phase to 2 – phase and 6 – phase conversions.

Course Learning Outcomes (CLO):

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

1. Test the transformer and calculate its efficiency and performance in distribution system.
2. Compare the performance of auto-transformer with that of two winding transformer.
3. Use special purpose transformer for measurement and protection.
4. Compute the performance of DC motors and generators in various modes.

5. Explain the advantages of increasing load with parallel operation.
6. Explain the speed control and starting methods of DC motors for specific purpose(s).

Text Books:

1. *Bimbhra, P.S., Electrical Machinery, Khanna Publishers (2008).*
2. *Mukherjee, P.K. and Chakravorty, S., Electrical Machines, Dhanpat Rai (2004).*
3. *Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill (2004).*

Reference Books:

1. *Bimbhra, P.S., Generalized Theory of Electrical Machines, Khanna Publishers (2007).*
2. *Toro, Vincert, Electromechanical Devices for Energy Conversion,* Prentice Hall of India *(2004).*
3. *Fitzgerald, A.E., Kingsley, C. Jr. and Umans, Stephen, Electric Machinery, McGraw Hill (2002).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

UEE406: POWER SYSTEM PRACTICES

L	T	P	Cr.
3	0	0	3.0

Course objective: To make the students understand the concepts of energy scenario, energy conservation, auditing and various stages of financial management. To introduces the concept of restructuring and deregulation of power industry.

Energy Scenario: Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy conservation and its importance, Energy strategy for the future, Energy conservation Act-2001 and its features.

Energy Management and Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments

Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques-Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracts and role of ESCOs.

Introduction to Deregulation: Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process: Entities involved, The levels of competition, The market place mechanisms, Sector-wise major changes required, Reasons and objectives of deregulation of various power systems across the world: The US, The UK and India. Market models based on contractual arrangements: Monopoly model, Single buyer model, Wholesale competition model, Retail competition model.

Electricity vis-à-vis Other Commodities: Distinguishing features of electricity as a commodity, Four pillars of market design: Imbalance, Scheduling and Dispatch, Congestion Management, Ancillary Services. Framework of Indian power sector and introduction to the availability based tariff (ABT)

Course learning Outcomes (CLO):

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

1. Analyze about energy scenario nationwide and worldwide
2. Decide about energy management in more effective way.
3. Carry out financial management.
4. Analyze about deregulation of power industry.
5. Explain about various pillars of electricity market design.

Text Books:

1. *Kothari D. P., NagrathI.J., Modern Power System Analysis, Tata McGraw Hill Education Private Limited (2009).*
2. *Shahedepour M.,Yamin H., Zuyi Li., Market operations in power systems: Forecasting, Scheduling, and Risk Management, John Wiely& Sons, New York.*

3. *Abbi, Y.P. and Jain, S., Handbook on Energy Audit and Environment Management, Teri Bookstore (2006).*
4. *Diwan, P., Energy Conservation, Pentagon Press (2008).*

Reference Books:

1. *Bhattacharya K., Bollen M.,Daalder, Jaap E., Power System Restructuring: Springer (2001).*
2. *Younger, W., Handbook of Energy Audits, CRC Press (2008).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	50
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	20

UEE407: NETWORK THEORY AND DESIGN

L	T	P	Cr.
3	1	2	4.5

Course Objective: To make the students understand the concepts of graph theory, two port networks, filter design, attenuators, oscillator and network synthesis.

Graph Theory: Graph, Tree and link branches, Network matrices and their relations, Choice of linearly independent network variables, Topological equations for loop current and for nodal voltage, Duality.

Network Theorems: Source transformation, Superposition Theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Reciprocity theorem and Maximum power transfer theorem as applied to A.C. circuits, Compensation theorem, Tellegen's theorem and their applications.

Two Port Networks: Two port network description in terms of open circuits impedance, Short circuit admittance, Hybrid and inverse hybrid, ABCD and inverse ABCD parameters, Inter-connection of two port network, Indefinites admittance matrix and its applications**.**

Network Functions: Concepts of complex frequency, Transform impedance, Networks function of one port and two port network, concepts of poles and zeros, property of driving point and transfer function.

Passive Network Synthesis: Introduction, Positive Real Functions: Definition, Necessary and sufficient conditions for a function to be positive real, Synthesis vs. analysis, Elements of circuit synthesis, Foster and cauer forms of LC Networks, Synthesis of RC and RL networks.

Filters and Attenuators: Classification of filters, Analysis of a prototype low pass, High pass, Band pass, Band stop and M – derived filter, Attenuation, Types of attenuators: symmetrical and asymmetrical.

Operational amplifier: Characteristics of op-amp, Differential and common mode operation, Inverting and Non-Inverting Configuration, open-Loop and closed-loop operation, Feedback configurations.

Active Filters Introduction to Active filters, first and second order low pass Butterworth filter, First and second order high pass Butterworth filter, Band pass filter.

Laboratory Work: Verification of Network Theorems, Determination of Z, Y, hybrid and ABCD parameters of two port network, Inter-connection of two port networks, Analysis of T and π - Attenuator.

Course Learning Outcome (CLO):

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

1. Apply various laws and theorems to solve electric networks.
2. Explain and analyze the behaviour of two port networks.
3. Familiarise with network synthesis.
4. Analyze the behaviour of passive filters and attenuators.
5. Design of passive and active filters.

Text Books:

1. *Hayt, W., Engineering Circuit Analysis, Tata McGraw−Hill (2006).*
2. *Hussain, A., Networks and Systems, CBS Publications (2004).*
3. *Valkenberg, Van, Network Analysis,* Prentice−Hall of India Private Limited *(2007).*
4. *Gayakwad, A. Op-Amps and Linear Integrated Circuits,* Prentice−Hall of India *(2006).*

Reference Books:

1. *Chakarbarti,A., Circuit Theory, Dhanpat Rai and Co. (P) Ltd. (2006).*
2. *Roy Chowdhuary, D., Networks and Systems, New Age International (P) Limited, Publishers (2007).*
3. *Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education, (2009).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

UEE505: ANALOG AND DIGITAL SYSTEMS

L	T	P	Cr.
3	1	2	4.5

Course Objective: To introduce the students about h-model of BJT and FET, working of power devices, and oscillators. To understand design concept of combinational and sequential digital circuits.

Bipolar Junction Transistor and Field Effect Transistor: Different configurations and their static characteristics; CE configuration as two port network: h−parameters, h−parameter equivalent circuit; Biasing and load line analysis; High frequency operation of BJT; Structure and working of JFET and MOSFET; output and transfer characteristics, Applications of JFET and MOSFET

Oscillators and Wave Shaping Circuits: Condition for sustained oscillation, R-C phase shift, Hartley, Colpitts, Crystal and Wien Bridge Oscillators, Negative Resistance oscillator; Switching characteristics of diodes and transistors including square wave response, High pass and low pass filters using R-C Circuits; $R-L$, $R-L-C$ circuits, Attenuators; Clipping and clamping circuits; Clamping circuit theorem; Comparators; Multivibrators.

Simplification of Boolean Expressions: Quine-McClusky method in SOP and POS forms, determination of prime implications, simplification using Map-entered variables.

Combinational and Sequential Circuits: Introduction, Adders: Parallel Binary adder, Serial adder, BCD adder, Subtractors, Binary multiplier, Dividers, ALU, Code converters, Magnitude comparators, Parity Generators/checkers, Encoders, Decoders, Multiplexers, Demultiplexer; Introduction of sequential circuits, Flip-flops, Registers: Serial/Parallel in/out, Bi-directional, Universal shift register, Counters: Synchronous, Asynchronous, Decade, Binary, Modulo-n, Shift register counters; Design of Synchronous sequential circuits, FSM, Concept of Moore and Mealy machines, Synchronous detector.

Memories: Introduction and classification of ROM, ROM organization, Static and Dynamic RAM, DRAM Refreshing, Representative circuits for cells using BJT and FET's, Timing diagrams of memories, Memory expansion using IC's, Flash memory, CCD, Magnetic Memories.

Converters: Digital to Analog conversion, R2R ladder DAC, Weighted Resistor DAC, Analog-Digital conversion, Flash type, Counter type ADC, Dual-slope ADC, Successive approximation type ADC.

Laboratory Work: Series voltage regulator, RC coupled amplifier in CE mode, Use of Bistable, Astable and monostable multivibrator, Hartley and Colpitts Oscillator, shift register and binary counting using JK flip flop, asynchronous/synchronous up/down counters, Variable modulus counters, Usage of IC tester, Computer simulation using EDA tools.

Minor Project: Design of LED lighting system for household application; street lighting system; soft starting of DC machine.

Course Learning Outcome (CLO):

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

1. Design different type of circuits such as rectifiers, clippers, clampers, filters etc.
2. Design power supplies and solve problems related to amplifiers and oscillators.
3. Design combinational and sequential circuits.
4. Differentiate various type of memories and there use in different applications.
5. Demonstrate the concept of logic circuits and converters.

Text Books:

1. *Boylestad R. L., Electronic Devices and Circuit Theory, Pearson Education (2007).*
2. *Millman, J. and Halkias, C.C., Integrated Electronics, Tata McGraw Hill (2006).*
3. *Floyd, T.L. and Jain, R. P., Digital Fundamentals, Pearson Education (2008).*
4. *Tocci, R. and Widmer, N., Digital Systems: Principles and Applications, Pearson Education (2007).*

Reference Books:

1. *Neamen, Donald A., Electronic Circuit Analysis and Design, McGraw Hill (2006).*
2. *Sedra A. S. and Smith K. C., Microelectronic Circuits, Oxford University Press (2006).*
3. *Mano, M. M. and Ciletti, M., Digital Design, Pearson Education (2008).*
4. *Kumar, A., Fundamentals of Digital Circuits, Prentice Hall (2007).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

UES012 ENGINEERING MATERIALS

L	T	P	Cr.
3	1	2	4.5

Course Objectives: The objective of the course is to provide basic understanding of engineering materials, their structure and the influence of structure on mechanical, chemical, electrical and magnetic properties.

Structure of Solids: Classification of engineering materials, Structure-property relationship in engineering materials, Crystalline and non-crystalline materials, Miller Indices, Crystal planes and directions, Determination of crystal structure using X-rays, Inorganic solids, Silicate structures and their applications. Defects; Point, line and surface defects.

Mechanical Properties of Materials: Elastic, Anelastic and Viscoelastic behaviour, Yielding and yield strength, Tensile strength, Stiffness, Ductility, Brittleness, Resilience, Toughness, True stress - true strain relationship, Hardness, Shrinkage, Plastic deformation by twinning and slip, Movement of dislocations, Critical shear stress, Strengthening mechanism, and Creep.

Equilibrium Diagram: Solids solutions and alloys, Gibbs phase rule, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

Electrical and Magnetic Materials: Conducting and resister materials, and their engineering application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications; Superconductors; Dielectric materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive and electrostrictive materials.

Diffusion and Corrosion: Diffusion in solids, Corrosion: their type, cause and protection against corrosion.

Materials Selection: Overview of properties of engineering materials, Material selection in design based on properties covering timber, aluminium, glass, polymers and ceramics.

Laboratory Work:

1. Determination of the elastic modulus and ultimate strength of a given fiber strand.
2. To measure grain size and study the effect of grain size on hardness of the given metallic specimens.
3. To determine fiber and void fraction of a glass fiber reinforced composite specimen.
4. To study cooling curve of a binary alloy.
5. Detection of flaws using ultrasonic flaw detector (UFD).
6. To determine the dielectric constant of a PCB laminate.
7. To estimate the Hall coefficient, carrier concentration and mobility in a semiconductor crystal.
8. To estimate the band-gap energy of a semiconductor using four probe technique.

Micro Project:

The micro-project will be assigned to the group(s) of students at the beginning of the semester. Based on the interest and branch of the student, he will carry out one of the followings:

1. Design experiments to determine various mechanical properties like strength, ductility, elastic modulus, etc. of a given specimen(s) and correlate them.
2. Design an experiment to classify the given specimens based on their electrical properties.
3. Identify the most suitable material from the given specimens for solar cell application.
4. Identify the suitability of given samples in marine, acidic and alkaline environment.
5. Design a virtual experiment to analyse / predict physical properties of a given material/composite.

Course Learning Outcomes (CLO):

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

1. classify engineering materials based on its structure.
2. draw crystallographic planes and directions.
3. distinguish between elastic and plastic behavior of materials.
4. Distinguish between Isomorphous and eutectic phase diagram.
5. classify materials based on their electrical and magnetic properties.
6. propose a solution to prevent corrosion.

Text Books:

1. *W.D. Callister, Materials Science and Engineering; John Wiley & Sons, Singapore, 2002.*
2. *W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.*
3. *V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.*

Reference Books:

1. *S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill, 2007.*
2. *L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press, India, 1998.*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional	40

UMA007 NUMERICAL ANALYSIS

L	T	P	Cr
3	1	2	4.5

Course Objective: The main objective of this course is to motivate the students to understand and learn various numerical techniques to solve mathematical problems representing various engineering, physical and real life problems.

Floating-Point Numbers: Floating-point representation, rounding, chopping, error analysis, -conditioning and stability.
Non-Linear Equations: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.
Linear Systems and Eigen-Values: Gauss elimination method using pivoting strategies, LU decomposition, Gauss--Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well conditioned systems, Rayleigh's power method for eigen-values and eigen-vectors.
Interpolation and Approximations: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations.
Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss--Legendre quadrature formulae.
Differential Equations: Solution of initial value problems using Picard, Taylor series, Euler's and Runge- Kutta methods (up to fourth-order), system of first-order differential equations.

Laboratory Work: Lab experiments will be set in consonance with materials covered in the theory. Implementation of numerical techniques using MATLAB.

Course Learning Outcomes (CLO):
Upon completion of this course, the students will be able to**:**

1. understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
2. learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods.
3. solve system of linear equations numerically using direct and iterative methods.
4. understand how to approximate the functions using interpolating polynomials.
5. learn how to solve definite integrals and initial value problems numerically.

Texts Books:

1. *Curtis F. Gerald and Patrick O. Wheatley, Applied Numerical Analysis, Pearson, (2003) 7th Edition,*
2. *M. K. Jain, S .R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers (2012), 6th edition.*
3. *Steven C. Chappra, Numerical Methods for Engineers, (2014)McGraw-Hill Higher Education; 7 edition*

References Books:

1. *J. H. Mathew, Numerical Methods for Mathematics, Science and Engineering, Prentice Hall, (1992) 2nd edition,*
2. *Richard L. Burden and J. Douglas Faires, Numerical Analysis, Brooks Cole (2004), 8th edition.*
3. *K. Atkinson and W. Han, Elementary Numerical Analysis, John Willey & Sons (2004), 3rd Edition.*

Evaluation Scheme:

Sr.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	40
3.	Sessionals (May include assignments/quizzes)	15
4.	Laboratory Evaluation	20

UEE401: ALTERNATING CURRENT MACHINES

L	T	P	Cr.
3	1	2	4.5

Course objective: To introduce the concept of single phase and three phase AC machines, their construction and performance parameters.

