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

COURSE SCHEME

FOR

B.E. – ELECTRONICS (INSTRUMENTATION & CONTROL) ENGINEERING

2016

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

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	19.5	19	16	15	4.5	-	-	-	74.0
Core-Professional (CF) Courses	-	-	4.5	11.5	21.5	20.5	16.5	-	74.5
Professional & Generic (PE/GE) Electives	-	-	-	-	3.5	-	7.5	-	11.0
Project Based (PR) Courses	4	5	6	-	-	-	8	20	43.0
								Total	202.5

SEMESTER-I

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEE001	ELECTRICAL ENGINEERING	CF	3	1	2	4.5
2	UHU003	PROFESSIONAL COMMUNICATION	CF	2	0	2	3.0
3	UMA003	MATHEMATICS - I	CF	3	1	0	3.5
4	UPH004	APPLIED PHYSICS	CF	3	1	2	4.5
5	UTA007	COMPUTER PROGRAMMING - I	CF	3	0	2	4.0
6	UTA008	ENGINEERING DESIGN - I	PR	2	4	0	4.0
		TOTAL		**16**	**7**	**8**	**23.5**

SEMESTER-II

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UCB008	APPLIED CHEMISTRY	CF	3	1	2	4.5
2	UEC001	ELECTRONIC ENGINEERING	CF	3	1	2	4.5
3	UES009	MECHANICS	CF	2	1	2*	2.5
4	UMA004	MATHEMATICS - II	CF	3	1	0	3.5
5	UTA009	COMPUTER PROGRAMMING - II	CF	3	0	2	4.0
6	UTA010	ENGINEERING DESIGN – II (6 SELF EFFORT HOURS)		1	0	2	5.0
		TOTAL		**15**	**4**	**8**	**24.0**

*** Each student will attend one Lab Session of 2 hrs in a semester for a bridge project in this course. (Mechanics)**

SEMESTER-III

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEI403	ELECTRICAL AND ELECTRONIC MEASUREMENTS	CP	3	1	2	4.5
2	UES010	SOLIDS AND STRUCTURES	CF	3	1	2	4.5
3	UES011	THERMO-FLUIDS	CF	3	1	2	4.5
4	UMA031	OPTIMIZATION TECHNIQUES	CF	3	1	0	3.5
5	UTA002	MANUFACTURING PROCESSES	CF	2	0	3	3.5
6	UTA019	ENGINEERING DESIGN – III (6 SELF EFFORT HOURS)	PR	1	0	4	6.0
		TOTAL		**15**	**4**	**13**	**26.5**

SEMESTER-IV

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEI303	TECHNIQUES ON SIGNALS AND SYSTEMS	CP	3	1	0	3.5
2	UEI304	SENSORS AND SIGNAL CONDITIONING (7 SELF EFFORT HOURS)	CP	3	1	2	8.0
3	UEN002	ENERGY AND ENVIRONMENT	CF	3	0	0	3.0
4	UES012	ENGINEERING MATERIALS	CF	3	1	2	4.5
5	UHU005	HUMANITIES FOR ENGINEERS	CF	2	0	2	3.0
6	UMA007	NUMERICAL ANALYSIS	CF	3	1	2	4.5
		TOTAL		**17**	**4**	**8**	**26.5**

SEMESTER-V

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEE503	NETWORK ANALYSIS AND SYNTHESIS	CP	3	1	0	3.5
2	UEE505	ANALOG AND DIGITAL SYSTEMS	CP	3	1	2	4.5
3	UEI501	CONTROL SYSTEMS	CP	3	1	2	4.5
4	UEI601	INDUSTRIAL INSTRUMENTATION	CP	3	1	2	4.5
5	UEI609	FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS	CP	3	1	2	4.5
6	UTA012	INNOVATION AND ENTREPRENEURSHIP (5 SELF EFFORT HOURS)	CF	1	0	2	4.5
7		ELECTIVE – I		3	1	0	3.5
		TOTAL		**19**	**6**	**10**	**29.5**

SEMESTER-VI

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEE504	POWER ELECTRONICS	CP	3	1	2	4.5
2	UEI605	PROCESS DYNAMICS AND CONTROL	CP	3	0	2	4.0
3	UEI607	DIGITAL SIGNAL PROCESSING AND APPLICATIONS	CP	3	1	2	4.5
4	UEI608	BIO-MEDICAL INSTRUMENTATION	CP	3	0	2	4.0
5	UEI693	CAPSTONE PROJECT – START (4 SELF EFFORT HOURS)	PR	-	-	2	-
6	UEI841	ADVANCED CONTROL SYSTEMS	CP	3	1	0	3.5
		TOTAL		**15**	**3**	**10**	**20.5**

SEMESTER-VII

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEE606	ELECTRICAL MACHINES AND DRIVES	CP	3	1	2	4.5
2	UEI701	DATA ACQUISITION AND SYSTEM DESIGN	CP	3	0	2	4.0
3	UEI793	CAPSTONE PROJECT (8 SELF EFFORT HOURS)	PR	-	-	2	8.0
4	UEI801	ADVANCED PROCESS CONTROL	CP	3	1	2	4.5
5	UEI844	VIRTUAL INSTRUMENTATION	CP	2	0	3	3.5
6		ELECTIVE – II		3	1	2	4.5
7		GENERIC ELECTIVE		3	0	0	3.0
		TOTAL		**17**	**3**	**13**	**32.0**

SEMESTER-VIII

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEI892	PROJECT SEMESTER*	PR	-	-	-	20.0
		TOTAL		**-**	**-**	**-**	**20.0**

*TO BE CARRIED OUT IN INDUSTRY/RESEARCH INSTITUTION

OR

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEE806	ALTERNATE SOURCES OF ENERGY	CP	3	0	2	4.0
2	UEI805	ENVIRONMENTAL INSTRUMENTATION	CP	3	0	0	3.0
3	UEI894	DESIGN PROJECT	PR	-	-	-	13.0
		TOTAL		**6**	**0**	**2**	**20.0**

OR

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEI895	START- UP SEMESTER**	PR	-	-	-	20.0
		TOTAL		**-**	**-**	**-**	**20.0**

****** BASED ON HANDS ON WORK ON INNOVATIONS AND ENTREPRENEURSHIP

LIST OF PROFESSIONAL ELECTIVES

ELECTIVE–I

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEE507	ENGINEERING ELECTROMAGNETICS	PE	3	1	0	3.5
2	UEI831	BIO–SENSOR AND MEMS	PE	3	1	0	3.5
3	UEI833	OPTICAL INSTRUMENTATION	PE	3	1	0	3.5
4	UEI846	BIO–MEDICAL DSP	PE	3	1	0	3.5
5	UEI847	ROBOTICS AND AUTOMATION	PE	3	1	0	3.5

ELECTIVE–II

SR. NO.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UEI401	ARTIFICIAL INTELLIGENT TECHNIQUES AND APPLICATIONS	PE	3	1	2	4.5
2	UEI721	DIGITAL IMAGE PROCESSING	PE	3	1	2	4.5
3	UCS740	DATA STRUCTURES AND ALGORITHMS	PE	3	1	2	4.5
4	UEI720	ANALYTICAL INSTRUMENTATION	PE	3	1	2	4.5
5	UCS739	OBJECT ORIENTED PROGRAMMING AND APPLICATIONS	PE	3	1	2	4.5
6	UEI719	EMBEDDED CONTROL SYSTEM	PE	3	1	2	4.5