Three – Phase Induction Motors: Construction, working principle, Sip and its effect on rotor parameters: rotor frequency, Torque – slip characteristics, Power flow diagram, Efficiency, Synchronous watt, Measurement of slip, Equivalent circuit, No–load test, Blocked rotor test, Circle diagram, Starting methods, Speed control methods, Crawling, Cogging, Deep cage and Double cage rotors, Applications, self excited and grid connected Induction generator.
Fractional kW Motors and Special Machines: Classification, Production of rotating field, Double revolving field theory, Equivalent circuit, Determination of equivalent circuit parameters, Split phase induction motor, Capacitor motor, Permanent split capacitor motor; Shaded pole motor, Universal motor, Stepper motor.
Synchronous Generators/Alternators: Introduction, Comparison with DC generator, Advantages of rotating field over rotating armature, Constructional features, Excitation systems, Armature windings, EMF equation, Winding factor, Harmonics, Armature resistance, Armature reaction: Unity power factor, Zero lagging and Zero leading power factor, Armature reaction reactance, Equivalent circuit of an alternator, Voltage equation, Phasor diagram of a loaded alternator for various types of loads, Voltage regulation and methods of estimation of voltage regulation, Load characteristic of alternators, power equation, Two reaction theory and Torque–angle characteristic of a salient–pole alternator, Maximum reactive power for a salient–pole alternator, Losses and efficiency, Determination of X_d and X_q, Parallel operation of alternators, Synchronising procedures, Synchronising power and Torque co–efficient, Damper Windings, Hunting.
Synchronous Motors: Voltage equation, Phasor diagram, Operation at constant load with variable excitation, Power equations, salient pole Synchronous motor, Starting of synchronous motors, Applications, Synchronous condensers.

Laboratory work: Voltage regulation, Direct and quadrature axis reactances, Operating characteristics, Synchronizing, Parallel operation and load division, Sudden short circuit analysis and determination of sub transient, Transient and steady state reactances and various time constants, Determination of positive, negative and zero sequence reactances, Synchronous motor starting, Efficiency. Three phase induction motors: starting methods, Equivalent circuit parameters, Load test, Polarity test, Single phasing, Efficiency, Schrage motor, Single-phase induction motors: Equivalent circuit parameters and performance indices.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Simulate the steady-state and transient state performance of induction and synchronous machines
2. Validate and identify the machine parameters.

3. Select the appropriate AC motor for different large power application.
4. Analyse the stability of single machine – infinite bus system and form the grid to supply large load.
5. Choose the appropriate fractional horse power motor as per the usage in daily life.

Text Books:

1. *Bimbhra, P.S., Electrical Machinery, Khanna Publishers (2008).*
2. *Mukherjee, P.K. and Chakravorty, S., Electrical Machines, Dhanpat Rai and Co. (P) Ltd. (2004).*
3. *Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill (2004).*

Reference Books:

1. *Bimbhra, P.S., Generalized Theory of Electrical Machines, Khanna Publishers (2007).*
2. *Toro, Vincert, Electromechanical Devices for Energy Conversion, Prentice Hall of India (2004).*
3. *Fitzgerald, A.E., Kingsley, C. Jr., and Umans, Stephen, Electric Machinery, McGraw – Hill (2002).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations	40

UEE403: MEASUREMENT AND TRANSDUCERS

L	T	P	Cr.
3	0	2	4.0

Course objective: To introduce the classification of standards, to get familiar with principle, operation and comparison of electromechanical indicating instruments. To get familiarize with power and energy measurement systems, working and applications of various type of bridges and transducer.

Units, Systems and Standards: SI units, Classification of standards, Time and frequency standards, Electrical standard.
Electromechanical Indicating Instruments: PMMC galvanometer, Ohmmeter, Electrodynamometer, Moving iron meter, Rectifier and thermo-instruments, Comparison of various types of indicating instruments.
Power and Energy Measurement: Electrodynamometer type of wattmeter and power factor meter, Single-phase induction and Electronic energy meters.
Bridges for Measurement: Kelvin double bridge, AC bridges: Maxwell's bridge, Hay's bridge, Schering bridge, Wien's bridge, Low and High resistance measurement.
Electronic Instruments: Electronic multi-meter, Quantization error, Digital frequency meter, Q meter, Spectrum Analyzer, Digital Storage Oscilloscopes.
Sensors and Transducers: Basic principle and applications of Resistive, Inductive, Capacitive and, Piezoelectric sensors, Synchros and Resolvers, Fiber optic sensors, Hall-Effect, Photo transducer, Photovoltaic, Digital transducers, Tacho-generators, shaft parameters measurement in rotating shafts.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Select various types of instruments for measurement of variables.
2. Select and use various types of sensors in different conditions.
3. Select and use various types of bridge circuits with different sensors.
4. Explain the working of electronic instruments.
5. Explain the working of sensors and transducers.

Text Books:

1. *Golding, E.W., and Widdis, F.C., Electrical Measurements and Measuring Instruments, Pitman (2003).*
2. *Sawhney, A.K., A Course in Electrical and Electronic Measurements and Instrumentation, DhanpatRai and Co. (P) Ltd. (2007).*
3. *Nakra, B. C. and Chaudhry, K. K., Instrumentation Measurement and Analysis, Tata McGraw–Hill (2003).*

Reference Books:

1. *Murthy, D.V.S., Transducers and Instrumentation, Prentice−Hall of India Private Limited (2003).*
2. *Doeblin, E.O., Measurement systems, Applications and Design, McGraw−Hill (1982)*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	40
3.	Sessionals (Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	35

UEI501: CONTROL SYSTEMS

L	T	P	Cr.
3	1	2	4.5

Course Objectives: To understand concepts of the mathematical modeling, feedback control and stability analysis in Time and Frequency domains. The concept of time response and frequency response of the system will be studied.

Basic Concepts: Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, , Block diagrams and signal flow graphs.
Components: D.C. and A.C. Servomotors, D.C. and A.C. Tachogenerators, Potentiometers and optical encoders, Synchros and stepper motors
Analysis: Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.
Stability: Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.
Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.
State Space Analysis: Concepts of state, State variables and state models, State space equations, transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposition of transfer function, Controllability and observability.

Laboratory: Linear system simulator, Compensation design, D.C. position control and speed control, Synchro characteristics, Servo demonstration, Stepper motor, Potentiometer error detector, Rate control system, Series control system, Temperature control system.

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:

1. Develop the mathematical model of the physical systems.
2. Analyze the response of the closed and open loop systems.
3. Analyze the stability of the closed and open loop systems.
4. Design the various kinds of compensator.
5. Develop and analyze state space models

Text Books:

1. *Gopal, M., Digital Control System, Wiley Eastern (1986).*
2. *Nagrath, I.J. and Gopal, M., Control System Engineering, New Age International (P) Limited, Publishers (2003).*
3. *Ogata, K., Modern Control Engineering, Prentice–Hall of India Private Limited (2001).*

Reference Books:

1. *Kuo, B.C., Automatic Control System, Prentice–Hall of India Private Limited (2002).*
2. *Sinha, N.K., Control System, New Age International (P) Limited, Publishers (2002).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	40

UEE504: POWER ELECTRONICS

L	T	P	Cr.
3	1	2	4.5

Course objective: To review the operational aspects of power electronic devices and principle of conversion and control of AC and DC voltages for high power applications.

Introduction: Introduction to Thyristors and its family, static and dynamic characteristics, turn-on and turn - off methods and firing circuits, Ratings and protection of SCR'S, series and parallel operation.

Phase Controlled Converters: Principle of phase control, Single phase and three phase converter circuits with different types of loads, continuous and discontinuous conduction, effect of source inductance, Dual converters and their operation**.**

DC Choppers: Principle of chopper operation, control strategies, types of choppers, step up and step down choppers, steady state time domain analysis with R, L, and E type loads, voltage, current and load commutated choppers.

Inverters: Single phase voltage source bridge inverters and their steady state analysis, modified Mcmurray half bridge inverter, series inverters, three phase bridge inverters with 180^0 and 120^0 modes. single-phase PWM inverters, current source inverters, CSI with R load (qualitative approach).

AC Voltage Controllers: Types of single-phase voltage controllers, single-phase voltage controller with R and RL type of loads.

Cycloconverters: Principles of operation, single phase to single phase step up and step down cycloconverters, three phase to single phase cycloconverters, output voltage equation for a cycloconverter.

Laboratory Work: SCR V-I characteristics, Gate firing circuit, DC -DC chopper, Semi converter and Full converter with R , RL and RLE type of loads, DC shunt motor speed control, Single phase AC voltage controller with R load, Inverters, Simulation of power electronics converters.

Minor Project: Design and development of power converters

Course learning Outcomes (CLO):

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

1. Select the power devices as per the usage for energy conversion and control.
2. Exhibit the designing of firing and commutation circuits for different converter configurations.
3. Analyse various converter configuration / topology with different types of load.
4. Identify converter configurations for various power applications.
5. Exhibit the usage of power converters for harmonic mitigation, voltage and frequency control.

Text Books:

1. *Dubey, G.K., Doradla, S.R., Joshi, A. and Sinha, R.M.K., Thyristorised Power Controllers, New Age International (P) Limited, Publishers (2004).*

2. *Rashid, M., Power Electronics,* Prentice–Hall of India *(2006).*
3. *Bimbhra,P.S., Power Electronics, Khanna Publishers(2012).*

Reference Books:

1. *Mohan, N., Underland, T. and Robbins, W. P., Power Electronics: Converter Applications and Design, John Wiley (2007) 3rd ed.*
2. *Bose, B.K., Handbook of Power Electronics, IEEE Publications*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

UEI610: FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	Cr.
3	0	2	4.0

Course Objectives: To make the students able to understand microprocessors and microcontroller and their applications.

INTEL 8085 Microprocessor: Evolution of microprocessor, Types of various architectures; Harvard and Von-Neumann, RISC and CISC, Pin Functions, Architecture, Addressing Modes, Instruction Set, Timing Diagrams, Interrupts, Programming Examples, Direct Memory Access, I/O Mapping.

Introduction to 8051 Microcontroller: Difference between microprocessor and microcontroller, 8051-architecture and pin diagram, Registers, Timers Counters, Flags, Special Function Registers, Addressing Modes, Data types, instructions and programming, Single bit operations, Timer and Counter programming, Interrupts programming, Serial communication, Memory accessing and their simple programming applications.

Hardware interfacing:I/O Port programming, Bit manipulation, Interfacing to a LED, LCD, Keyboard, ADC, DAC, Stepper Motors and Sensors.

Introduction to latest 16 bit processor and their applications

Laboratory work: Introduction IDE like Keil/EdSim/UMPS etc., Programming examples of 8085, Programming and Application development around 8051 microcontroller, Interfacing to LED, LCD, Keyboard, ADC, DAC, Stepper Motors and sensors etc.

Course Learning Outcome (CLO):

After the successful completion of the course the students will be able to:

1. Elucidate the architecture and addressing modes of 8-bit microprocessor.
2. Elucidate the architecture and addressing modes of 8051 microcontroller.
3. Perform assembly language programming for microprocessors and microcontrollers for the given application.
4. Use hardware interfacing of 8051 to develop solutions of real world problems.

Text Books:

1. *Gaonkar, R. S., The 8085 Microprocessor- Architecture, Programming and Interfacing, Penram International Publishing (India) Pvt. Ltd. (2004).*
2. *Ayala, K.J., The 8051 Microcontroller Architecture, Programming and applications, Penram International Publishing (India) Pvt. Ltd. (2007).*
3. *Mazidi, M.A., The 8051 Microcontroller and Embedded System, Pearson Education (2008).*

Reference Books:

1. *Brey, B.B., The INTEL Microprocessors, Prentice–Hall of India Private Limited (2002).*
2. *Predko, M., Customizing The 8051 Microcontroller, Tata McGraw–Hill (2002).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	40
3.	Sessionals (May incl Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	35

UTA012: INNOVATION AND ENTREPRENEURSHIP
(5 SELF EFFORT HOURS)

L	T	P	Cr
1	0	2*	4.5

[*] 2 hours every alternate week.

Course Objectives: This course aims to provide the students with a basic understanding in the field of entrepreneurship, entrepreneurial perspectives, concepts and frameworks useful for analysing entrepreneurial opportunities, understanding eco-system stakeholders and comprehending entrepreneurial decision making. It also intends to build competence with respect business model canvas and build understanding with respect to the domain of startup venture finance.

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioural; entrepreneurial challenges.
Entrepreneurial Opportunities: Opportunities - discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.
Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem , Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches**,** - Effectuation and Causation.
Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions - conventional industry logic, value innovation logic; customer focused innovation; building and analysing business models; Business model canvas , Introduction to lean startups, Business Pitching.
Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of organisation, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

Course Learning Outcomes (CLO):
Upon successful completion of the course, the students should be able to:
1. Explain the fundamentals behind the entrepreneurial personality and their intentions
2. Discover/create and evaluate opportunities
3. Identify various stakeholders for the idea and develop value proposition for the same.
4. Describe various Business Models and design a business model canvas.
5. Analyse and select suitable finance and revenue models for start-up venture.

Text Books:

1. *Ries, Eric(2011), The lean Start-up: How constant innovation creates radically successful businesses, Penguin Books Limited.*
2. *Blank, Steve (2013), The Startup Owner's Manual: The Step by Step Guide for Building a Great Company, K&S Ranch.*
3. *Osterwalder, Alex and Pigneur, Yves (2010) Business Model Generation.*
4. *T. H. Byers, R. C. Dorf, A. Nelson, Technology Ventures: From Idea to Enterprise, McGraw Hill (2013)*

Reference Books:

1. *Kachru, Upendra, India Land of a Billion Entrepreneurs, Pearson*
2. *Bagchi, Subroto, (2008), Go Kiss the World: Life Lessons For the Young Professional, Portfolio Penguin*
3. *Bagchi, Subroto, (2012). MBA At 16: A Teenager's Guide to Business, Penguin Books*
4. *Bansal, Rashmi, Stay Hungry Stay Foolish, CIIE, IIM Ahmedabad*
5. *Bansal, Rashmi, (2013). Follow Every Rainbow, Westland.*
6. *Mitra, Sramana (2008), Entrepreneur Journeys (Volume 1), Booksurge Publishing*
7. *Abrams, R. (2006). Six-week Start-up, Prentice-Hall of India.*
8. *Verstraete, T. and Laffitte, E.J. (2011). A Business Model of Entrepreneurship, Edward Elgar Publishing.*
9. *Johnson, Steven (2011). Where Good Ideas comes from, Penguin Books Limited.*
10. *Gabor, Michael E. (2013), Awakening the Entrepreneur Within, Primento.*
11. *Guillebeau, Chris (2012), The $100 startup: Fire your Boss, Do what you love and work better to live more, Pan Macmillan*
12. *Kelley, Tom (2011),The ten faces of innovation, Currency Doubleday*
13. *Prasad, Rohit (2013), Start-up sutra: what the angels won't tell you about business and life, Hachette India.*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	20
2	EST	40
3	Sessionals(Assignments/Projects/Tutorials/Quizzes/Lab Evaluations)	40

UEE603: SWITCHGEAR AND PROTECTION

L	T	P	Cr.
3	0	2	4.0

Course objective: To introduce the concept of protection system attributes, types of fuses, circuit breakers, earthing, relays, and various protection schemes.

Introduction: A protection system and its attributes, System transducers, duties of switchgear, various power system elements that needs protection.
Fuses: Types, ratings and characteristics, construction and application of HRC fuses, limitations and application of fuses, Introduction to MCBs.
Circuit Breakers: Theory of arc formation and its extinction (AC and DC), re-striking and recovery voltage, Current chopping, circuit breakers: specifications of circuit breakers, different types of circuit breakers like oil, Air, Vacuum and SF_6, comparative merits and demerits, HVDC circuit breaker system.
Earthing: Earthing requirements, Earthing practices, Earth resistivity and earth gradient, Neutral shift.
Protective Relays: Functions, Constructional and operating principles of electromagnetic type like over-current, Directional, Differential and distance relays, Characteristics, General equation. Basic principles of static relaying, Phase and amplitude comparator, Microprocessor based relays.
Protection Schemes: Over−current and Over−voltage protection of transmission lines, differential protection, transformer protection, Bus bar protection, distance protection of transmission line, carrier aided protection of transmission lines, generator protection, induction motor protection.

Laboratory work: Sequence impedance and their calculations, Symmetrical fault level measurement on a D.C. network analyzer, Unsymmetrical fault level measurement on a D.C. network analyzer for various types of faults, Measurement of ground resistivity and resistance of a ground electrode, Plotting of characteristics of different types of relays, Performance or different types of protection schemes, ABCD constants of an artificial transmission line, String efficiency of insulator string, use of standard software package for short circuit studies and relay co-ordination.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Explain various protection strategies applied for power system protection.
2. Select the protection elements namely fuse, circuit breakers and relays for a given configuration.
3. Design the basic Earthing requirement for residential and other purposes.
4. Select required protection measures against overcurrent, overvoltage in transmission lines.
5. Select suitable protection scheme for different power system equipment.

Text Books:

1. *Chakraborti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., A Text Book on Power System Engineering, Dhanpat Rai and Co. (P) Ltd. (2008).*
2. *Pathinkar, Y.G. and Bhide, S.R., Fundamentals of Power System Protection, PHI Learning Pvt. Limited (2008).*
3. *Rao, S.S., Switchgear and Protection, Khanna Publishers (2007).*

Reference Books:

1. *Deshpande, M.V., Switchgear and Protection, Tata McGraw–Hill (2005).*
2. *Elmore, W.A., Protective Relaying Theory and Applications, ABB Power T and D Company Inc. (2003).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	40
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	35

UEE605: POWER SYSTEM ANALYSIS AND STABILITY

L	T	P	Cr.
3	1	2	4.5

Course objective: To explain power system components models during steady state and faults, and concepts of power flow analysis, fault analysis and power system stability.

Representation of Power System: Representation of power system components, regulating transformers generators, transmission line and loads, phase shift in star-delta transformer, sequence impedance of transmission line, transformer and generators, sequence networks of power system, Y-Bus and Z-Bus building algorithm.
Load Flow Study: Load flow problem, power flow equations, load flow solution using Gauss Seidal and Newton Raphson methods, decoupling between real and reactive power control, decoupled and fast decoupled methods, comparison of load flow methods.
Fault Analysis: Symmetrical fault, algorithm for symmetrical fault analysis, unbalanced faults (Single line to ground fault, Line to line and double line to ground, Open conductor), Bus Impedance matrix method for the analysis of unsymmetrical shunt faults.
Power System Stability: Concepts of types of stability limits, steady state stability analysis, transient stability analysis, Swing equation and its solution by point-by-point method, Equal area criterion, critical clearing angle and improvement of transient stability.

Laboratory work: Develop software for various matrix inversion techniques, load flow problems with all methods, Fault analysis and stability studies; Use of standard software for simulation and steady state analysis of power system.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Develop an appropriate mathematical model of power system
2. Carry out power flow analysis of practical power system for balanced system.
3. Conduct studies during balanced faults to decide the fault levels and circuit breaker ratings.
4. Conduct studies during unbalanced faults to decide the fault levels and circuit breaker ratings.
5. Analyze the stability of single machine-infinite bus system and can decide the critical clearing time of circuit breakers.

Text Books:

1. *Chakraborti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., A Text Book on Power System Engineering, Dhanpat Rai and Co. (P) Ltd. (2008).*
2. *Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw–Hill (2007).*
3. *Stevenson, W.D., Power System Analysis, McGraw–Hill (2007).*

Reference Books:

1. *Gupta, B.R., Power System Analysis and Design, S.Chand and Company Limited (2009).*
2. *Pabla, A.S., Electric Power Distribution, Tata McGraw−Hill (2008).*
3. *Wadhwa, C.L., Electrical Power Systems, New Age International (P) Limited, Publishers (2008).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

CAPSTONE PROJECT

	L	T	P	Cr
UEE795: Semester VI (starts)	**0**	**0**	**2**	**--**
UEE795: Semester VI (Completion)	**0**	**0**	**2**	**8.0**

Course Objective: To facilitate the students learn and apply an engineering design process in electrical engineering, including project resource management. As a part of a team, the students will make a project, that emphasizes, hands-on experience, and integrates analytical and design skills. The idea is to provide an opportunity to the students to apply what they have learned throughout the course of graduate program by undertaking a specific problem.

Course Description: Capstone Project is increasingly interdisciplinary, and requires students to function on multidisciplinary teams. It is the process of devising a system, component or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs. It typically includes both analysis and synthesis performed in an iterative cycle. Thus, students should experience some iterative design in the curriculum. As part of their design experience, students have an opportunity to define a problem, determine the problem scope and to list design objectives. The project must also demonstrate that students have adequate exposure to design, as defined, in engineering contexts. Engineering standards and realistic constraints are critical in engineering design. The program must clearly demonstrate where standards and constraints are taught and how they are integrated into the design component of the project. Each group will have 4-5 students. Each group should select their team leader and maintain daily diary. Each Group will work under mentorship of a Faculty supervisor. Each group must meet the assigned supervisor (2hrs slot/week) till the end of the semester (record of attendance will be maintained), as per the time slot which will be provided to them by the respective supervisor. This is mandatory requirement for the fulfilment of the attendance as well as the successful completion of the project. The faculty supervisor of the project will continuously assess the progress of the works of the assigned groups. Some part of the analysis and design of the system will be done in the first section of project in semester VI. The second section would comprise of completion of the project in semester VII in which each team will have to submit a detailed report of the project along with a poster.

Course Learning Outcomes (CLO):

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

1. To identify design goals and analyse possible approaches to meet given specifications with realistic engineering constraints.
2. To design an electrical engineering project implementing an integrated design approach applyingknowledge accrued in various professional courses.
3. To perform simulations and incorporate appropriate adaptations using iterative synthesis.
4. To use modern engineering hardware and software tools.
5. To work amicably as a member of an engineering design team.
6. To improve technical documentation and presentation skills.

UEE801: ELECTRIC DRIVES

L	T	P	Cr.
3	1	2	4.5

Course objective: To introduce the concept of electric drives and it features. To get familiarize with estimation of motor rating and solid-state controlled drives.

Definitions and Dynamics of Electric Drives: Concept of electric drive and its classifications, Types of loads, Four-quadrant drive, Dependence of load torque on various factors, Dynamics of motor-load combination, Steady state stability of an electric drive system, Load Equalization.
Drive Features of Importance: Multi-quadrant operations of DC and AC motors, Energy relations during starting and braking.
Static Control of Motors: Contactors and relays for electric drives, Control circuits for automatic starters of DC and AC motors.
Estimation of Motors Rating: Thermal modeling of motors, Types of duty cycles, Calculation of motor rating for duty cycles, Overload factor calculation for short and intermittent duty cycle, Use of load diagrams.
Solid State Controlled Drives: Control of DC drives fed through single-phase and three-phase semi converter and full-converter phase-controlled configurations, their analysis, Regeneration and braking through static power converters, control of three phase induction motors by stator voltage and frequency control for speeds below and above synchronous speed, Static rotor resistance control, Static kramer and scherbius drives, V/f and Vector control, Energy efficient drives, losses in electrical drive system, Energy conservation in electric drives.
Laboratory work: Starting and running characteristics of converter fed AC and DC motor control, Harmonic analysis of AC and DC Drives, V/f based drive, Microprocessor based Drive, PLC based drive, Project on drives using standard software.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Conceptualize the basic drive system and analyse it for different types of loads
2. Analyse the motor situation during starting and braking
3. Develop control circuitry and devices for control of motor
4. Estimate the motor rating for different condition of load
5. Design the converter circuit for control purpose along with its different configuration
6. Use PLC and converter control to drive on the basis of energy efficiency

Text Books:

1. *Dubey, G.K., Power Semiconductor Controlled Drives, Prentice Hall Inc. (1989).*
2. *Pillai, S.K., A Course in Electric Drives, New Age International (P) Limited, Publishers (1989).*

Reference Books:

1. *Bose, B.K., Modern Power Electronics and AC Drives, Prentice-Hall of India Private Limited (2006).*
2. *Dubey, G.K., Fundamentals of Electric Drives, Narosa Publications (2001).*
3. *Sen, P.C., Thyristor DC Drives, John Wiley and Sons (1981).*

Evaluation Scheme:

S No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

UHU005: HUMANITIES FOR ENGINEERS

L	T	P	Cr
2	0	2	3.0

Course Objectives: The objective of the course is to understand the interplay between, psychological, ethical and economic principles in governing human behaviour. The course is designed to help the students to understand the basic principles underlying economic behaviour, to acquaint students with the major perspectives in psychology to understand human mind and behavior and to provide an understanding about the how ethical principles and values serve as a guide to behavior on a personal level and within professions.

UNIT I: PSYCHOLOGICAL PERSPECTIVE

Introduction to Psychology: Historical Background, Psychology as a science. Different perspectives in Psychology.

Perception and Learning: Determinants of perception, Learning theories, Behavior Modification.

Motivational and Affective basis of Behaviour: Basic Motives and their applications at work. Components of emotions, Cognition and Emotion. Emotional Intelligence.

Group Dynamics and Interpersonal relationships.

Development of self and personality.

Transactional Analysis.

Culture and Mind.

Laboratory work:

1. Experiments on learning and behaviour modification.
2. Application of Motivation Theories: Need based assessment.
3. Experiments on understanding Emotions and their expressions.
4. Personality Assessment.
5. Exercises on Transactional analysis.
6. Role plays, case studies, simulation tests on human behaviour.

UNIT II: HUMAN VALUES AND ETHICAL PERSPECTIVE

Values: Introduction to Values, Allport-Vernon Study of Values, Rokeach Value Survey, Instrumental and Terminal Values.

Value Spectrum for a Good Life: Role of Different Types of Values such as Individual, Societal, Material, Spiritual, Moral, and Psychological in living a good life.

Moral and Ethical Values: Types of Morality, Kant's Principles of Morality, Factors for taking ethical decisions, Kohlberg's Theory of Moral Development.

Analyzing Individual human values such as Creativity, Freedom, Wisdom, Love and Trust.

Professional Ethics and Professional Ethos, Codes of Conduct, Whistle-blowing, Corporate Social Responsibility.

Laboratory Work:

Practical application of these concepts by means of Discussions, Role-plays and Presentations, Analysis of Case studies on ethics in business and CSR.

UNIT III: ECONOMIC PERSPECTIVE

Basics of Demand and Supply

Production and cost analysis

Market Structure: Perfect and Imperfect Markets.

Investment Decisions: capital Budgeting, Methods of Project Appraisal.

Macroeconomic Issues: Gross domestic product (GDP), Inflation and Financial Markets.

Globalisation: Meaning, General Agreement on Trade and tariffs (GATT), World Trade Organisation (WTO). Global Liberalisation and its impact on Indian Economy.

Laboratory Work:

The practicals will cover numerical on demand, supply, market structures and capital budgeting, Trading games on financial markets, Group discussions and presentations on macroeconomic issues. The practicals will also cover case study analysis on openness and globalisation and the impact of these changes on world and Indian economy.

Micro Project: Global Shifts and the impact of these changes on world and Indian economy.

Course Learning Outcomes (CLO):

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

1. Improve the understanding of human behavior with the help of interplay of professional, psychological and economic activities.
2. Able to apply the knowledge of basic principles of psychology, economics and ethics for the solution of engineering problems.
3. Explain the impact of contemporary issues in psychology, economics and ethical principles on engineering.