LIST OF GENERIC ELECTIVES

S.NO.	Course No.	TITLE	CODE	L	T	P	Cr
1	UHU006	INTRODUCTORY COURSE IN FRENCH	GE	3	0	0	3.0
2	UCS001	INTRODUCTION TO CYBER SECURITY	GE	3	0	0	3.0
3	UTD007	EMPLOYABILITY DEVELOPMENT SKILLS	GE	2	2	0	3.0
4	UEN004	TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT	GE	3	0	0	3.0
5	UHU008	INTRODUCTION TO CORPORATE FINANCE	GE	3	0	0	3.0
6	UHU009	INTRODUCTION TO COGNITIVE SCIENCE	GE	3	0	0	3.0
7	UPH063	NANO SCIENCE AND NANO-MATERIALS	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

SEMESTER WISE CREDITS FOR BE (ELECTRONICS (INSTRUMENTATION & CONTROL) ENGINEERING)

SEMESTER	CREDITS
FIRST	23.5
SECOND	24.0
THIRD	26.5
FOURTH	26.5
FIFTH	29.5
SIXTH	20.5
SEVENTH	32.0
EIGHTH	20.0
TOTAL CREDITS	**202.5**

UEE001: ELECTRICAL ENGINEERING

L	T	P	Cr.
3	1	2	4.5

Course Objective: To introduce concepts of DC and AC circuits, electromagnetism, 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 supplysystems.

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

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, Magnetisation curve of DCgenerator.

Course Learning Outcomes (CLO):

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

1. Learn about applications of networks laws and theorems to solve electric circuits.
2. Represent AC quantities through phasor and compute AC system behaviour during steady state.
3. Learn about principle, construction, characteristics and application of Electro-Mechanical energy conversion devices**.**

Text Books:

1. *Hughes, E., Smith, I.M., Hiley, J. and Brown, K., Electrical and Electronic Technology, Prentice Hall(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 IndiaPrivate Limited(2004)*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional (May include Assignments/Projects/Tutorials/Quizes/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 Communicationskills.
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. Needs-assessment of spoken and written communication andfeedback.
2. Training for Group Discussions through simulations and roleplays.
3. Training for effectivepresentations.
4. Project based teampresentations.
5. Proposals and papers-review andsuggestions.

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

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

1. Understand and appreciate the need of communication training.
2. Use different strategies of effective communication.

3. Select the most appropriate mode of communication for a given situation.
4. Speak assertively and effectively.
5. Correspond effectively through different modes of written communication.
6. Write effective reports, proposals and papers.
7. Present himself/ herself professionally through effective resumes and Interviews.

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 NewDelhi.(2011).*
3. *Mukherjee H.S.,Business Communication-Connecting at Work,Oxford University Press New Delhi, (2013).*

Reference Books:

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

Evaluation Scheme:

S.No	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals (Group Discussions; professional presentations; panel discussions; public speaking; projects, quizzes)	40

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 engineeringprofession.

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 conditionalconvergence.

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, approximate functions and solve the problem of maxima and minima.
2) determine the convergence/divergence of infinite series.
3) evaluate multiple integrals and their applications to engineering problems.
4) analyse and design mathematical problems encountered in engineering applications.

Text Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007), 9th ed.
2. Stewart James, Essential Calculus; Thomson Publishers (2007), 6thed.

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	Weight age (%)
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

Objectives:

To introduce the student to the basic physical laws of oscillators, acoustics of buildings, ultrasonics, electromagnetic waves, wave optics, lasers, and quantum mechanics and demonstrate their applications in technology. To introduce the student to measurement principles and their application to investigate physical phenomena

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 - skindepth.

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 variousmedia.
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 diffractiong rating.
5. Determination of specific rotation of cane sugarsolution.
6. Study and proof of Malus' law inpolarization.
7. Determination of beam divergence and beam intensity of a given laser.
8. Determination of displacement and conducting currents through adielectric.
9. Determination of Planck'sconstant.

Micro project: Students will be given physics-based projects/assignments 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. *Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007) 6^{th}ed.*
2. *Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999) 3^{rd}ed.*
3. *Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001) 4^{th}ed.*

Reference Books

1 *Wehr, M.R, Richards, J.A., Adair, T.W., Physics of The Atom, Narosa Publishing House (1990) 4^{th}ed.*

2 *Verma, N.K., Physics for Engineers, Prentice Hall of India (2014)1^{st}ed.*

3 *Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice Hall^{TM} (2008) 3^{rd}ed.*

Evaluation Scheme:

Sr.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include assignments/quizzes)	40

UTA007: 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.

Introduction to 'C++' programming: Fundamentals, Structure of a C++ program, Compilation and linking processes.

Expressions and Console I/O: Basic Data types, Identifier Names, Variables, Scope, Type qualifiers, Storage class specifier, Constants, Operators, Reading and writing characters, Reading and writing strings, Formatted and console I/O, cin(), cout(), Suppressing input.

Statements: True and False, Selection statements, Iteration statements, Jump statements, Expression statements, Block statements.

Arrays and Strings: Single dimension array, two-dimension array, Strings, Array of strings, Multi-dimension array, Array initialization, Variable length arrays.

Structures, Unions, Enumerations, and Typedef: Structures, Array of structures, passing structures to functions, Structure pointers, Arrays and structures within structures, Unions, Bit-fields, Enumerations, typedef.

Introduction to Object Oriented Programming with C++: Objects and Classes, basic concepts of OOPs (Abstraction, Encapsulation, Inheritance, Polymorphism), Constructors/Destructor, Copy constructor, Dynamic Constructor, Overloading (Function and Operator).

Pointers: Pointer variables, Pointer operators, Pointer expressions, Pointers and arrays, multiple indirection, Pointer initialization, Pointers to arrays, dynamically allocated arrays, Problems with pointers, Pointers and classes, pointer to an object, this pointer.

Functions: General form of a function, understanding scope of a function, Function arguments, Command line arguments, Return statement, Recursion, Function prototype, Pointers to functions, Friend function and class.

Pre-processor and Comments: Pre-processor, #define, #error, #include, Conditional compilation directives, #undef, Single line and multiple line comments.

File I/O: Streams and files, File system basics, fread() and fwrite(), fseek() and random access I/O, fprintf() and fscanf(), Standardstreams.

Laboratory Work:

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

Course Learning Outcomes (CLO):

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

1. write, compile and debug programs in C++language.
2. use different data types, operators and console I/O function in a computerprogram.
3. design programs involving decision control statements, loop control statements and case controlstructures.
4. understand the implementation of arrays, pointers and functions and apply the dynamics of memory by the use ofpoiners.
5. comprehend the concepts of structures and classes: declaration, initialization and implementation.
6. apply basics of object oriented programming, polymorphism andinheritance.
7. use the file operations, character I/O, string I/O, file pointers, pre-processor directives and create/update basic datafiles.

Text Books:

1. *Kanetkar Y., Let Us C++, BPB Publications,2nded.*
2. *Balaguruswamy E., Object Oriented Programming with C++, McGraw Hill,2013.*

Reference Books:

1. *Brian W. Kernighan, Dennis M. Ritchie, The C++ Programming Language, Prentice Hall)*
2. *Schildt H., C++: The Complete Reference, Tata Mcgraw Hill,2003.*

Evaluation Scheme:

Sr.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	40
3.	Sessionals (May include assignments/quizzes)	35

UTA008 ENGINEERING DESIGN - I

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 projectionsystem
3. IsometricProjections
4. AuxiliaryProjections
5. PerspectiveProjections
6. Introduction to MechanicalDrawing
7. Sketching engineeringobjects
8. Sections, dimensions andtolerances

AutoCAD

1. Management of screen menuscommands
2. Introduction to drawing entities
3. Co-ordinate systems: Cartesian, polar and relativecoordinates
4. Drawing limits, units of measurement andscale
5. Layering: organizing and maintaining the integrity ofdrawings
6. Design of prototype drawings astemplates.
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

1. **Micro Projects /Assignments:**
2. Completing the views - Identification and drawing of missing lines in the projectionof objects
3. Missing views – using two views to draw the projection of the object in the thirdview, primarily restricting to Elevation, Plan and Profileviews
4. Projects related to orthographic and isometricprojections

a. Using wax blocks or soap bars to develop three dimensional object from given orthographicprojections
b. Using wax blocks or soap bars to develop three dimensional object, section it and color thesection
c. Use of AUTOCAD as a complementary tool for drawing the projections ofthe objects created in (1) and(2).