Text Books:

1. *Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, McGraw Hill Book Co(International Student (1986).*
2. *A. N. Tripathi**,** Human Values**,** New Age International (P) Ltd (2009)*.
2. *Krugman, Paul and Wells Robin, Economics, W.H. Freeman & Co Ltd. Fourth Edition (2015).*
3. *Rubinfeld Pindyck. Microeconomic Theory and application, Pearson Education New Delhi (2012).*
4. *Samuelson, Paul, A. and Nordhaus, William, D. Economics, McGraw Hill, (2009).*
5. *Mankiw, Gregory N. Principles of Macroeconomics, South-Western College Pub., (2014).*
6. *Gregory, Paul R. and Stuart, Robert C. The Global Economy and Its Economic Systems, 2013 South-Western College Pub (2013).*

Reference Books:

1. *Atkinson, R.L., Atkinson, R.C., Smith, E.E., Bem, D.J. and Nolen-Hoeksema, S. (2000). Hilgard's Introduction to Psychology, New York: Harcourt College Publishers.*
2. *Berne, Eric (1964). Games People Play – The Basic Hand Book of Transactional Analysis. New York: Ballantine Books.*
3. *Ferrell, O. C and Ferrell, John Fraedrich Business Ethics: Ethical Decision Making & Cases, Cengage Learning (2014).*

4. *Duane P. Schultz and Sydney Ellen Schultz, Theories of Personality, Cengage Learning, (2008).*
5. *Saleem Shaikh. Business Environment, Pearson (2007).*
6. *Chernilam, Francis International Buisness-Text and Cases, Prentice Hall (2013).*
7. *Salvatore, Dominick, Srivastav, Rakesh., Managerial Economics: Principles with Worldwide Applications, Oxford, 2012.*
8. *Peterson H. Craig. and. Lewis, W. Cris. Managerial Economics, Macmillan Pub Co; (1990).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	45
3	Sessionals (Include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations)	30

UEE604: FLEXIBLE AC TRANSMISSION SYSTEMS

L	T	P	Cr.
3	1	0	3.5

Course objective: To review the concept of power system control, operational aspects of various FACTS compensators and their usage for power flow and stability improvement**.**

Power Transmission control: Fundamentals of ac power transmission, Transmission problems and needs, Overview of stability, the emergence of FACTS, FACTS controller and consideration.
Static power convertor: Review of Power Electronics fundamentals: Static power convertor structures, AC controller based structure, DC link convertor topologies, Convertor output and harmonic control.
Shunt Compensation: Shunt SVC principles, Configuration and control, STATCOM, Configuration applications.
Series Compensation: Fundamental of series compensation, Principle of operation, Application of TCSC for different problems of power system, TCSC lay out, SSSC principle of operation.
Phase Shifter: Principle of operation, Steady state model of static phase shifter, Operating characteristics of SPS, Power current configuration of SPS application.
Unified Power Flow Controllers: Basic operating principles and characteristics, Control UPFC installation applications, UPFC model for power flow studies.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Describe the converter configuration for different power systems applications such as HVDC, FACTS etc.
2. Evaluate the converters, harmonics on AC and DC side and filtering.
3. Classify various compensators suited for various power system purposes.
4. Analyze power system behaviour with different shunt compensators.
5. Appraise series compensated power system behaviour with different series compensators.
6. Analyse system behaviour with hybrid shunt-series compensators.

Text Books:

1. *Hingorani, N.G. and Gyragyi,L., Understanding FACTS :Concepts and Technology of Flexible AC Transmission System, Standard Publishers and Distributors (2005).*
2. *Sang, Y.H. and John, A.T., Flexible AC Transmission Systems, IEEE Press (2006).*
3. *Ghosh,A. and Ledwich,G., Power Quality Enhancement Using Custom Power Devices, Kluwer Academic Publishers (2005).*

Reference Books:

1. *Mathur, R.M. and Verma, R.K., Thyristor Based FACTS Controllers for Electrical Transmission Systems, IEEE Press (2002).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	25

UEE608: SOFT COMPUTING IN ELECTRICAL ENGINEERING

L	T	P	Cr.
3	0	2	4.0

Course objective: To elucidate the concepts of techniques based on artificial intelligence such as fuzzy logic, neural networks and genetic algorithms and their problem solving capability.

Introduction: Concept of artificial intelligence, Introduction to classical problem solving methods and heuristic search techniques.
Fuzzy Systems: Fuzzy sets, Operation on fuzzy sets, Fuzzy relations, measures, Fuzzy logic, Fuzzy logic controller (FLC).
Artificial Neural Networks: Fundamental concepts, Basic models, Learning rules, Single layer and multi-layer feed-forward and feedback networks, Supervised and unsupervised methods of training, Recurrent networks, Modular network.
Genetic Algorithm: Basic principle, Evolution of genetic algorithm, Hybrid genetic algorithm, trends in stochastic search.
Hybrid Systems: Integrated hybrid systems such as neuro-fuzzy, fuzzy-neuro.
Applications: Short term and long term load forecasting, Identification, Classification, Fault location and fault diagnosis, Economic load dispatch, DC/AC four quadrant drive control.
Laboratory work: Training algorithms of neural networks and fuzzy logic, Implementation of fuzzy logic, Neural networks and genetic algorithms on various applications, Use of simulation tools of fuzzy logic and NN.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Examine the fuzzy system and implement fuzzy controllers for control and classification.
2. Explain neural networks behaviour and use them for classification, control system and optimization problem.
3. Obtain the optimum solution of well formulated optimisation problem using evolutionary approach.
4. Develop hybrid system based on integration of neuro and fuzzy system.
5. Formulate hybrid intelligent algorithms for typical electrical application.

Text Books:

1. *Lin, C., Lee, G., Neural Fuzzy Systems, Prentice Hall International Inc. (2000).*
2. *Rajashekran, S. and Vijaylaksmi Pai, G.A., Neural Networks, Fuzzy Logic and Genetic Algorithm Systhesis and Applications, Prentice Hall of India Private Limited (2004).*
3. *Zurada, J.M., C++ Neural Networks and Fuzzy Logics, BPS Publication (2001).*

Reference Books:

1. *Kosko, B., Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence, Prentice Hall of India Private Limited (1992).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	40
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	35

CAPSTONE PROJECT

	L	T	P	Cr
UEE795: Semester VI (starts)	**0**	**0**	**2**	**--**
UEE795: Semester VI (Completion)	**0**	**0**	**2**	**8.0**

Course Objective: To facilitate the students learn and apply an engineering design process in electrical engineering, including project resource management. As a part of a team, the students will make a project, that emphasizes, hands-on experience, and integrates analytical and design skills. The idea is to provide an opportunity to the students to apply what they have learned throughout the course of graduate program by undertaking a specific problem.

Course Description: Capstone Project is increasingly interdisciplinary, and requires students to function on multidisciplinary teams. It is the process of devising a system, component or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs. It typically includes both analysis and synthesis performed in an iterative cycle. Thus, students should experience some iterative design in the curriculum. As part of their design experience, students have an opportunity to define a problem, determine the problem scope and to list design objectives. The project must also demonstrate that students have adequate exposure to design, as defined, in engineering contexts. Engineering standards and realistic constraints are critical in engineering design. The program must clearly demonstrate where standards and constraints are taught and how they are integrated into the design component of the project. Each group will have 4-5 students. Each group should select their team leader and maintain daily diary. Each Group will work under mentorship of a Faculty supervisor. Each group must meet the assigned supervisor (2hrs slot/week) till the end of the semester (record of attendance will be maintained), as per the time slot which will be provided to them by the respective supervisor. This is mandatory requirement for the fulfilment of the attendance as well as the successful completion of the project. The faculty supervisor of the project will continuously assess the progress of the works of the assigned groups. Some part of the analysis and design of the system will be done in the first section of project in semester VI. The second section would comprise of completion of the project in semester VII in which each team will have to submit a detailed report of the project along with a poster.

Course Learning Outcomes (CLO):

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

1. To identify design goals and analyse possible approaches to meet given specifications with realistic engineering constraints.
2. To design an electrical engineering project implementing an integrated design approach applying knowledge accrued in various professional courses.
3. To perform simulations and incorporate appropriate adaptations using iterative synthesis.
4. To use modern engineering hardware and software tools.
5. To work amicably as a member of an engineering design team.
6. To improve technical documentation and presentation skills.

UEE804: OPERATION AND CONTROL OF POWER SYSTEMS

L	T	P	Cr.
3	1	2	4.5

Course objective: To make the student able to understand the basics of economic operation of Power Systems, load-frequency control, power system security and voltage stability.

Economic Operation of Power Systems: Fuel consumption, Characteristics of thermal unit, Incremental fuel rate and their approximation, Minimum and maximum power generation limits.
Economic Dispatch: Economic dispatch problem with and without transmission line losses, Unit Commitment, Their solution methods.
Hydrothermal Co-ordination: Hydro-scheduling, Plant models, Scheduling problems, Hydrothermal scheduling problems and its approach.
Power System Control: Ideas of load frequency and voltage control, Reactive power control, Block diagrams of P-f and Q-V controllers, ALFC control, Static and dynamic performance characteristics of ALFC and AVR controllers, Excitation systems model, concept of area and Tie-line operations.
Power System Security: Factors affecting security, Contingency analysis, Network sensitivity, correcting the generation dispatch by using sensitivity method and linear programming.
Small Scale Stability Analysis: d-q model of generator, State space representation, Eigen value and participation factor analysis.
Voltage Stability: Basic concepts, Voltage collapse, P-V and Q-V curves, Impact of load, Static and dynamic analysis of voltage stability, Prevention of voltage collapse.
Laboratory Work: Simulation of thermal scheduling with and without losses, Unit commitment by dynamic programming, simulation of hydro-thermal scheduling by gradient method, Stability analysis of single area frequency control, Bias control of two area system and AVR.

Course learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Develop small scale model of alternator, excitation and governing systems.
2. Decide the scheduling of thermal units and hydro-thermal units for overall economy.
3. Design and apply control for frequency and voltage of power system represented by multi area.
4. Comprehend power system security and contingency.
5. Computation of small scale and voltage stability**.**

Text Books:

1. *Chakraborti A., Soni,M.L., Gupta,P.V. and Bhatnagar,U.S., A Text Book on Power System Engineering, Dhanpat Rai and Co. (P) Ltd. (2008).*
2. *Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw Hill (2007).*
3. *Stevenson, W.D., Power System Analysis, McGraw Hill (2007).*

Reference Books:

1. *Kothari, D.P., Dhillon, J.S., Power System Optimization, PHI Learning (2010).*

2. *Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheble, Power Generation, Operation and Control, Wiley-Interscience (2013).*
3. *Kimbark, E. W., Power System Stability, Volumes-I, IEEE Press (1995).*
4. *Jizhong Z., Optimization of power system operation, Edition Wiley (1996).*
5. *Elgerd, O. Electric Energy Systems Theory, McGraw Hill Education Private Limited (2001).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

UEE502: HIGH VOLTAGE ENGINEERING

L	T	P	Cr.
3	0	2	4.0

Course objective: To introduce the concepts of breakdown in gases, solids, generation and measurement of high voltage and their tests.

Introduction: Introduction to AC and DC impulse voltages and their use, Problems in dealing with high voltages.

Breakdown in Gases: Elementary ideas on ionization by electron collision, Townsend mechanism, Townsend first and second ionization coefficients, Paschen law, breakdown in non-uniform fields and corona discharges, vacuum breakdown mechanisms, breakdown in liquids, fundamentals of insulating oils, conduction and breakdown in pure and commercial liquids.

Breakdown in Solids: Fundamentals of solid insulating materials intrinsic, electromechanical and thermal breakdown, breakdown in simple and composite dielectrics, types of insulating materials, temperature classification, factor affecting dielectric strength, insulation design of rotating machines, transformers, transmission lines, Switch gear, etc.

Generation of High Voltages: Generation of high voltages, testing transformers in cascade, series resonant circuits and their advantages, half and full wave rectifier circuits, voltage doubler and cascade circuits, electrostatic generator, characteristics parameters of impulse voltages, single stage impulse generator circuits, multistage impulse generation circuits.

Measurement of High Voltages: Measurement of direct, alternating and impulse voltages by electrostatic voltmeters, sphere gap, uniform field gap, ammeter in series with high voltage resistors and voltage divider

Non-Destructive High Voltage Tests: Loss in a dielectric and its measurement,dielectric loss measurement by Schering bridge, partial discharges at alternating voltages, external and internal partial discharges and discharge measurements.

Laboratory work: Voltage measurement by sphere gap and Chubb and Fortesque methods, Insulation resistance measurement using Meggar,Experimental setup for standard lightning wave, Efficiency and peak voltage measurement by sphere gap impulse voltage time curves, Breakdown voltage, Conductivity and dissipation factor measurement with Schering bridge, partial discharge measurements

Course Learning Outcomes (CLO):

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

1. Conceptualize the idea of high voltage and safety measures involved.
2. Analyse the breakdown mechanism of solids, liquids and gases.
3. Analyse and calculate the circuit parameters involved in generation of high voltages.
4. Measure direct, alternating and impulse high voltage signals.
5. Measure the dielectric loss and partial discharge involved in non-destructive high voltage tests.

Text Books:

1. *Khalifa, M., High Voltage Engineering: Theory and Practice, Marcel Dekker Inc. (2000).*
2. *Naidu, M.S. and Kamraju, V., High Voltage Engineering, Tata McGraw–Hill (2008).*
3. *Wadhwa, C .L., High Voltage Engineering, New Age International (P) Limited, Publishers (2006).*

Reference Books:

1. *Dass, R., Extra High Voltages, Tata McGraw–Hill (2006).*
2. *Kind, D. and Feser, K, High Voltage Test Techniques, Reed Educational and Professional Publishing Limited (2001).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	40
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	35

UEE891: PROJECT

L	T	P	Cr
-	-	-	20.0

Course Objectives: The project semester is aimed at developing the undergraduate education programme in Electrical Engineering to include a practical training in a professional engineering set up (a company, top educational institution, research institute etc.) hereafter referred to as host "organization" as deemed appropriate. The participating organizations are selected that are either already visiting Thapar University for placement or are forming new relationships of mutual benefit. The project semester gives the student the opportunity to translate engineering theory into practice in a professional engineering environment. The technical activity in the project semester should be related to both the student's engineering studies and to the host organization's activities and it should constitute a significant body of engineering work at the appropriate level. It should involve tasks and methods that are more appropriately completed in a professional engineering environment and should, where possible, make use of human and technology resources provided by the organization. It consolidates the student's prior learning and provides a context for later research studies. The student remains a full time registered student at Thapar University during the project semester and this activity is therefore wholly distinct from any industrial interactions which may occur over vacation periods.

Assessment Details: Each student is assigned a faculty supervisor who is responsible for managing and assessment of the project semester. The faculty supervisor monitors the student's progress in a semester and interacts with the industry mentor during his/her visit to the host organization twice. This includes a Reflective Diary which is updated throughout the project semester, an Interim Project Report, a Final Report with Learning Agreement/Outcomes and a Final Presentation & Viva which involves the faculty Supervisor and some other members from the department. The mentor from the host organization is asked to provide his assessment on the designated form. The faculty supervisor is responsible for managing and performing the assessment of the project semester experience.

Course learning Outcomes (CLO):

Upon completion of project semester, the students will be able to:

1. Acquire knowledge and experience of software and hardware practices in the area of project.
2. Carry out design calculations and implementations in the area of project.
3. Associate with the implementation of the project requiring individual and teamwork skills.
4. Communicate their work effectively through writing and presentation.
5. Demonstrate the knowledge of professional responsibilities and respect for ethics.

UEE806: ALTERNATE SOURCES OF ENERGY

L	T	P	Cr.
3	0	2	4.0

Course objective: To make student learn about energy scenario, services, availability and characteristics of renewable sources. To get familiarize with stand-alone generating units.