5. Develop the lateral surface of different objects involving individual or a combinationof solids like Prism, Cone, Pyramid, Cylinder, Sphere , etc
6. 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 engineeringobjects
2. draw dimensioned orthographic and isometric projections of simple engineeringobjects.
3. interpret the meaning and intent of toleranced dimensions and geometric tolerance symbolism;
4. create the engineering drawings for simple engineering objects usingAutoCAD
5. manage screen menus and commands usingAutoCAD
6. operate data entry modes and define drawings geometrically in terms of Cartesian, polar and relative coordinates inAutoCAD
7. create and edit drawings making selections of objects, discriminating by layering and using entities, object snap modes, editing commands, angles and displacements using 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
3	Sessional: (may include the following) Continuous evaluation of drawing assignments in tutorial/ regular practice of AutoCAD tutorial exercises & Individual independent project work/drawing and AutoCAD assignment	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, Gibbs phase rule, One component and two component systems.

Water Treatment and Analysis: Hardness and alkalinity of water: Units and determination,External and internal method 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 polymers and inorganic polymers.

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

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 conductometrictitrations.
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 ionexchange.
4. concept of phase rule, fuel quality parameters and alternativefuels.
5. polymerization, molecular weight determination and applications as biodegradable and conductingpolymers.
6. laboratory techniques like pH metry, potentiometry, colourimetry, conductometry and volumetry.

Text Books

1. *Ramesh, S. and Vairam S. Engineering Chemistry, Wiley India (2012)1sted.*
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,1sted*
2. *Sivasankar, B., Engineering Chemistry, Tata McGraw-Hill Pub. Co. Ltd, New Delhi(2008).*
3. *Shulz, M.J. Engineering Chemistry, CengageLearnings (2007)1sted.*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	Mid semester test	25
2	End semester test	40
3	Sessional: (May include Quizzes/Assignments/Lab Evaluation)	35

UEC 001: 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, Karnaughmaps.

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 of CRO and Electronic Components, Diodes characteristics Input-Output and Switching characteristics, BJT and MOSFET Characteristics, Zener diode as voltage regulator, Transistorized Series voltage regulator. Half and Full wave Rectifiers with and without filter circuit, Half and full adder circuit implementation, Decoder, DMUX and MUX, Binary/BCD up/down counters.

Course learning outcome (CLO):

The student will be able to:

1. Demonstrate the use of semiconductor diodes in variousapplications.
2. Discuss and Explain the working of transistors and operational Amplifiers, theirconfigurations andapplications.
3. Recognize and apply the number systems and BooleanAlgebra.
4. Reduce Boolean Expressions and implement them with LogicGates.
5. Analyze, design and Implement combinational and sequentialcircuits.
6. Analyze and differentiate logic families, TTL andCMOS.

Text Books:

1. *M. M. Mano and M.D. Ciletti, Digital Design, Pearson, Prentice Hall,2013.*
2. *Milliman, J. and Halkias, C.C., Electronic Devices and Circuits, Tata McGraw Hill,2007.*
3. *Donald D Givone, Digital Principles and Design, McGraw-Hill,2003.*

Reference Books:

1. *John F Wakerly, Digital Design: Principles and Practices, Pearson,(2000).*
2. *N Storey, Electronics: A Systems Approach, Pearson, Prentice Hall,(2009).*
3. *Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason(2009).*

Evaluation Scheme:

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

UES009: MECHANICS

L	T	P	Cr
2	1	2*	2.5

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 bepredicted.

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):

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

1) Determine resultants in plane forcesystems.
2) Identify and quantify all forces associated with a staticframework.
3) Solve problems in kinematic and dynamicsystems.

Text Books

1) *Shames, I. H. Engineering Mechanics: Dynamics, Pearson Education India(2002).*
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(2000).*

Evaluation Scheme

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	30
2.	EST	45
3.	Sessionals (May include Assignments/Projects/Tutorials/Quizzes)	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), 8^{th} ed.*
2. *Jain, R.K. and Iyenger, S.R.K , Advanced Engineering Mathematics, Narosa Publishing House(2011), 11^{th}ed.*

Evaluation Scheme:

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

UTA009: COMPUTER PROGRAMMING – II

L	T	P	Cr
3	0	2	4.0

Course Objective: Understand fundamentals as well as advanced topics of object oriented programming in java. To help students understand fundamentals of programming such as variables, conditional and iterative execution, methods, I/O and thread communication followed by data structure implementation.

Introduction to Java: History and evolution of Java, Java vs other popular languages, Java programming environment, fundamental of Java programming language, primitive data types and variables, floating point types, literals, variables, type conversion and casting, arithmetic operators, bit wise operators, relational, Boolean expressions, statements and blocks, control flow statements selection, iteration and jump statements.

ObjectOrientedProgrammingConceptsinJava: Objectsandclasses,declaringobjects,constructors, this keyword, method overloading and constructor overloading, nestedclasses.

Inheritance and Exception Handling: Defining, applying and implementing interfaces; method overriding, super and final keywords, polymorphism, generics, defining, finding and importing packages, exceptions handling with try, catch, throw, throws and finally keywords, wrapper classes.

I/O and Threads: Binary I/O, file handling, thread model, creating a thread, synchronization, inter thread communication, thread lifecycle.

DataStructuresinJava: Arrays,theuseofclassestoencapsulatedatastoragestructuresandtheclass interface.Searching,insertion,anddeletioninarraysandorderedarrays.Linearsearchingandbinary searching. Simple Sorting: the bubble sort, selection sort, and insertion sort. Stacks and Queues: the stack, queue, and priority queue. Linked Lists: linked lists, including doubly linked lists and double- ended lists. Recursion: Towers of Hanoi puzzle and the mergesort.

Laboratory Work:

Main focus is on implementing basic concepts of object oriented programming and to enhance programming skills to solve specific problems.

Course Learning Outcomes (CLO):

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

1. comprehend the concepts of Object Oriented Computing inJava.
2. implement decision statements and loopingstatements.
3. grasp the concepts of input and output handling from console andfiles.
4. develop applications to demonstrate use of datastructures.

Text Books:

1. Deitel H. and Deitel P., JAVA - How to Program, Pearson Education(2003).
2. Hortsmann CS., Cornell G., Core Java Volume I-Fundamentals, Prentice Hall,(2012).
3. Data Structures & Algorithms in Java. RobertLafore.

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weight age (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include assignments/quizzes)	40

UTA010: ENGINEERING DESIGN-II

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 optimize 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 redesign with reflection, prototype competition, Final Presentation and viva-voce	30 30 10 30

SEMESTER – III

UEI403: ELECTRICAL AND ELECTRONIC MEASUREMENTS

L	T	P	Cr
3	1	2	4.5

Course Objectives: To understand concepts of various electrical and electronic measuring instruments.