Introduction: Global and national energy scenarios, concept of energy services, patterns of energy supply, energy resource availability, cultural, economic and national security aspects of energy consumption, forms and characteristics of renewable energy sources, energy classification, source and utilization, thermodynamic power cycles and binary cycles.
Solar Energy: Solar radiation, flat plate collectors, solar concentration, thermal applications of solar energy, photovoltaic technology and applications, energy storage.
Biomass Energy: Energy from biomass, thermo chemical, biochemical conversion to fuels, biogas and its applications.
Wind Energy: Wind characteristics, resource assessment, horizontal and vertical axis wind turbines, electricity generation and water pumping, Micro/Mini hydro power system, water pumping and conversion to electricity, hydraulic pump.
Other Alternate Sources: Ocean thermal energy conversion, Geothermal, Tidal, Wave energy, MHD, Fuel cells, environmental issues of energy services.
Stand alone generating units: Synchronous generator and induction generator, operation and characteristics, voltage regulation, lateral aspects of renewable energy technologies and systems.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Explain various advantages and disadvantages of renewable energy sources.
2. Familiarization with different standalone, off grid energy sources
3. Explain different technology associate with solar, wind, biomass and other renewable energy sources.
4. Describe Explain the basic renewable energy sources like solar, wind ,biomass etc
5. Describe the working of micro/mini hydropower system.

Text Books:

1. *Rai, G.D., Non Conventional Energy Sources, Khanna Publishers (2005).*
2. *Rao, S. and Parulekar, B.B., Energy Technology: Non Conventional, Renewable and Conventional, Khanna Publishers (2005).*
3. *Wadhwa, C.L., Generation, Distribution and Utilization of Electric Energy, New Age International (P) Limited, Publishers (2007).*
4. *Simon , Christopher A., Alternate Source of Energy, Rowman and LittleField Publishers Inc.(2007).*

Reference Books:

1. *Venikov, V.A. and Putyain, E.V., Introduction to Energy Technology, Mir Publishers (1990).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	40
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	35

UEI805: ENVIRONMENTAL INSTRUMENTATION

L	T	P	Cr.
3	0	0	3.0

Course Objectives: To understand the concepts of pollution monitoring, to enable select, design and configure pollution monitoring instruments

Air Pollution: Impact of man of the environment: An overview, Air pollution sources and effects, Metrological aspect of air pollutant dispersion, Air pollution sampling and measurement, Air pollution control methods and equipment, Air sampling techniques, soil pollution and its effects, Gas analyzer, Gas chromatography, Control of specific gaseous pollutants, Measurement of automobile pollution, Smoke level meter, CO/HC analyzer.

Water pollution: Sources and classification of water pollution, Waste water sampling and analysis, Waste water sampling techniques and analyzers: Gravimetric, Volumetric, Calometric, Potentiometric, Flame photometry, Atomic absorption spectroscopy, Ion chromatography, Instruments used in waste water treatment and control, Latest methods of waste water treatment plants.

Pollution Management: Management of radioactive pollutants, Noise level measurement techniques, Noise pollution and its effects, Solid waste management techniques, social and political involvement in the pollution management system

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. Explain sources and effects of air and water pollutants
2. Explain air pollution sampling and measurement techniques
3. Explain water sampling and analysis techniques
4. Explain solid waste management and noise level measurement techniques
5. Describe solid waste management techniques

Text Books:

1. *Bhatia, H.S., A Text Book in Environmental Pollution and control, Galgotia Publication (1998).*
2. *Dhameja, S.K., Environmental Engineering and Management, S.K Kataria (2000).*
3. *Rao, M.N. and Rao, H.V., Air Pollution, Tata McGraw Hill (2004).*
4. *Rao. C.S., Environmental Pollution Control, New Age International (P) Limited, Publishers (2006) 2nd ed.*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	50
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	20

UEE892: DESIGN PROJECT

L	T	P	Cr.
-	-	-	13.0

Course Objectives: The design project is introduced in Electrical Engineering undergraduate programme to include a practical training in the university itself for six months. The project offers the student the opportunity to demonstrate engineering theory into practice under the supervision of a faculty supervisor in electrical engineering department. The students are also offered with two courses. The technical activity in the project semester should be related to both the student's engineering studies and the faculty supervisor's guide lines to make working model in the area of application of electrical engineering. It involves tasks and methods that are more appropriately completed in an academic practical environment and should, where possible, make use of human and technology resources provided by the university. It consolidates the student's prior learning and provides a context for later research studies. The student remains a full time registered student at Thapar University during the project semester and this activity is, therefore, wholly distinct from any industrial interactions which may occur over vacation periods.

Assessment Details: Each student is assigned a faculty supervisor who is responsible for managing and assessment of the alternate project semester. The faculty supervisor guides the students till the end of semester and monitors the student's progress throughout the same. This includes a Reflective Diary which is updated throughout the alternate project semester, an Interim Project Report, a Final Report with Learning Agreement/Outcomes and a Final Presentation & Viva which involves the faculty Supervisor and some other faculty members from the department.

Course learning Outcomes (CLO):

Upon completion of project semester, the students will be able to:

1. Acquire knowledge and experience of software and hardware practices in the area of project.
2. Carry out design calculations and implementations in the area of project.
3. Associate with the implementation of the project requiring individual and teamwork skills.
4. Communicate their work effectively through writing and presentation.
5. Demonstrate the professional responsibilities and respect for ethics in university ambiance.

UEE893: STARTUP SEMESTER

L	T	P	Cr.
-	-	-	20.0

Course Objective: This course provides the students with competence building workshops and need based skill trainings that enable them to develop their prototype/working model/software application, which is supported by a Business Plan. This semester long interaction with entrepreneurial ecosystem, will provide ample opportunity to students to lay a strong foundation to convert their idea into a startup immediately or in the near future.

This course would include a practical training in a professional set up (a startup or a company, Business incubator, Startup Accelerator etc.) hereafter referred to as host "organization" as deemed appropriate.

Activities during the Startup semester

6. Fundamentals of 'Entrepreneurship & Innovation'
7. Opportunity identification and evaluation, Customer validation
8. Developing a Business Model Canvas
9. Business Development Process related to the startup, relating theoretical framework with the business idea, Industry dynamics, opportunity canvas and regulatory aspects related to the business idea.
10. Design thinking
11. Technical development
12. Financial management
13. Entrepreneurial Marketing
14. Interaction with existing Startups and pitching of projects,
15. Presentation of Prototype/Working model/useful App or a working Software

Assessment Details

Each student is assigned a faculty supervisor and industry mentor. Faculty supervisor is responsible for managing and assessment of the Startup semester. The faculty supervisor monitors the student's progress in a semester and interacts with the industry mentor during his/her visit to the host organization twice.

The semester includes maintenance of a Reflective Diary, which is updated throughout the startup semester, an Interim Project Report, a Final Report with Learning Agreement/Outcomes and a Final Presentation & Viva, which involves the faculty Supervisor, and some other members from the department.

The mentor from the host organization is asked to provide the assessment on a designated form. The faculty supervisor is responsible for managing and performing the assessment of the startup semester experience.

Course learning outcome (CLO):

Upon successful completion of the startup semester, the students should be able to:

1. Demonstrate an ability to develop a business plan.
2. Carry out design calculations/simulations and implementations in the area of project.
3. Develop a prototype/working model/software application.
4. Comprehend the fundamentals of business pitching.
5. Demonstrate the knowledge of professional responsibilities and respect for ethics.

UEE631: HVDC TRANSMISSION SYSTEMS

L	T	P	Cr.
3	0	0	3.0

Course objective: To introduce the concepts of DC transmission systems, HVDC control, protection methods, and AC & DC side filter design. To get familiarize with concept of reactive power control.

DC power transmission technology: Introduction, Comparison of HVAC and HVDC transmission system, Applications of DC transmission, Description of DC transmission system, Configurations, Modern trends in DC transmission.

Analysis of HVDC converters: Pulse number, Choice of converter configuration, Simplified analysis of Graetz circuit, Converter bridge characteristics, Characteristics of a twelve-pulse converter, Detailed analysis of converters with and without overlap.

Converter and HVDC system control: General, Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Current and extinction angle control, Starting and stopping of DC link, Power control, Higher level controllers.

Converter faults and protection: Converter faults, Protection against over-currents, Over-voltages in a converter station, Surge arresters, Protection against over-voltages.

Smoothing reactor and DC line: Introduction, Smoothing reactors, DC line, Transient over voltages in DC line, Protection of DC line, DC breakers, Monopolar operation, Effects of proximity of AC and DC transmission lines.

Reactive power control: Reactive power requirements in steady state, Sources of reactive power, Static VAR systems, Reactive power control during transients, Harmonics and filters, Generation of harmonics, Design of AC filters, DC filters.

Component models for the analysis of ac/dc systems: General, Converter model, Converter control, Modelling of DC network, Modelling of AC networks.

Power flow analysis in AC/DC systems: General, Modelling of DC links, Solution of DC load flow, Discussion, Per unit system for DC quantities.

Course learning Outcomes (CLO):

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

1. Choose intelligently AC and DC transmission systems for the dedicated application(s).
2. Identify the suitable two-level/multilevel configuration for high power converters.
3. Select the suitable protection method for various converter faults.
4. Identify suitable reactive power compensation method.
5. Decide the configuration for harmonic mitigation on both AC and DC sides.

Text Books:

1. *Arrillaga, J., HVDC Transmission, IEE Press (2007).*
2. *Edwart, K., Direct Current Transmission (Vol. 1), John Wiley and Sons (2008).*
3. *Padiyar, K.R., HVDC Power Transmission System, New Age International (P) Limited, Publishers (2008).*

Reference Book:

1. *Arrillaga, J. and Smith, B.C., AC to DC Power System Analysis, IEE Press (2008).*

Evaluation Scheme:

S No	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	50
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	20

UEE632: POWER GENERATION AND ECONOMICS

L	T	P	Cr.
3	0	0	3.0

Course objective: To impart learning about the principle and concept of conventional, non-conventional power plants and power plant economies. To get familiarize with the concept of cogeneration.

Introduction: Energy sources and their availability, Principle types of power plants, their special features and applications, Present status and future trends.

Hydro Electric Power Plants: Essentials, Classifications, Hydroelectric survey, Rainfall run-off, Hydrograph, Flow duration curve, Mass curve, Storage capacity, Site selection, Plant layout, various components, Types of turbines, Governor and speed regulation, Pumped storage, Small scale hydro–electric plants (mini and micro).

Thermal Power Plant: General developing trends, Essentials, Plant layout, Coal – its storage, Preparation, Handling, Feeding and burning, Cooling towers, Ash handling, Water treatment plant, High pressure boilers and steam turbines, Components of thermal power plant.

Gas Turbine Power Plants: Field of use, Components, Plant layout, Comparison with steam power plants, combined steam and gas power plants.

Nuclear Power Plant: Nuclear fuels, Nuclear energy, Main components of nuclear power plant, Nuclear reactors types and applications, Radiation shielding, Radioactive and waste disposal safety aspect.

Non-Conventional Power Generation: Geothermal power plants, Electricity from biomass, Direct energy conversion systems (Solar and Wind) Thermo-electric conversion system, Fuel cells, Magneto Hydro dynamic system.

Cogeneration: Definition and scope, Cogeneration technologies, Allocation of costs, Sale of electricity and impact on cogeneration.

Power Plant Economics: Cost of electrical energy, Selection of type of generation and generation equipment, Performance and operating characteristics of power plants, Economic scheduling principle, Load curves, Effect of load on power plant design, Load forecasting, electric tariffs, Peak load pricing.

Course learning Outcomes (CLO):

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

1. Apply knowledge of India's power scenario, power system structure and related agencies.
2. Explain about various types of power plants i.e., hydro, thermal, gas and nuclear.
3. Harness power from conventional and renewable sources.
4. Select the methods and size of plant generating power for overall economy.
5. Decide the tariff structure for different type of users.

Text Books:

1. *Arora, S.C and Domkundawar, S., A course in Power Plant Engineering, Dhanpat Rai (2002).*
2. *Deshpande, M.V., Power Plant Engineering, Tata McGraw Hill (2004).*
3. *Gupta, B.R., Generation of Electrical Energy, S. Chand (1998).*

Reference Books:

1. *Deshpande, M.V., Electrical Power System Design, McGraw Hill (2004).*
2. *Wood, A.J. and Wollenberg, B.F., Power Generation and Control, John Wiley (2004).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	50
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	20

UEE633: GENERALIZED THEORY OF ELECTRICAL MACHINES

L	T	P	Cr.
3	0	0	3.0

Course objective: To get familiarize with linear transformation in dc, induction, and synchronous machines. To impart learning about the principle and working of advanced machines

Introduction: Common essential constructional and operational features of electrical machines, basic two pole machine representation of different types of electrical machines, Kron's primitive machine, Voltage equations in matrix form for Kron's primitive machine, Impedance matrix.
Linear Transformations in Machines: Reference frame theory, 3-phase to 2-phase transformation, Transformation from rotating axes to stationary axes, Physical concept of park's transformation, Volt-ampere and torque equations, Space vector concept.
DC Machine: Transfer function for DC machine, (Shunt, Series and compound), Linearization technique, Analysis under motoring and generating made, Dynamic analysis.
Synchronous Machine: General machine equation in different frame, Dynamic analysis, Power angle characteristics, Phases diagram for cylindrical rotor and salient pole machine, Electromagnetic and reluctance torque, Electric braking of synchronous machine.
3-phase Induction Machine: Performance equations in different rotating frames, Equivalent circuit, Different inductance, Effect of voltage and frequency on the performance, Braking, Unbalance operations.
Advanced Machines: 1-phase synchronous motor, 2-phase servomotor, AC tachometers, Switched reluctance motor, Brushless DC machine.

Course learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Express the revolving field and reference frame theory
2. Develop mathematical model of three-phase AC machines and parameters in different reference frame
3. Simulate the transient performance of three-phase ac machines in different reference frames.
4. Investigate the transient performance of different DC machines.
5. Select special purpose small machines for different applications

Text Books:

1. *Kraus, P.C., Analysis of Electric Machine, McGrawHill (2000).*
2. *Bimbhra, P.S., Generalized Theory of Electric Machines, Khanna Publishers (2006).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	50
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	20

UEE634: REAL TIME POWER SYSTEMS

L	T	P	Cr.
2	0	2	3.0

Course objective: To introduce the students about important contemporary issues due to the integration of DG: technical challenges, benefits, and perspectives in real time environment. To make familiar with hardware components including measurement and control in hardware in loop system.