Electrical Standards: Standards of e.m.f. and resistance, Frequency dependence of resistance, Inductance and Capacitance, Time and frequency standards.

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, Power in poly phase system: two wattmeter method, Single-phase induction and Electronic energy meters.

Instrument Transformers: Current and Voltage transformers, Constructional features, Ratio and Phase angle errors.

Magnetic Measurements: Determination of B-H curve and hysteresis loop, Measurement of iron losses with Llyod Fisher square.

Bridge Measurements: AC bridges: Applications and conditions for balance, Maxwell's bridge, Hay's bridge, Schering bridge, Wien's bridge, De Sauty's bridge, Insulation testing, Ground resistance measurement, Varley and Murray loop test.

Electronic Instruments: Electronic multimeter, Digital voltmeters, General characteristics ramp type voltmeter, Quantization error, Digital frequency meter/Timer, Q meter and its applications, Distortion meter, Wavemeter and Spectrum Analyzer, Block diagram and Applications of oscilloscopes, Storage type digital oscilloscopes.

Laboratory Work:

Experiments around sensitivity of wheat stone bridge, Comparison of various types of indicating instruments, Single□phase induction type energy meter, AC bridges, Measurement of iron losses with Llyod Fisher square, Storage type digital oscilloscopes.

Project: Development of power supplies using transformers.

Course Learning Outcomes (CLO):

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

1. compare various electromechanical indicating instruments,
2. measure power and energy
3. design various AC bridges
4. analyze various waveform with the help of storage oscilloscope

Text Book:

1. Golding, E.W., and Widdis, F.C., Electrical Measurements and Measuring Instruments, Pitman (2003).

2. Helfrick, A.D., and Cooper, W.D., Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India (2007).

Reference Books:

1. Kalsi, H.S., Electronic Instrumentation, Tata McGraw□Hill (2007).

2. Nakra, B.C., Chaudhry, K.K., Instrumentation Measurement and Analysis, Tata McGraw□Hill (2003).

Evaluation Scheme:

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

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 strains that 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 of beams; axial, shear force and bending moment diagrams: simply supported, overhang and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment, equation of condition, load function equation,

Bending & Shear Stresses in beams: Derivation of flexural formula for straight beams, concept of 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 plane strain, Mohr's stress circle, relation between elastic constants, strain measurements, strain rosettes.

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

Laboratory Work: The following experiments will be performed in the lab:

1. Calculation of tensile strength
2. 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.
3. Torsion: Study the behavior of circular shafts under torsion and analysis of failure and indirect evaluation of the modulus of rigidity.

Experimental project assignment: Students in groups of 4/5 will do a project covering any of the following topics:

1. Tensile strength of bars
2. Flexural strength of beams
3. Torsion of shafts

Course Learning Outcomes (CLO):

After completion of this course, thestudents 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

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

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 Ccompletion 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

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

1. analyze various machining processes and calculate relevant quantities such as velocities, forces, powers etc.;

2. suggest appropriate process parameters and tool materials for a range of different operations and workpiece materials;
3. understand the basic mechanics of the chip formation process and how these are related to surface finish and process parameters;
4. recognize cutting tool wear and identify possible causes and solutions;
5. develop simple CNC code, and use it to produce components while working in groups.
6. perform calculations of the more common bulk and sheet forming, casting and welding processes and given a particular component.
7. select the most appropriate manufacturing process to achieve product quality through the efficient use of materials, energy and process.

Text Books:

1. *Degarmo, E. P., Kohser, R. A. and Black, J. T., Materials and Processes in Manufacturing, Prentice Hall of India (2002).*
2. *Kalpakjian, S. and Schmid, S. R., Manufacturing Processes for Engineering Materials, Pearson Education Asia (2000).*

Reference Books:

1. *Chapman, W. A. J., Workshop Technology, Vol.1 & II, Arnold Publishers (2001).*
2. *Zimmer E. W. and Groover, M. P., Computer Aided Designing and Manufacturing, Prentice Hall of India (2008).*
3. *Pandey, P. C. and Shan, H. S., Modern Machining Processes, Tata McGraw Hill (2004).*
4. *Mishra, P. K., Non-Conventional Machining, Narosa Publications (2006).*
5. *Campbell, J. S., Principles of Manufacturing, Materials and Processes, Tata McGraw Hill Company (1995).*
6. *Lindberg, A. R., Process and Materials of Manufacture, Prentice Hall of India (1998).*

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

UTA019:ENGINEERING DESIGN- III (10 SELF EFFORT HOURS)

L	T	P	Cr
1	0	4	6.0

Course Objective: Understanding of Arduino microcontroller architecture and programming, Interfacing of Arduino board with various I/O devices. Serial data transmission using Arduino board.Learning of ARM processor Instruction set and programming concepts.

Arduino Microcontroller:

Features of Ardunio Microcontroller, Architecture of Arduino, Different boards of Arduino, Arduino Interfacing and Applications, Anatomy of an Interactive Device like Sensors and Actuators, A to D converters and their comparison, Blinking an LED, LCD Display, Driving a DC and stepper motor, Temperature sensors, Serial Communications, Sending Debug Information from Arduino to Your Computer, Sending Formatted Text and Numeric Data from Arduino, Receiving Serial Data in Arduino, Sending Multiple Text Fields from Arduino in a Single Message, Receiving Multiple Text Fields in a Single Message in Arduino. Light controlling with PWM.

Introduction to ARM processor: Features of ARM processor, ARM Architecture, Instruction set, ARM Programming

Programming of Arduino: The Code designing step by step. Taking a Variety of Actions Based on a Single Variable, Comparing Character and Numeric Values, Comparing Strings, Performing Logical Comparisons, Performing Bitwise Operations, Combining Operations and Assignment, Using Embedded techniques to program Arduino microcontroller, Understanding the libraries of Arduino programming language and applying for circuit design

TASK 1:

1. Introduction to Uno board and interfacing of Uno board with PC and Interfacing of LED and I/O ports of Uno board.
2. Interfacing of DC motor with Uno Board, speed and direction control of motors and interfacing of keyboard with Arduino.
3. Interfacing of IR Sensor and Ultrasonic sensor with Arduino board on inclined surface.
4. Interfacing of Gyro sensor, Accelerometer Sensor and Ultrasonic sensor with Arduino board on inclined surface.
5. Control of buggy through Zig-bee transmission and reception using PC.

TASKS 2:

1. To make buggy move in circular defined patron at given speed and radius without any sensors through programming only.
2. To make buggy intelligent to sense path and follow that path using IR sensor.

3. The buggy should able to sense Obstacles in the path and should stop without colliding with the obstacle and able to follow different path by bypassing the obstacle.
4. To make buggy climb an inclined path with given speed using accelerometer and gyro sensor and come down on the same inclined surface with given speed.
5. Make the buggy's five in number to move front, back, right and left together by taking command from PC through Zig-bee sensor.

Course Learning Outcomes (CLO):

The student should be able to:

1. Apply the engineering process of problem solving.
2. Clearly demonstrate group working, including task sub-division and integration of individual contributions from the team.
3. Develop practical experimental skills in electronic circuit testing.
4. Develop practical experimental skills in software system testing.
5. Recognize issues to be addressed in a combined hardware and software system design.
6. Implement project tracking and code version control.

Text Books:

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

Reference Book:

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

SEMESTER – IV

UEI303: TECHNIQUES ON SIGNALS AND SYSTEMS

L	T	P	Cr
3	1	0	3.5

Course Objectives: To introduce the basic concepts and processing of analog and digital signals.

Introduction: Signals and Systems, Classification of signals, Continuous time signals and its classifications, Standard continuous time signals, Classification of continuous time systems, Discrete time signals and its classifications, Concept of frequency in discrete time signals, Standard discrete time signals, Discrete time systems, Classification of discrete time systems, Nyquist rate, Sampling theorem, Aliasing, Convolution, Correlation.

Fourier Transform: Introduction, Condition for existence of Fourier Integral, Fourier Transform and its properties, Energy density and Power Spectral Density, Nyquist Theorem, System Analysis using Fourier Transform.

Z□Transform: Introduction, Region of Convergence(ROC), Properties of z□transform. Initial yvalue theorem, Final Value theorem, 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.

Random Signals: Introduction, Probability, Random variables, Gaussian distribution, Transformation of random variables, random processes, stationary processes, Correlation and Covariance Functions.

Course Learning Outcomes (CLO):

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

1. Apply sampling theorem for different applications
2. Solve problems related to Fourier transforms
3. Apply Fourier transforms for different applications
4. Apply z-transform and Laplace transform for system characterization
5. Elucidate the concepts of random signals

Text Books:

1. *Oppenheim, A.V. and Willsky, A.S., Signals and Systems, Prentice Hall of India (1997).*
2. *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall (2007).*

Reference Books:

1. *Lathi, B.P., Signal Processing and Linear System, Oxford University Press (2008).*
2. *Roberts, M.J., Fundamentals of Signals and Systems, McGraw Hill (2007).*

Evaluation Scheme:

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

UEI304: SENSORS AND SIGNAL CONDITIONING (WITH PROJECT)

L	T	P	Cr
3	1	2	8

Course Objectives: To introduce the basics of measurements. To elucidate sensors and signal conditioning circuits. To introduce different error analysis methods. To familiarize with different sensors and transducers. To explain signal conditioning circuits.

Introduction: Definition, Application and types of measurements, Instrument classification, Functional elements of an instrument, Input-output configuration of measuring instruments, Methods of correction for interfering and modifying inputs, Standards, Calibration, Introduction to Static characteristics and Dynamic characteristics, Selection of instruments, Loading effects.
Error Analysis: Types of errors, Methods of error analysis, Uncertainty analysis, Statistical analysis, Gaussian error distribution, Chi-Square test, Correlation coefficient, Student's t-test, Method of least square, Curve fitting, Graphical analysis, General consideration in data analysis, Design of Experiment planning.
Sensors/Transducers: Definition, Types, Basic principle and applications of Resistive, Inductive, Capacitive, Piezoelectric and their Dynamic performance. Fiber optic sensors, Bio-chemical sensors, Hall-Effect, Photoemissive, Photo Diode/ Photo Transistor, Photovoltaic, LVDT, Strain Gauge Digital transducers: Principle, Construction, Encoders, Absolute and incremental encoders, Silicon micro transducers.
Signal Conditioning: Operational Amplifiers: application in instrumentation, Charge amplifier, Carrier amplifier, Introduction to active filters, Classification, Butterworth, Chebyshev, Couir filters, First order, Second order and higher order filters, Voltage to frequency and frequency to voltage converters.
Laboratory Work: Measurement of Linear Displacement, Angular displacement, Temperature, Light intensity, Capacitance, Resistance, Inductance.
Project: Projects based upon sensors and signal conditioning i.e. temperature measuring system, Pressure Measuring system, Level measuring system etc.

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

1. Apply different methods for the measurement of length and angle
2. Elucidate the construction and working of various industrial parameters / devices used to measure pressure, sound and flow
3. Explicate the construction and working of various industrial parameters / devices used to measure temperature, level, vibration, viscosity and humidity
4. Ability to analyse, formulate and select suitable sensor for the given industrial applications
5. Describe signal conditioning circuits

Text Books:

1. *Doebelin, E.O. and Manic, D.N., Measurement Systems: Applications and Design, McGraw□Hill (2004).*
2. *Sawhney, A.K. and Sawhney, P., A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai (2008).*

Reference Books:

1. *Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India (2003).*
2. *Nakra, B.C. and Chaudhry, K.K., Instrumentation, Measurement and Analysis, Tata McGraw Hill (2003).*

Evaluation Scheme:

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

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 andenvironment.

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

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

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 naturalresources

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

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 solidwaste 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. Correlate major local and regional environmental issues with changes in ecology and human health
2. Monitor and document the development and dynamics of ecosystems in experimental or naturalmicrocosms

3. Define and document local resource consumption patterns and conservationstrategies
4. Define opportunities available for energy conservation and for use of renewable energy resources in local and regionalentities.

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) 9^{th}ed.*
3. *O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd.(1993).*

Evaluation Scheme:

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

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, Engineering stress and engineering strain relationship, True stress - true strain relationship, review of mechanical properties, 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, Unary and binary eutecticphase diagram, 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.

Corrosion process: Corrosion, Cause of corrosion, Types of corrosion, Protection against corrosion.

Materials selection: Overview of properties of engineering materials, Selection of materials for different engineering applications.

Laboratory Work and Micro-Project:

Note: The micro-project will be assigned to the group(s) of students at the beginning of the semester. Based on the topic of the project the student will perform any of the six experiments from the following list:

1. To determine Curie temperature of a ferrite sample and to study temperature dependence of permeability in the vicinity of Curie temperature.
2. To study cooling curve of a binary alloy.
3. Determination of the elastic modulus and ultimate strength of a given fiber strand.
4. To determine the dielectric constant of a PCB laminate.

5. Detection of flaws using ultrasonic flaw detector (UFD).
6. To determine fiber and void fraction of a glass fiber reinforced composite specimen.
7. To investigate creep of a given wire at room temperature.
8. To estimate the Hall coefficient, carrier concentration and mobility in a semiconductorcrystal.
9. To estimate the band-gap energy of a semiconductor using four probe technique.
10. To measure grain size and study the effect of grain size on hardness of the given metallic specimens.

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.
3. K. G. Budinski, Engineering Materials – Properties and selection, Prentince Hall India, 1996

Evaluation Scheme

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	35
3.	Sessionals (May include Assignments/Projects/Tutorials/Quiz/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 behavior. The course is designed to help the students to understand the basic principles underlying economic behavior, 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. Differentperspectives in Psychology.

Perception and Learning: Determinants of perception, Learning theories, BehaviorModification.

Motivational and Affective basis of Behavior: 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 : Experiments on learning and behavior modification.

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

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 fortaking 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).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. *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 *SaleemShaikh. 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).*

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: 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, McGraw-Hill Higher Education; 7 edition (1 March 2014)

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	Weight age (%)
1.	MST	25
2.	EST	40
3.	Sessionals (May include assignments/quizzes)	15
4.	Laboratory Evaluation	20

SEMESTER – V

UEE503: NETWORK ANALYSIS AND SYNTHESIS

L	T	P	Cr
3	1	0	3.5

Course Objective: To make the students understand concepts of graph theory, two port networks, 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 topological equation 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, Elements of circuit synthesis, Foster and cauer forms of LC Networks, Synthesis of RC and RL networks.

Course Learning Outcomes (CLO):

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

1. understanding the various laws and theorems related to electric networks.
2. understanding the concept of two port networks.
3. familiarisation with network synthesis.

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. *Sudhakar, A., Circuits and Networks, Tata McGraw–Hill (2006).*
4. *Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education, (2009).*

Evaluation Scheme:

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

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:

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

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

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.
5. design the various kinds of compensator.
6. 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

UEI601: INDUSTRIAL INSTRUMENTATION

L	T	P	Cr
3	1	2	4.5

Course objectives: To provide the knowledge of Pressure, Sound, Flow, Temperature, Level,Humidity, Torque, Viscosity and Vibration measurements.