Introduction: Hardware-in-loop simulation systems, distributed control architecture, reliability enhancement by redundancy, Real time operating systems: Features, primary components, Structured design of real time systems.
Developing a mathematical model for Power system and control, Mathematical model of the real environment, Design of hardware device meant to be used in HIL.
Testing and parameter adjustment for real time implementation of real-time simulator, Design of desired control schemes for AC and DC electrical machine drives and other applications: Micro-grid and renewable and its testing in HIL.
Real time control strategy based on FPGA, dSpace, Understanding four-quadrant amplifier for HIL system.

Lab work: Off-line simulations for the various experiments related to hardware in-the-loop simulation system to predict ahead of conducting the lab experiment the operating characteristics and compare results; Microgrid operation and control using HIL; Implement hardware such as PV and Wind system on the simulated grid to test hardware device in the real environment.

Course learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Demonstrate about Hardware-in-loop simulation systems.
2. Explain about mathematical model for power system and control in real environment.
3. Design control schemes for AC and DC electrical machine drives.
4. Demonstrate the concepts of real time control strategy based on FPGA, dSpace.

Text Book:

1. *N. Hatziargyriou "Microgrids: Architectures and Control", Wiley-IEEE Press, January (2014).*

Reference Book:

1. *HIL System catalogues; Opal-RT, RTDS and Typhoon.*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

UEE524: POWER QUALITY MONITORING AND CONDITIONING

L	T	P	Cr.
3	1	0	3.5

Course objective: To understand the aspects of power quality in distribution system and various indices to estimate the power quality. To get familiarize with power conditioning standards.

Overview and definition of power quality (PQ): Sources of pollution and regulations, Power quality problems, Rapid voltage fluctuations voltage unbalance, Voltage dips and voltage swells, Short duration outages.

Definitions Voltage sag analysis and mitigation: Sag caused by motor starting, Sag caused by utility fault clearing, Sag mitigation, Sag magnitude and duration calculations, RMS voltage, Calculation in 1-phase systems, Equipment performance in presence of sag, Computers, AC and DC drives.

Harmonics: Effects-within the power system, Interference with communication harmonic measurements, Harmonic elimination.

Harmonic distortion: Power Overview system harmonics, Harmonic analysis, Harmonic sources-the static converters, Transformer magnetization and non-linearities, Rotating machines, Arc furnaces, Fluorescent lighting, Total harmonic distortion, rms and average value calculations, Effects of harmonic distortion.

Principles for controlling harmonics: Locating sources of harmonics, Passive and active filters, Harmonic filter design.

Monitoring power quality: Monitoring essentials, Power quality measuring equipment, Current industry trends.

Power Conditioning: Electric power conditioning, Active and passive filters, IEEE, IEC, ANSI standards, Power acceptability curves, Various standards.

Course learning Outcomes (CLO):

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

1. Reliably identify the sources of various power quality problems.
2. Explain about causes of harmonic and its distortion effect.
3. Estimate the impact of various power quality problems on appliances.
4. Educate the harmful effects of poor power quality and harmonics.
5. Decide the compensators and filters to keep the power quality indices within the standards.

Text Books:

1. *Kennedy, B., Power Quality Primer, McGrawHill (2000).*
2. *Beaty, H. and Santoso,S., Electrical Power System Quality, McGrawHill (2002).*

Reference Books:

1. *Bollen, M.H.J., Power Quality Problems: Voltage Sag and Interruptions, IEEE Press (2007).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	25

UCS049: DATA STRUCTURES AND ALGORITHMS

L	T	P	Cr
2	0	2	3.0

Course Objectives: To become familiar with different types of data structures and their applications and learn different types of algorithmic techniques and strategies.

Introduction and Overview: Basic Terminology, Elementary Data Organization, Data Structures, Control Structures, Asymptotic Notations for Algorithms, Big O notation: formal definition and use, Little o, big omega and big theta notation, Arithmetic Expressions, Polish
Notations, Arrays, Records, Pointers, Storing Strings, String Operations, Pattern Matching Algorithms, Stacks, Queues, Recursion, Towers of Hanoi.
Searching and Sorting: Linear Arrays, Traversing and Searching in Linear Arrays, Inserting and Deleting, Bubble Sort, Linear Search, Binary Search, Insertion Sort, and Selection Sort.
Non-Linear Data Structures: Trees, Binary Trees, Traversing Binary Trees, Binary Search Trees, Searching and Inserting in Binary Search Trees, Deleting in a Binary Search Tree, Preorder, Postorder and Inorder Traversal, Heaps, Graph, Graph Algorithms, Breadth First Search, Depth First Search.
Linked List: Introduction, Insertion into a linked list, Deletion into a linked list. Stack, Queues, trees using linked list, Hashing, Hash Functions.

Laboratory work: Implementation of Arrays, Recursion, Stacks, Queues, Lists, Binary trees, Sorting techniques, Searching techniques. Implementation of all the algorithmic techniques.

Course learning outcomes (CLOs):
On completion of this course, the students will be able to

1. Implement the basic data structures and solve problems using fundamental algorithms.
2. Implement various search and sorting techniques.
3. Analyze the complexity of algorithms, to provide justification for that selection, and to implement the algorithm in a particular context.
4. Analyze, evaluate and choose appropriate data structure and algorithmic technique to solve real-world problems.

Text Books:

1. *Seymour Lipschutz Data Structures, TATA McGraw Hill (2016).*
2. *Corman, Leiserson&Rivest, Introduction to Algorithms, MIT Press (2009).*
3. *Narasimha Karumanchi, Data Structures and Algorithms Made Easy (2014).*

Reference Books:

1. *Sahni, Sartaj, Data Structures, Algorithms and Applications in C++, Universities Press (2005).*

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessionals (May include Assignments/Quizzes)	25

UEE841: INDUSTRIAL ELECTRONICS

L	T	P	Cr.
3	1	0	3.5

Course objective: Familiarize the students with the concept of electric traction system, illumination, electric heating principles, power factor control, and DC motor control.

Conventional dc and ac Traction: Electric traction services, Nature of traction load, Coefficient of adhesion, Load sharing between traction motors, Main line and suburban train configurations, Calculation of traction drive rating and energy consumption. Important features of traction drives, Conventional DC and AC traction drives, Diesel electric traction.
Static converters for Traction: Semi conductor converter controlled drive for ac traction, Semiconductor chopper controlled dc traction.
Illumination: Nature of light, Basic laws of illumination, Light sources and their characteristics, Light production by excitation and ionization, Incandescence and fluorescence, Different types of lamps, Their construction, Operation and characteristics, Applications, Latest light sources, Design of illumination systems.
Electric Heating: Introduction to electric heating, Advantages of electric heating, Resistance heating, Temperature control of furnaces, Induction and dielectric heating.
Power Supplies: Performance parameters of power supplies, Comparison of rectifier circuits, Filters, Regulated power supplies, Switching regulators, Switch mode converter.
Power factor Control: Static reactive power compensation, Shunt reactive power compensator, Application of static SCR controlled shunt compensators for load compensation, Power factor improvement and harmonic control of converter fed systems, Methods employing natural and forced commutation schemes, Methods of implementation of forced commutation.
Motor Control: Voltage control at constant frequency, PWM control, Synchronous tap changer, Phase control of DC motor, Servomechanism, PLL control of a DC motor.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Simulate and analyse the semiconductor controlled ac and DC drive system
2. Design and develop an illumination system for domestic, industry and commercial sites.
3. Design an electric heating system for industrial purposes.
4. Equip the skill to design and develop a regulated power supply.
5. Simulate and analyse the series and shunt compensators for power factor improvement in drive system.

Text Books:

1. *Dubey, G.K., Power Semiconductor Controlled Drives, Prentice Hall inc. (1989).*
2. *Paul, B., Industrial Electronic and Control, Prentice Hall of India Private Limited (2004).*

Reference Books:

1. *J.M.D. Murphy, F.G. Turnbull, Power Electronic Control of Ac Motors, Pergamon (1990).*
2. *Sen, P.C., Thyristor DC Drives, John Wiley and Sons (1981).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	25

UEE521: ELECTRIC MACHINE DESIGN

L	T	P	Cr.
3	1	0	3.5

Course objective: Familiarize the students with the concept of design concepts of electric machines, transformer. To explain the concepts of computer aided design of electrical machines.
Introduction: Design of Machines, Factors, limitations, Modern trends. Materials: Conducting, magnetic and insulating materials.

Magnetic Circuits: Calculations of mmf for air gap and teeth, real and apparent flux densities, iron losses, field form, leakage flux, specific permanence.
Heating and Cooling: Modes of heat dissipation, Temperature gradients, types of enclosures, types of ventilation, conventional and direct cooling, amount of coolants used, Ratings.
Armature Windings: Windings for dc and ac machines and their layout.
Design of Transformers: Output equation, Types of transformer windings, design of core and windings and cooling tank, performance calculations.
Concepts and Constraints in Design of Rotating Machines: Specific loading, output equation and output co-efficient, effects of variation of linear dimension.
Skeleton Design of Rotating Machines: Calculation of D and L for dc, induction and synchronous machines, length of air gap, design of field coils for dc and synchronous machines, selection of rotor slots of squirrel cage induction motors, design of bars and ends, design of rotor for wound rotor for induction motors, design of commutator and inter poles for dc machines.
Computer Aided Design of Electrical Machines: Analysis and synthesis approaches, design algorithms, Introduction to optimization techniques, Implementing computer program for design of three phase induction motor.

Course Learning Outcomes (CLO):
After the completion of the course the students will be able to:

1. Design DC machines.
2. Design transformers with reduced losses
3. Calculate the losses and efficiency in the machines
4. Analyze and synthesis of computer aided design of electrical machines.
5. Design three phase induction motor.

Text Books:

1. *Ramamoorty, M., Computer Aided Design of Electrical Equipment, Eastern Press Private Limited (1989).*
2. *A.K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai & CO. (2013).*
3. *Say, M.G., Design and Performance of Machines, CBS Publications (1981).*
4. *Hamdi, E.S., Design of Small Electrical Machine, John Wiley and Sons (1994).*

Reference Books:

1. *Smith, S.P. and Say, M.G., Electrical Engineering Design Manual, Chapman and Hall (1984).*
2. *Walker, J.H., Large AC Machines: Performance and Operation, BHEL (1997).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	25

UEE850: SMART GRID

L	T	P	Cr.
3	1	0	3.5

Course objective: To explain general communication techniques used in power system communication infrastructure and information system for control centers. To familiarize with interconnection issues related with integration of distributed generation technologies.

Communication Technologies for Power System: Fiber Optical Networks, WAN based on Fiber Optical Networks, IP based Real Time data Transmission, Substation communication network, Zigbee.

Information System for Control Centers (ICCS): ICCS Configuration, ICCS communication Network, ICCS Time Synchronization, E-Commerce of Electricity, GIS, GPS.

Integration, Control and Operation of Distributed Generation: Distributed Generation Technologies and its benefits, Distributed Generation Utilization Barriers, Distributed Generation integration to power grid.

Monitoring the smart grid: Load dispatch centers, wide-area monitoring system (WAMS), PMU; Smart sensors/telemetry, advanced metering infrastructure (AMI);smart metering; smart grid system monitoring; communication infrastructure and technologies; self-healing.

Micro grid: Integration of distributed energy sources; concept, operation, control and protection of Micro grid**.**

Hybrid Power Systems: Integration of conventional and non conventional energy sources.

Course Learning Outcomes (CLO):

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

- Explain various aspects of the smart grid, including, Technologies, Components, Architectures and Applications.
- Explain communication infrastructure of smart grid.
- Explain various integration aspects of conventional and non-conventional energy sources.
- Explain distributed generation coordination including monitoring of smart grid using modern communication infrastructure.
- Analyze Microgrid as a hybrid power system with advantages and challenges in future.

Text Books:

1. *INIEWSKI , Smart Grid Infrastructure And Networking, McGraw-Hill Education India Pvt.Ltd (2012), 1st Edition*
2. *James Momoh, Smart Grid: Fundamentals of Design and Analysis, IEEE Computer Society Press (2012)*

Reference Books:

1. *Ekanayake J.,Jenkins N., Liyanage K., Wu, J., Yokoyama A., Smart Grid: Technology and applications, Wiley Publications.*
2. *Momoh J., Smart Grid: Fundamentals of design and analysis, John Wiley & Sons.*

3. *Flick T., Morehouse J., Securing the smart grid: Next generation power grid security, paperback).*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	25

UEI841: ADVANCED CONTROL SYSTEMS

L	T	P	Cr.
3	1	0	3.5

Course Objective: To learn the methods for analyzing the behavior of nonlinear control systems and the designing of control systems.

Nonlinear Control Systems: Introduction to Nonlinear systems and their properties, Common Non-linearities, Describing functions, Phase plane method, Lyapounov's method for stability study, concept of Limit Cycle.

Optimal Control Theory: Introduction, Optimal control problems, Mathematical procedures for optimal control design: Calculus of variations, Pontryagin's optimum policy, Bang-Bang Control, Hamilton-Jacobi Principle

Z-Plane Analysis of Discrete-Time Control Systems: Introduction, Impulse sampling and data hold, Reconstructing original signal from sampled signals, concept of pulse transfer function, Realization of digital controllers.

Design of Discrete-time Control Systems: Introduction, Stability analysis of closed-loop systems in the z-plane, Transient and steady state response analysis, Design based on the root-locus method, Design based on the frequency-response method.

State-Space Analysis: Introduction, State-space representations of discrete-time systems, Solving discrete-time state-space equations, Pulse transfer function matrix, Discretization of continuous time state space equations,Lyapunov stability analysis, Controllability and Observability, Design via pole placement, State observer design.

Course Learning Outcomes (CLO):

After the successful completion of the course the students will be able to:

1. Demonstrate non-linear system behaviour by phase plane and describing function methods
2. Perform the stability analysis nonlinear systems by lyapunov method develop design skills in optimal control problems
3. Derive discrete-time mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform).
4. Predict and analyse transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear, time-invariant, discrete-time control systems.
5. Acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers

Text Books:

1. *Slotine& Li, Applied Non-Linear Control,* Englewood Cliffs, NJ: Prentice-Hall, (1991).
2. *Bandyopadhyay, M.N., Control Engineering: Theory and Practice, Prentice-Hall of India Private Limited (2003).*
3. *Ogata, K., Discrete-time Control Systems, Pearson Education (2005).*

Evaluation Scheme:

S.NO.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional (May include Assignments//Quizzes/Lab Evaluations)	25

UEE714: DIGITAL SIGNAL PROCESSING FUNDAMENTALS

L	T	P	Cr.
2	1	2	3.5

Course objective: To explain the concepts of Fourier analysis, digital signal processing, stability analysis of digital system, digital filter design and application of DSP for specific protection and drive.

Introduction: Definition, conversion from analog signal to digital signal, advantages and disadvantages of digital signal processing, Basic Terminologies.

z-Transform: Region of Convergence (ROC), Properties of z-transform, Initial and Final Value theorems, Partial Sum, Parseval's Theorem, z-transform of standard sequences, Inverse z-transform, Pole-Zero plot, System function of LTI system, Causality and Stability in terms of z-transform.

DFT and FFT: Discrete Fourier Series, Discrete Fourier Transform and its Properties, Efficient Computation of DFT using FFT algorithms, Linear Filtering Approach to Computation of DFT.

Digital Filter Structure: Describing Equation, Structures for FIR Systems, Structures for IIR Systems, Representation of Structures using Signal Flow Graph.

Design of Digital Filters: Introduction, Difference between analog and digital filters, Implementation of digital filter, Types of filters, LTI systems as filters, Design of IIR filters from analog filters, IIR filter design using Butterworth Approximation, Frequency transformation, FIR filters design, Least square filter design, Designing digital filter from pole-zero placement, Butterworth filter design using Bilinear transformation, FIR filter design using windows, Design of filters using pole-zero combination, Analysis of coefficient quantization effects in FIR filters, Analysis of round-off errors, Dynamic range scaling, Low sensitivity digital filters, Limit cycles in IIR filters.

Hardware Architecture of DSP Processor: Desirable features of DSP processors, Types of architectures, Internal architecture, Features, System interface and Instruction set of ADSP-21xx, ADSP-21xxDevelopment tools, TMS DSP processor.

Applications: Dual-tone multi frequency signal detection, Spectral analysis using DFT, Short term DFT, oversampling, Protection.

Course Learning Outcomes (CLO):

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

- Explain the digital signal processing concepts and stability analysis of digital system.
- Demonstrate the hardware architecture of DSP Processor.
- Design digital filter and harmonic mitigation.
- Carryout spectrum analysis using DFT.
- Apply DSP concepts for power system purposes such as relaying, protection and metering

Text Books:

1. *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing, Prentice Hall of India (1996).*

2. *Rabiner, C.R. and Gold, B., Theory and Applications of Digital Signal Processing, Prentice Hall of India (2000)*

Reference Books:

1. *Antonion, A., Digital Filters: Analysis Design and Application, Prentice-Hall of India (1999).*
2. *Oppenhein, A.V. and Schafer, R.W., Digital Signal Processing, Prentice-Hall of India (1998).*
3. *Helmut, U. and Willibald, W., Protection Techniques in Electrical Engg. Systems,Marcel Dekker Inc. (2001)*

Evaluation Scheme:

S N	Evaluation Elements	Weightage (%)
1.	MST	20
2.	EST	40
3.	Sessionals(Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

GENERIC ELECTIVES

UPH063 NANOSCIENCE AND NANOMATERIALS

L	T	P	Cr
3	0	0	3.0

Course Objectives: To introduce the basic concept of Nanoscience and advanced applications of nanotechnology,

Fundamental of Nanoscience: Features of Nanosystem, Free electron theory and its features, Idea of band structures, Density of states in bands, Variation of density of state and band gap with size of crystal,

Quantum Size Effect: Concepts of quantum effects, Schrodinger time independent and time dependent equation, Electron confinement in one-dimensional well and three-dimensional infinite square well, Idea of quantum well structure, Quantum dots and quantum wires,

Nano Materials: Classification of Nano Materials their properties, Basic concept relevant to application, Fullerenes, Nanotubes and nano-wires, Thin films chemical sensors, Gas sensors, Vapour sensors and Bio sensors,

Synthesis and processing: Sol-gel process, Cluster beam evaporation, Ion beam deposition, Chemical bath deposition with capping techniques and ball milling, Cluster assembly and mechanical attrition, Sputtering method, Thermal evaporation, Laser method,

Characterization: Determination of particle size, XRD technique, Photo luminescence, Electron microscopy, Raman spectroscopy, STEM, AFM,

Applications: Photonic crystals, Smart materials, Fuel and solar cells, Opto-electronic devices

Course Learning Outcomes (CLOs):

Upon completion of the course, Students will be able to

1. discriminate between bulk and nano materials,
2. establish the size and shape dependence of Materials' properties,
3. correlate 'quantum confinement' and 'quantum size effect' with physical and chemical properties of nanomaterials,
4. uses top-down and bottom-up methods to synthesize nanoparticles and control their size and shape
5. characterize nanomaterials with various physico-chemical characterization tools and use them in development of modern technologies

Recommended Books:

1. *Booker, R., Boysen, E., Nanotechnology, Wiley India Pvt, Ltd, (2008)*
2. *Rogers, B., Pennathur, S., Adams, J., Nanotechnology, CRS Press (2007)*
3. *Bandyopadhyay, A,K., Nano Materials, New Age Int,, (2007)*
4. *Niemeyer, C. N., and Mirkin, C, A., Nanobiotechnology: Concepts, Applications and Perspectives, Wiley VCH, Weinhein, Germany (2007)*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55

UEN004 TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT

L	T	P	Cr
3	0	0	3.0

Course Objectives: To provide acquaintance with modern cleaner production processes and emerging energy technologies; and to facilitate understanding the need and application of green and renewable technologies for sustainable development of the Industry/society

Course Contents:

Concepts of Sustainability and Industrial Processes: Industrialization and sustainable development; Cleaner production (CP) in achieving sustainability; Source reduction techniques - Raw material substitution; Process modification and equipment optimization; Product design or modification; Reuse and recycling strategies; Resources and by-product recovery from wastes; Treatment and disposal; CDM and Pollution prevention programs; Good housekeeping; CP audits,

Green Design: Green buildings - benefits and challenges; public policies and market-driven initiatives; Effective green specifications; Energy efficient design; Passive solar design; Green power; Green materials and Leadership in Energy and Environmental Design (LEED)

Renewable and Emerging Energy Technologies: Introduction to renewable energy technologies- Solar; wind; tidal; biomass; hydropower; geothermal energy technologies; Emerging concepts; Biomolecules and energy; Fuel cells; Fourth generation energy systems,

Course Learning Outcomes (CLOs):

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

1. comprehend basic concepts in source reduction, waste treatment and management
2. Identify and plan cleaner production flow charts/processes for specific industrial sectors
3. examine and evaluate present and future advancements in emerging and renewable energy technologies

Recommended Books

1. *Kirkwood, R,C, and Longley, A,J, (Eds,), Clean Technology and the Environment, Chapman & Hall, London (1995),*
2. *World Bank Group; Pollution Prevention and Abatement Handbook – Towards Cleaner Production, World Bank and UNEP; Washington DC (1998),*
3. *Modak, P,, Visvanathan, C, and Parasnis, M,, Cleaner Production Audit, Course Material on Cleaner Production and Waste Minimization; United Nations Industrial Development Organization (UNIDP) (1995),*
4. *Rao, S, and Parulekar, B,B,, Energy Technology: Non-conventional; Renewable and Conventional; Khanna Pub,(2005) 3rd Ed,*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55

UHU009 INTRODUCTION TO COGNITIVE SCIENCE

L	T	P	Cr
3	0	0	3.0

Course Objectives: This course provides an introduction to the study of intelligence, mind and brain from an interdisciplinary perspective, It encompasses the contemporary views of how the mind works, the nature of reason, and how thought processes are reflected in the language we use, Central to the course is the modern computational theory of mind and it specifies the underlying mechanisms through which the brain processes language, thinks thoughts, and develops consciousness,

Overview of Cognitive Science: Newell's big question, Constituent disciplines, Interdisciplinary approach, Unity and diversity of cognitive science,
Philosophy: Philosophy of Mind, Cartesian dualism Nativism vs, empiricism, Mind-body problem, Functionalism, Turing Test, Modularity of mind, Consciousness, Phineas Gage, Physicalism.
Psychology: Behaviorism vs, cognitive psychology, The cognitive revolution in psychology, Hardware/software distinction , Perception and psychophysics, Visual cognition, Temporal dynamics of visual perception, Pattern recognition, David Marr's computational theory of vision, Learning and memory, Theories of learning, Multiple memory systems, Working Memory and Executive Control, Memory span, Dissociations of short- and long-term memory, Baddeley's working memory model.
Linguistics: Components of a grammar, Chomsky, Phrases and constituents, Productivity, Generative grammars, Compositional syntax, Productivity by recursion, Surface- and deep structures, Referential theory of meaning, Compositional semantics, Semantics, Language acquisition, Language and thought.
Neuroscience: Brain anatomy, Hierarchical functional organization, Decorticate animals, Neuroimaging, Neurophysiology, Neuron doctrine, Ion channels, Action potentials, Synaptic transmission, Synaptic plasticity, Biological basis of learning, Brain damage, Amnesia, Aphasia, Agnosia, Parallel Distributed Processing(PDP), Computational cognitive neuroscience, The appeal of the PDP approach, Biological Basis of Learning, Cajal's synaptic plasticity hypothesis, Long-term potentiation (LTP) and depotentiation (LTD), NMDA receptors and their role in LTP, Synaptic consolidation, Vertical integration, The Problem of representation, Shannon's information theory.
Artificial Intelligence: Turing machines, Physical symbol systems, Symbols and Search Connectionism, Machine Learning,, Weak versus strong AI, Subfields, applications, and recent trends in AI, Turing Test revisited, SHRDLU, Heuristic search, General Problem Solver (GPS), Means-ends analysis.
Cognitive architectures: Tripartite architecture, Integration, ACT-R Architecture Modularity.

Course Learning Outcomes (CLOs):
Upon completion of the course, the students will be able to:

1. identify cognitive science as an interdisciplinary paradigm of study of cross-cutting areas such as Philosophy, Psychology, Neuroscience, Linguistics, Anthropology, and Artificial Intelligence.
2. explain various processes of the mind such as memory and attention, as well as representational and modelling techniques that are used to build computational models of mental processes;
3. acquire basic knowledge of neural networks, linguistic formalism, computing theory, and the brain.

4. apply basic Artificial Intelligence techniques to solve simple problems.

Recommended Books

1. *Bermúdez, J.L., Cognitive Science: An Introduction to the Science of the Mind (2nd Ed,), Cambridge, UK: Cambridge (2014).*
2. *Friedenberg ,J,D, and Silverman,G, Cognitive Science: An Introduction To The Study Of Mind, Sage Publications:, London* (2014)
3. *Thagard, P., Mind: An introduction to Cognitive Science, MIT Press, (2005)*
4. *Thagard, P., (1998) Mind Readings: Introductory Selections on Cognitive Science, MIT Press, Cambridge, Mass,*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55

UHU008 INTRODUCTION TO CORPORATE FINANCE

L	T	P	Cr
3	0	0	3.0

Course Objective:
This course aims to provide the students with the fundamental concepts, principles and approaches of corporate finance, enable the students to apply relevant principles and approaches in solving problems of corporate finance and help the students improve their overall capacities.

Introduction to corporate finance: Finance and corporate finance. Forms of business organizations, basic types of financial management decisions, the goal of financial management, the agency problem; the role of the financial manager; basic types of financial management decisions.
Financial statements analysis: Balance sheet, income statement, cash flow, fund flow financial statement analysis Computing and interpreting financial ratios; conducting trend analysis and Du Pont analysis.
The time value of money: Time value of money, future value and compounding, present value and discounting, uneven cash flow and annuity, discounted cash flow valuation.
Risk and return: Introduction to systematic and unsystematic risks, computation of risk and return, security market line, capital asset pricing model.
Long-term financial planning & Financial Decisions: Various sources of long term financing, the elements and role of financial planning, financial planning model, percentage of sales approach, external financing needed. Cost of capital, financial leverage, operating leverage. Capital structure, theories of capital structure net income, net operating income & M&M proposition I and II.
Short-term financial planning and management: Working capital, operating cycle, cash cycle, cash budget, short-term financial policy, cash management, inventory management, credit management.
Capital budgeting : Concepts and procedures of capital budgeting, investment criteria (net present value, payback, discounted payback, average accounting return, internal rate of return, profitability index), incremental cash flows, scenario analysis, sensitivity analysis, break-even analysis,
Dividend policy: Dividend, dividend policy, Various models of dividend policy (Residual approach, Walter model, Gordon Model, M&M, Determinants of dividend policy.
Security valuation: Bond features, bond valuation, bond yields, bond risks, stock features, common stock valuation, and dividend discount & dividend growth models. Common stock yields, preferred stock valuation.

Course Learning Outcomes (CLO):

1. Ability to evaluate critically corporate financial management practices with the aim of proposing and implementing improvements.
2. Apply the methods and procedures of financial management, with particular reference to investment evaluation corporate evaluation and risk management.
3. Applying the knowledge to estimate a company's cost of capital; determine whether a company is creating or destroying value.
4. Applying the various theories of corporate finance to design a company's optimal mix of debt and equity financing; and compensate shareholders in the most convenient way.
5. Apply the methods and procedures to value stocks and bonds; assess the risk and return of assets.

Recommended Books:

1. *Brealey, R. A., Myers. S.C., Allen, F., Principles of Corporate Finance (9th edition), The McGraw-Hill, London, (2006).*
2. *Ehrhardt, M.C., Brigham, E.F., Financial Management: Theory and Practice (10th edition) South Western-Cengage, New York (2011)*
3. *Van Horne, J.C., Wachowicz, J.M., Kuhlemeyer, G.A., 2005, Fundamentals of Financial Management, Pearson, Vancouver (2010)*
4. *Pandey, I. M., Financial management, Vikas Publishing House Pvt. Ltd., Noida (2011)*
5. *Elton, E.J. and Gruber, M.J., Modern Portfolio Theory and Investment Analysis, (7th Edition), John Wiley and Sons, New York (2007)*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55

UMA062 GRAPH THEORY AND APPLICATIONS

L	T	P	Cr
3	0	0	3.0

Course Objective:
The objective of the course is to introduce students with the fundamental concepts in graph Theory, with a sense of some its modern applications. They will be able to use these methods in subsequent courses in the computer, electrical and other engineering,

Introduction: Graph, Finite and infinite graph, incidence and degree, Isolated vertex, Pendent vertex and null graph, Isomorphism, Sub graph, Walks, Paths and circuits, Euler circuit and path, Hamilton path and circuit, Euler formula, Homeomorphic graph, Bipartite graph, Edge connectivity, Computer representation of graph, Digraph.
Tree and Fundamental Circuits: Tree, Distance and center in a tree, Binary tree, Spanning tree, Finding all spanning tree of a graph, Minimum spanning tree.
Graph and Tree Algorithms: Shortest path algorithms, Shortest path between all pairs of vertices, Depth first search and breadth first of a graph, Huffman coding, Cuts set and cut vertices, Warshall's algorithm, topological sorting.
Planar and Dual Graph: Planner graph, Kuratowski's theorem, Representation of planar graph, five-color theorem, Geometric dual.
Coloring of Graphs: Chromatic number, Vertex coloring, Edge coloring, Chromatic partitioning, Chromatic polynomial, covering.
Application of Graphs and Trees: Konigsberg bridge problem, Utilities problem, Electrical network problem, Seating problem, Chinese postman problem, Shortest path problem, Job sequence problem, Travelling salesman problem, Ranking the participant in a tournament, Graph in switching and coding theory, Time table and exam scheduling, Applications of tree and graph in computer science.