Metrology (Measurement of Length, Angle and Area): Dimensional measurement, Dial gauges, Gauge blocks, Comparators, Flatness measurement, Optical flats, Sine bar, Angle gauges, Planimeter.

Motion and Vibration Measurement: Translational and rotational displacement using potentiometers, Strain gauges, Differential transformer, Different types of tachometers, Accelerometers

Pressure Measurement: Moderate pressure measurement, Bourdon tube, Bellows and diaphragms, High pressure measurement: Piezoelectric, Electric resistance, Low pressure measurement: Mcleod gauge, Knudsen Gauge, Viscosity gauge, Thermal conductivity, Ionization gauge, Dead weight gauges.

Flow Measurement: Obstruction meter, Orifice, Nozzle, Venturi, Pitot tube, Rotameter, Turbine, Electromagnetic, Vortex, Positive displacement, Anemometers, Weirs and flumes, Laser Doppler anemometer, Ultrasonic flow meter, Mass flow meter.

Temperature Measurement: Bimetallic thermometers, Liquid-in-glass, Pressure thermometer, Semiconductor sensors, Digital thermometers, Pyrometers.

Level Measurement: Visual level indicators, Purge method, Buoyancy method, Resistance, Capacitance and inductive probes, Ultrasonic, Laser, Optical fiber, Thermal, Radar, Radiation.

Miscellaneous Measurements: Humidity, Dew point, Viscosity, nuclear radiation measurements.

Laboratory work: Experiments around Measurement of Length, Angle, Pressure, Temperature, Flow, Level, Humidity, Vibration using different techniques.

Course Learning Outcomes (CLO):

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

1. illustrate the different methods for the measurement of length and angle
2. elucidate the construction and working of various industrial devices used to measure pressure, sound and flow
3. explicate the construction and working of various industrial devices used to measure temperature, level, vibration, viscosity and humidity
4. ability to analyze, formulate and select suitable sensor for the given industrial applications

Text Books:

1. *Doeblin, E.O., Measurement systems, Applications and Design, McGraw–Hill (1982).*
2. *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. *Sawhney, A.K., A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Co. (P) Ltd. (2007).*

Evaluation Scheme:

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

UEI609: FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	Cr
3	1	2	4.5

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

INTEL 8086 Microprocessor: Pin Functions, Architecture, Characteristics and Basic Features of Family, Segmented Memory, Addressing Modes, Instruction Set, Data Transfer Instructions, Arithmetic, Logical, Shift and Rotate Instructions, String Instructions, Flag Control Instructions, Transfer of Control Instructions, Processor Control Instructions, Programming Examples, Interrupt Structures, Multitasking and Multiprogramming, MIN/MAX Modes of 8086,Co-processors 8087 and 8089.

Introduction to 8051 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.

Laboratory work: Introduction to INTEL kit, Programming examples of 8086, Interfacing using 8086 kits,ADC, DAC, 8253, Microprocessor based project, Programming and Application development around 8051, 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. demonstrate the concept of microprocessor and to be able to design a microprocessor based system to get desired results.
2. use 8086 microprocessor in advanced applications, which will give them a good platform to work further.
3. graduates will be able to update with current trends through self-study and show genuine need to learn on continuous basis.
4. students will be able to use hardware interfacing of 8051 to develop solutions of real world electrical problems.

Text Books:

1. *Hall, D.V., Microprocessor- Interfacing Programming and Hardware, Tata McGraw–Hill (1997).*
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. *Liu, Y. C. and Gibson, G.A., Microcomputer Systems: The 8086/8088 Family–Architecture, Programming and Design, Prentice–Hall of India Private Limited (2007).*
3. *Uffenbeck, J., The 8086/ 8088 Family, Prentice–Hall of India Private Limited (1994).*
4. *Predko, M., Customizing The 8051 Microcontroller, Tata McGraw–Hill (2002).*

Evaluation Scheme:

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

UTA012: INNOVATION AND ENTREPRENEURSHIP

L	T	P	Cr
1	0	2*	4.5

[*] 2 hours every alternate week.
6– Self Effort Hours.

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, BusinessPitching.
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 outcome (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. *S. Carter and D. Jones-Evans, Enterprise and small business- Principal Practice and Policy, Pearson Education (2006)*

Reference Books:

1. *T. H. Byers, R. C. Dorf, A. Nelson, Technology Ventures: From Idea to Enterprise, McGraw Hill (2013)*
2. *Osterwalder, Alex and Pigneur, Yves (2010) Business Model Generation.*
3. *Kachru, Upendra, India Land of a Billion Entrepreneurs, Pearson*
4. *Bagchi, Subroto, (2008), Go Kiss the World: Life Lessons For the Young Professional, Portfolio Penguin*
5. *Bagchi, Subroto, (2012). MBA At 16: A Teenager's Guide to Business, Penguin Books*
6. *Bansal, Rashmi, Stay Hungry Stay Foolish, CIIE, IIM Ahmedabad*
7. *Bansal, Rashmi, (2013). Follow Every Rainbow, Westland.*
8. *Mitra, Sramana (2008), Entrepreneur Journeys (Volume 1), Booksurge Publishing*
9. *Abrams, R. (2006). Six-week Start-up, Prentice-Hall of India.*
10. *Verstraete, T. and Laffitte, E.J. (2011). A Business Model of Entrepreneurship, Edward Elgar Publishing.*
11. *Johnson, Steven (2011). Where Good Ideas comes from, Penguin Books Limited.*
12. *Gabor, Michael E. (2013), Awakening the Entrepreneur Within, Primento.*
13. *Guillebeau, Chris (2012), The $100 startup: Fire your Boss, Do what you love and work better to live more, Pan Macmillan*
14. *Kelley, Tom (2011),The ten faces of innovation, Currency Doubleday*
15. *Prasad, Rohit (2013), Start-up sutra: what the angels won't tell you about business and life, Hachette India.*

SEMESTER – VI

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 Mc murray 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, Methods of turning on of an SCR through gate triggering, DC -DC chopper, Solid state fan regulator, Semi converter and Full converter with R and RL type of loads, DC shunt motor speed control, Single phase AC voltage controller with R load, Simulation of all converters using software CASPOC

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. Demonstrate capability to analyse various converter configuration / topology.
4. Identify converter configurations for various power applications such as electric drives, HVDC and FACTS.
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:

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

UEI605: PROCESS DYNAMICS AND CONTROL

L	T	P	Cr
3	0	2	4.0

Course objective: To make the students understand basic ideas, challenges, techniques, and applications of process control for controlling various processes.

Introduction: Historical perspective, Incentives of process control, Synthesis of control system. Classification and definition of process variables.

Mathematical Modeling: Need and application of mathematical modeling, Lumped and distributed parameters, Analogies, Thermal, Electrical and chemical systems, Modeling of CSTR, Modeling of heat exchanger, Interacting and non-interacting type of systems, Dead time elements

Control Modes: Definition, Characteristics and comparison of on-off, Proportional (P), Integral (I), Differential (D), PI, PD, PID, Dynamic behavior of feedback controlled processes for different control modes ,Control system quality, IAE, ISE, IATE criterion, Tuning of controllers Ziegler-Nichols, Cohen-Coon methods

Realization of Control Modes: Realization of different control modes like P, I, D, In Electric, Pneumatic, Hydraulic controllers.