Course Learning Outcomes (CLO):
Upon completion of the course, the students will be able to:

1) understand the basic concepts of graphs, directed graphs, and weighted graphs and able to present a graph by matrices.
2) understand the properties of trees and able to find a minimal spanning tree for a given weighted graph.
3) understand Eulerian and Hamiltonian graphs.
4) apply shortest path algorithm to solve Chinese Postman Problem .
5) apply the knowledge of graphs to solve the real life problem.

Recommended Books

1. *Deo, N., Graph Theory with Application to Engineering with Computer Science, PHI, New Delhi (2007)*
2. *West, D. B., Introduction to Graph Theory, Pearson Education, London (2008)*
3. *Bondy, J. A. and Murty, U.S.R., Graph Theory with Applications, North Holland Publication, London (2000)*
4. *Rosen, K. H., Discrete Mathematics and its Applications, Tata-McGraw Hill, New Delhi (2007)*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55

UMA061 ADVANCED NUMERICAL METHODS

L	T	P	Cr
3	0	0	3.0

Course Objective:
The main objective of this course is to motivate the students to understand and learn various advanced numerical techniques to solve mathematical problems governing various engineering and physical problems.

Non-Linear Equations: Methods for multiple roots, Muller's, Iteration and Newton-Raphson method for non-linear system of equations and Newton-Raphson method for complex roots.
Polynomial Equations: Descartes' rule of sign, Birge-vieta, Giraffe's methods.
System of Linear Equations: Cholesky and Partition methods, SOR method with optimal relaxation parameters.
Eigen-Values and Eigen-Vectors: Similarity transformations, Gerschgorin's bound(s) on eigenvalues, Given's and Rutishauser methods.
Interpolation and Approximation: Cubic and B – Spline and bivariate interpolation, Least squares approximations, Gram-Schmidt orthogonalisation process and approximation by orthogonal polynomial, Legendre and Chebyshev polynomials and approximation.
Differentiation and Integration: Differentiation and integration using cubic splines, Romberg integration and multiple integrals.
Ordinary differential Equations: Milne's, Adams-Moulton and Adam's Bashforth methods with their convergence and stability, Shooting and finite difference methods for second order boundary value problems.

Course Learning Outcomes (CLOs):
Upon completion of this course, the students will be able to**:**

1) find multiple roots of equation and apply Newton -Raphson's method to obtain complex roots as well solution of system of non - linear equations.
2) learn how to obtain numerical solution of polynomial equations using Birge - Vitae and Giraffe's methods.
3) apply Cholesky, Partition and SOR methods to solve system of linear equations.
4) understand how to approximate the functions using Spline, B- Spline, least square .approximations
5) learn how to solve definite integrals by using cubic spline, Romberg and initial value problems and boundary value problems numerically.

Recommended Books

1) *Gerald, C.F. and Wheatley, P.O., Applied Numerical Analysis, Pearson Education (2008) 7th ed.*
2) *Gupta, S.R., Elements of Numerical Analysis, MacMillan India (2009).*
1) *Atkinson, K.E., An introduction to Numerical Analysis, John Wiley (2004) 2nd ed.*
2) *S.D. Conte, S.D. and Carl D. Boor, Elementary Numerical Analysis: An Algorithmic Approach, Tata McGraw Hill (2005).*
3) *Jain M. K., Iyengar. S.R.K. and Jain, R.K. Numerical Methods for Scientific and Engineering Computation, New Age International (2008) 5th ed.*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55

UHU006 INTRODUCTORY COURSE IN FRENCH

L	T	P	Cr
3	0	0	3.0

Course Objectives:

The objectives of the course is to introduce to the students:

1. The basics of French language to the students. It assumes that the students have minimal or no prior knowledge of the language.
2. To help them acquire skills in writing and speaking in French, comprehending written and spoken French.
3. The students are trained in order to introduce themselves and others, to carry out short conversation, to ask for simple information, to understand and write short and simple messages, to interact in a basic way.
4. The main focus of the students will be on real life language use, integration of French and francophone culture, & basic phrases aimed at the satisfaction of needs of concrete type.
5. During class time the students are expected to engage in group & pair work.

Communicative skills: Greetings and Its Usage, Asking for and giving personal information, How to ask and answer questions, How to talk over the phone, Exchange simple information on preference, feelings etc. Invite, accept, or refuse invitation, Fix an appointment, Describe the weather, Ask for/give explanations, Describe a person, an object, an event, a place.

Grammar : Pronouns: Pronom sujets (Je/ Tu/Il/Elle/Nous/Vous/Ils/Elles), Nouns: Genders, Articles: Definite article and Indefinite articles, Verbs: Regular verbs (-er, -ir ending) Irregular verbs (-re ending), Auxiliary verbs (avoir, être, aller). Adjective: Description, Adjective possessive, Simple Negation, Tense: Present, Future, Questions, Singular & plural.

Vocabulary: Countries and Nationalities, Professions, Numbers (ordinal, cardinal), Colours, Food and drinks, Days of the week, Months, Family, Places.

Phonetics: The course develops the ability, to pronounce words, say sentences, questions and give orders using the right accent and intonation. To express surprise, doubt, fear, and all positive or negative feelings using the right intonation. To distinguish voiced and unvoiced consonants. To distinguish between vowel sounds.

Course Learning Outcomes (CLO):

Upon the completion of the course:

1. The students begin to communicate in simple everyday situations acquiring basic grammatical structure and vocabulary.
2. The course develops oral and reading comprehension skills as well as speaking and writing.
3. Students can demonstrate understanding of simple information in a variety of authentic materials such as posters, advertisement, signs etc.
4. Discuss different professions, courses and areas of specialisation.
5. Write simple messages, letters, composition and dialogues. Complete simple forms and documents.
6. Express feelings, preferences, wishes and opinions and display basic awareness of francophone studies.
7. Units on pronunciation and spelling expose students to the different sounds in the French language and how they are transcribed.

Recommended Books :

1. *Alter ego-1 : Méthode de français by Annie Berthet, Catherine Hugot, Véronique M. Kizirion, Beatrix Sampsonis, Monique Waendendries, Editions Hachette français langue étrangère.*
2. *Connexions-1 : Méthode de français by Régine Mérieux, Yves Loiseau, Editions Didier*
3. *Version Originale-1: Méthode de français by Monique Denyer, Agustin Garmendia.*
4. *Marie-Laure Lions-Olivieri, Editions Maison des Langues, Paris 2009*
5. *Latitudes-1 : Méthode de français by Régine Mérieux, Yves Loiseau, Editions Didier*
6. *Campus-1 : Méthode de français by Jacky Girardet, Jacques Pécheur, Editions CLE International.*
7. *Echo-1 : Méthode de français by J. Girardet, J. Pécheur, Editions CLE International.*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55

UBT509 BIOLOGY FOR ENGINEERS

L	T	P	Cr
3	0	0	3.0

Course Objective: To learn about living world and basic functioning of biological systems. The course encompasses understanding of origin of life, its evolution and some of its central characteristics. It also aims to familiarize engineering students to some of the intricate biological phenomena and mechanisms.

Characteristics of life: Living versus non-living organisms, origin of life, theory of evolution, diversity of life, classification of life into animals, plants, fungi, protists, archea and bacteria. Phylogenetics and its relationship with evolution.

Introduction to biological systems: Cell as basic unit of life, cellular organelles and their functions, important biomacromolecules (carbohydrates, lipids, proteins and nucleic acids) and their properties.

Cell membrane: Membrane structure, selective permeability, transport across cell membrane, active and passive transport, membrane proteins, type of transport proteins, channels and pumps, examples of membrane transport in cell physiology.

Classical and molecular genetics: Heredity and laws of genetics, genetic material and genetic information, Structure and properties of DNA, central dogma, replication of genetic information, universal codon system, encoding of genetic information via transcription and translation.

Course Learning Outcomes (CLOs):

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

1. Describe living-systems and differentiate them from non-living systems
2. Explain the theory of evolution and apply it non-living world
3. Apply properties of nucleic acids in molecular recognition based diagnostics
4. Familiarized with various transport mechanisms across cell membranes
5. Explain how genetic information is stored, replicated and encoded in living organisms.

Recommended Books:

1. *Nelson, D.L., Cox, M.M., Lehninger: Principles of Biochemistry, WH Freeman (2008) 5th ed.*
2. *Dhami, P.S., Srivastava, H.N. Chopra, G., A Textbook of Biology, Pradeep Publications (2008).*
3. *Das, H.K., Textbook of Biotechnology, John Wiley & Sons (2004) 3rd Edition.*
4. *Gardner, E.J., Simmons, M., Peter, S.D., Principles of Genetics, John Wiley & Sons (2008)*
5. *Albert, B., Essential Cell Biology, Taylor & Francis, London (2009)*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55

UCS001 INTRODUCTION TO CYBER SECURITY

L	T	P	Cr
3	0	0	3.0

Course Objectives: In this course, the student will learn about the essential building blocks and basic concepts around cyber security such as Confidentiality, Integrity, Availability, Authentication, Authorization, Vulnerability, Threat and Risk and so on.

Introduction: Introduction to Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, and Cryptography, Authentication, Access Control, Cryptography
Programs and Programming: Unintentional (Non-malicious) Programming Oversights, Malicious Code—Malware, Countermeasures
Web Security: User Side, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks
Operating Systems Security: Security in Operating Systems, Security in the Design of Operating Systems, Rootkit
Network Security: Network Concepts, Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service Strategic Defenses: Security Countermeasures, Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management
Cloud Computing and Security: Cloud Computing Concepts, Moving to the Cloud, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS
Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where the Field Is Headed
Management and Incidents: Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster
Legal Issues and Ethics: Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, Incident Analysis with Ethics
Emerging Topics: The Internet of Things, Economics, Computerized Elections, Cyber Warfare.

Course Learning Outcomes (CLOs):
After completion of this course, the students will be able to:

1. Understand the broad set of technical, social & political aspects of Cyber Security and security management methods to maintain security protection
2. Appreciate the vulnerabilities and threats posed by criminals, terrorist and nation states to national infrastructure
3. Understand the nature of secure software development and operating systems
4. Recognize the role security management plays in cyber security defense and legal and social issues at play in developing solutions.

Recommended Books:

1. *Pfleeger, C.P., Security in Computing, Prentice Hall, 5th edition (2010)*
2. *Schneier, B., Applied Cryptography, Second Edition, John Wiley & Sons (1996)*
3. *Rhodes-Ousley, M., Information Security: The Complete Reference, Second Edition, Information Security Management: Concepts and Practice. New York, McGraw-Hill, (2013).*

4. *Whitman, M.E. and Herbert J. M., Roadmap to Information Security for IT and Infosec Managers, Course Technology, Boston, MA (2011).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55

UTD007 EMPLOYABILITY DEVELOPMENT SKILLS

L	T	P	Cr
0	3	3	3.0

Course Objectives:

This course aims to sensitize students with the gamut of skills which facilitate them to enhance their employability quotient and do well in the professional space. These skills are imperative for students to establish a stronger connect with the environment in which they operate. An understanding of these skills will enable students to manage the placement challenges more effectively.

Emotional Intelligence: Understanding Emotional Intelligence (EI); Daniel Goleman's EI Model: Self Awareness, Self-Regulation, Internal Motivation, Empathy, Social Skills; Application of EI during Group Discussions & Personal Interview; Application of EI in personal life, student life and at the workplace

Team Dynamics & Leadership: Understanding the challenges of working within a team format in today's complex organizational environments; Stages of team formation; Appreciating forces that influence the direction of a team's behaviour and performance; Cross-functional teams; Conflict in Teams- leveraging differences to create opportunity Leadership in the team setting & energizing team efforts; Situational leadership; Application of team dynamics & collaboration in Group Discussions; Application of team dynamics at the workplace

Complex Problem Solving: Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions; Understanding a working model for complex problem solving - framing the problem, diagnosing the problem, identifying solutions & executing the solutions; Appreciation of complex problem solving at the workplace through case studies

Lateral Thinking: Understanding lateral thinking & appreciating the difference between vertical & lateral thinking, and between convergent & divergent thinking; Understanding brain storming & mind-maps; Solving of problems by an indirect and creative approach, typically through viewing the problem in a new and unusual light; Application of lateral thinking during Group Discussions & Personal Interviews; Application of lateral thinking at the workplace

Persuasion: Role of persuasion in communication; Application of ethos-pathos-logos; Using persuasive strategies to connect with individuals & teams to create competitive advantage

Quantitative Reasoning: Thinking critically and applying basic mathematics skills to interpret data, draw conclusions, and solve problems; developing proficiency in numerical reasoning; Application of quantitative reasoning in aptitude tests

Verbal Reasoning: Understanding and reasoning using concepts framed in words; Critical verbal reasoning; Reading Comprehension; Application of verbal reasoning in aptitude tests

Group Discussion (GD): Illustrating the do's and don'ts in Group Discussions; Specific thrust on types of GD topics; GD evaluation parameters; Understanding the challenge in a case discussion; SPACER model

Personal Interview (PI): Interview do's and don'ts; PI evaluation parameters; The art of introduction; Managing bouncer questions; Leading the panel in a PI

Course Learning Outcomes (CLOs):

The students will be able to

1. appreciate the various skills required for professional & personal success.
2. bridge the gap between current and expected performance benchmarks.
3. competently manage the challenges related to campus placements and perform to their utmost potential.

Recommended Books:

1. *Harvard Business Essentials; Creating Teams with an Edge; Harvard Business School Press (2004)*
2. *Edward de B., Six Thinking Hats; Penguin Life (2016)*
3. *Daniel, G., Working with Emotional Intelligence; Bantam Books (2000)*
4. *Aggarwal, R.S., Quantitative Aptitude for Competitive Examinations; S Chand (2017)*
5. *Agarwal, A., An expert guide to problem solving: with practical examples; CreateSpace Independent Publishing Platform (2016)*
6. *William, D., The Logical Thinking process; American Society for Quality (2007)*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	45
2	EST	55