Actuators: Hydraulic, Pneumatic actuators, Solenoid, E-P converters, Control valves, Types, Functions, Quick opening, Linear and equal percentage valve, Ball valves, Butterfly valves, Globe valves, Pinch valves, Valve application and selection

Advanced Controls: Introduction to advanced control schemes like Cascade, Feed forward, Ratio, Selective, Override, Split range and Auctioneering control

Laboratory Work: I to P, P to I, Valve characteristics, Simulation of different control modes, Experiments around Basic Process RIG.

Course Learning Outcomes (CLO):

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

1. demonstrate fundamental understanding of process control.
2. develop the mathematical model of various chemical processes.
3. explain different control modes and their application in controlling various processes.
4. explain the working of electric, hydraulic and pneumatic controllers.
5. demonstrate the working and application of different type of actuators and control valves

Text Books:

1. *Johnson, C.D., Process Control Instrumentation Technology, Prentice–Hall of India Private Limited (1992).*
2. *Stephanopoulos, G., Chemical Process Control, Prentice–Hall of India Private Limited (1983).*

Reference Books:

1. *Harriot, P., Process Control, Tata McGraw–Hill (1982).*
2. *Liptak, B.G., Instrument Engineers Handbook, Butterworth, Heinemann (2002).*
3. *Seborg, D.E. and Edgar, T., Process Dynamics and Control, John Wiley and Sons (1989).*

Evaluation Scheme:

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

UEI607: DIGITAL SIGNAL PROCESSING AND APPLICATIONS

L	T	P	Cr
3	1	2	4.5

Course Objective: To understand the basic concepts and techniques for digital signal processing, familiarization with DSP concepts by studying the design of different digital filters and transform-domain processing.

Introduction: Review of Discrete Time Signals and Systems and z-Transforms, Solution of Difference Equations Using One-sided z-Transform, Frequency domain Characteristics of LTI Systems, LTI Systems as Frequency-Selective Filters.

Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT): Discrete Fourier Transform and its Properties, Divide and Conquer Approach, Decimation in Time and Decimation in Frequency FFT Algorithms.

Digital Filter Structure: Describing Equation of digital filter, Structures for FIR Systems: Direct Form Structure, Cascade Form Structure, Structure for IIR Systems: Direct Form Structures, Cascade Form Structure, Parallel Form Structure and Lattice Structure.

Design of Digital Filters: Causality and its Implications, Difference between analog filters and digital filters, FIR filter design using windows, Design of IIR filters from analog filters using: Approximation of Derivatives, Impulse Invariance and Bilinear Transformation, Frequency transformations.

Analysis of Finite Word length Effects: Introduction, The quantization process and errors, Analysis of coefficient quantization effects in FIR filters, A/D noise analysis, Analysis of arithmetic round off errors, Limit cycles in IIR filters,

Laboratory work: Convolution and correlation, Solution of difference equations using z-Transform and Fourier tools, FFT and spectrum analysis, design of high pass, low pass, band pass and band stop FIR filter using window method, design of IIR filter using Matched Z Transform (MZT), Bilinear Z Transform (BZT), Pole Zero Placement and Impulse Invariant methods.

Course Learning Outcomes (CLO):

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

1. Analyze the signals in time and frequency domain
2. Apply the transformation tools on signals and systems and analyze their significance and applications.
3. design the structures of different types of digital filters
4. design various digital filters and analyze their frequency response
5. Analyse finite word length effects.

Text Books

1. *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing, Prentice Hall of India Private Limited (2006).*
2. *Rabiner, C.R. and Gold, B., Theory and Applications of Digital Signal Processing,Prentice Hall of India Private Limited (2000).*

Reference Books:

1. *Antonion, A., Digital Filters: Analysis Design and Application, Prentice Hall of India Private Limited (1999).*
2. *Oppenhein, A.V. and Schafer, R.W., Digital Signal Processing, Prentice Hall of India Private Limited (1998).*

Evaluation Scheme:

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

UEI608: BIO-MEDICAL INSTRUMENTATION

L	T	P	Cr
3	0	2	4.0

Course Objectives: The objective of this course is to introduce student to basic biomedical engineering technology and introduce different biological signals, their acquisition, measurements and related constraints.

Introduction of Bio-medical Instrumentation, Sources of Bioelectric Potentials and Electrodes: Introduction to man-instrument system, components of the man-instrument system, Physiological system of the body, Problems encountered in measuring a living system. Resting and action potentials, Propagation of action potentials, Bioelectric potentials, Biopotential electrodes, Biochemical transducers. Review of transducers

Cardiovascular System and Measurements: The heart and cardiovascular system, ECG, blood pressure and its measurement, respiration and pulse rate, characteristics and measurement of blood flow meter, cardiac output, phethysmography, pacemaker, defibrillators, heart sounds and its measurement,

Respiratory and Neuro-muscular System: The physiology of the respiratory system, test and instrument for the mechanics of breathing, the somatic nervous system, EEG, EMG and GSR.

Measurement and Recording of Noninvasive Diagnostic Instrumentation, Patient Care and Electrical Safety: Principle of ultrasonic measurement, ultrasonic, thermography, elements of intensive care monitoring,X-ray, CT – Scan and MRI, tonometer, dialysis**,** diathermy,Shock hazards from electrical equipment.

Laboratory work: Study the variance in pulse rate of subject in a batch, use Spiro meter on the subject, auditory system checkup using Audiometer, Measurement of Heart Rate using Stethoscope, Blood pressure using Sphygmomanometer, Pulse Rate and SpO_2 using Pulse Oximeter, Skin Conductance and Skin Potential using Galvanic Skin Response Module, Pulse Rate using Polyrite machine, Respiration Rate using Polyrite. Electromygram test using EMG biofeedback Trainer.

Course Learning Outcomes (CLO):

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

1. differentiate and analyse the biomedical signal sources.
2. elucidate cardiovascular system and related measurements.
3. explain the respiratory and nervous systems and related measurements
4. measure non-invasive diagnostic parameters.

.

Text Books:

1. *Cromwell, L. and Weibell, F.J. and Pfeiffer, E.A., Biomedical Instrumentation and Measurement, Dorling Kingsley (2006) 2nd ed.*
2. *Carr, J.J. and Brown, J.M., Introduction to Biomedical Equipment Technology, Prentice Hall (2000) 4th ed.*

Reference Books:

1. *Geddes, L.A., and Baker, L.E., Principles of Applied Biomedical Instrumentation, Wiley InterScience (1989) 3rd ed.*
2. *Khandpur, R.S., Handbook of Biomedical Instrumentation, McGraw Hill (2003) 2nd ed.*
3. *Webster, J.G., Medical Instrumentation Application and Design, John Wiley (2007) 3rd ed.*

Evaluation Scheme:

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

UEI693/793:CAPSTONE PROJECT

	L	T	P	Cr
UEI693: Semester VI (starts)	**0**	**0**	**2**	**--**
UEI793: Semester VII (Completion)	**0**	**0**	**2**	**8.0**

Course Objective: To facilitate the students learn and apply an engineering design process in instrumentation 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 whicheach 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 analyze possible approaches to meet given specifications with realistic engineering constraints.
2. To design an instrumentation 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.

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 behavior by phase plane and describing function methods and the
2. perform the stability analysis nonlinear systems by Lyapunovmethoddevelop 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 analyze 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

SEMESTER – VII

UEE606: ELECTRICAL MACHINES AND DRIVES

L	T	P	Cr
3	1	2	4.5

Course Objectives: In this course fundamental electromechanical, power electronic, and control theory in the context of electric drive systems will be covered. The capabilities and limitations of different types of electric machines in various drive applications will also be addressed.

Fundmentals of electromechanical devices:flux linkage/current relationships, concept of energy and co-energy, calculation of forces and torques.
Power Electronic Converters: voltage control using uncontrolled switches, controlled rectification, inversion, voltage controllers, converter waveforms, acoustic noise and cooling
Control Theory: Importance of Feedback control, requirement of feedback loops in drive applications, current-limit control, speed, torque and position control for electric drives, concept of PLL in speed control application.
DC Motor Drives: EMF and torque production of DC motor, dc motor types, transient and steady-state characteristics, four quadrant operation, thyristor and chopper fed dc motor drives.
Induction Motor Drives:concept of rotating magnetic field and torque production, motor types, torque-speed and torque-slip characteristics, methods of starting of squirrel cage motors, generating and braking modes, speed control using stator voltage control, variable frequency operation, rotor resistance control and slip power recovery schemes.
Motor/Drive Selection:power ratings and capabilities, drive characteristics, load requirements and general application considerations.
Laboratory work: The lab will consist of giving the students hands-on experience with electric machines (AC and DC), power electronic circuitry, and control algorithms for electric drives.

Course Learning Outcomes (CLO):

On successful completion of this course, the student should be able to:

1. Analyse the various forces and torques in electromechanical devices
2. explain the working of power electronic converters and inverters
3. elucidate the concepts of feedback control theory
4. analyze and compare the performance of DC and AC machines in various drive applications
5. design controllers for electric drives which achieve the regulation of torque, speed, or position in the above machines.

Text Books:

1. *Dubey, G.K., Fundamentals of Electric Drives, Narosa Publications (2001).*
2. *Mohan, N., Electric Drives: An Integrative Approach. MNPERE, (2001).*
3. *Krishnan, R., Electric Motor Drives: Modeling, Analysis, and Control. Prentice Hall, (2001).*

Reference Books:

1. *Hughes, A. and Drury, B., Electric Motors and Drives: Fundamentals, Types and Applications, Newnes,4th Ed., (2014).*
2. *Sharkawi, Mohammed.A.El, Fundamentals of Electric Drives, PWS-Brooks/Cole Pub. Company, (2000).*

Evaluation Scheme:

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

UEI701: DATA ACQUISITION AND SYSTEM DESIGN

L	T	P	Cr
3	0	2	4.0

Course Objectives: To understand concepts of acquiring the data from transducers/input devices, their interfacing and instrumentation system design.

Data Acquisition Techniques: Analog and digital data acquisition, Sensor/Transducer interfacing, unipolar and bipolar transducers, Sample and hold circuits, Interference, Grounding and Shielding.

Data Acquisition with Op-Amps: Operational Amplifiers, CMRR, Slew Rate, Gain, Bandwidth. Zero crossing detector, Peak detector, Window detector. Difference Amplifier, Instrumentation Amplifier AD 620, Interfacing of IA with sensors and transducer, Basic Bridge amplifier and its use with strain gauge and temperature sensors, Filters in instrumentation circuits

Data Transfer Techniques: Serial data transmission methods and standards RS 232-C: specifications connection and timing, 4-20 mA current loop, GPIB/IEEE-488, LAN, Universal serial bus, HART protocol, Foundation-Fieldbus, ModBus, Zigbee and Bluetooth.

Data Acquisition System (DAS): Single channel and multichannel, Graphical Interface (GUI) Software for DAS, RTUs, PC-Based data acquisition system.

Laboratory Work: Op-amp as a comparator and its application, Integrator and differentiator, Active filters, Simulation of the above applications using ORCAD, Instrumentation Amplifier/AD 620, Interfacing of sensors and transducers using DAQ cards.

Course Learning Outcomes (CLO):

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

1. elucidate the elements of data acquisition techniques.
2. design and simulate signal conditioning circuits.
3. explain various data transfer techniques
4. understand the components of data acquisition system

Text Books:

1. *Coughlin, R.F., Operational Amplifiers and Linear Integrated Circuits, Pearson Education (2006).*
2. *Kalsi, H.S., Electronic Instrumentation, Tata McGraw Hill (2002).*
3. *Gayakwad, R.A., Op-Amp and Linear Integrated Circuits, Pearson Education (2002).*
4. *Mathivanan, N., Microprocessor PC Hardware and Interfacing, Prentice Hall of India Private Limited (2007).*

Reference Books:

1. *Ananad, M.M.S., Electronic Instruments and Instrumentation Technology, Prentice Hall of India Private Limited (2004).*
2. *Murthy, D.V.S., Transducers and Instrumentation, Prentice Hall of India Private Limited (2006).*

Evaluation Scheme:

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

UE693/793: CAPSTONE PROJECT

	L	T	P	Cr
UEI693: Semester VI (starts)	0	0	2	--
UEI793: Semester VII (Completion)	0	0	2	8.0

Course Objective: To facilitate the students learn and apply an engineering design process in instrumentation 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 whicheach 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 analyze possible approaches to meet given specifications with realistic engineering constraints.
2. To design an instrumentation 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.

UEI801: ADVANCED PROCESS CONTROL

L	T	P	Cr.
3	1	2	4.5

Course Objectives: To make the students understand the basic concepts of advanced process control schemes, DCS, Artificial intelligence techniques used in Process Control, PLC and digital control system.

Introduction to advanced Control Schemes: Cascade, Feed-forward, Feed-forward plus Feedback, Ratio control, Inferential control, Dead time and Inverse response compensation, Adaptive control, Model reference adaptive control, Self tuning regulator Interactions and Decoupling of Control Loops: Design of cross controllers and selection of loops using Relative Gain Array

Distributed Control System (DCS): Evolution and advantages of computer control, Configuration of Supervisory, Direct digital control (DDC) and DCS.

Artificial Intelligence in Process Control: Expert systems, Neural networks, Fuzzy logic, Neuro Fuzzy , Genetic algorithm, Virtual instrumentation.

Programmable Logic Controllers: Comparison with hard wired relay and semiconductor logic, Hardware, Ladder diagram programming, Case studies, Introduction to CPLD, SPLD, FPGA

Digital Control: Sampling and reconstruction, Discrete systems analysis, Stability and controller design using z transform and difference equations, Smoothing filter realization using difference equations

Course Learning Outcomes (CLO):

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

1. explain the concept of advanced control schemes used in process control.
2. explain the working of distributed control system
3. elaborate the use of artificial intelligence techniques in process control.
4. explain the fundamental concepts of PLC.
5. explain the concept of digital control system.

Text Books:

1. *Stephanopoulos, G., Chemical Process Control, Prentice–Hall of India Private Limited (1983).*
2. *Liptak, B.G., Instrument Engineers Handbook , Chilton Book Company (1994).*

Reference Books:

1. *Deb, S.R., Robotics Technology and Flexible Automation, Tata McGraw–Hill (1994).*
2. *Johnson, C.D., Process Control Instrumentation Technology, Prentice–Hall of India Private Limited (2007).*

3. *Zaidi, A., SPC Concepts, Methodologies and Tools, Prentice–Hall of India Private Limited (1995).*

Evaluation Scheme:

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

UEI844: VIRTUAL INSTRUMENTATION

L	T	P	Cr.
2	0	3	3.5

Course Objective: The objective of this course is to introduce the concept of virtual instrumentation and to develop basic VI programs using loops, case structures etc. including its applications in image, signal processing and motion control.

Review of Virtual Instrumentation: Historical perspective, Block diagram and Architecture of Virtual Instruments

Data-flow Techniques: Graphical programming in data flow, Comparison with conventional programming.

VI Programming Techniques: VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O.

Data Acquisition Basics: ADC, DAC, DIO, Counters and timers.

Common Instrumentation Interfaces: RS232C/ RS485, GPIB, PC Hardware structure, DMA software and hardware installation.

Use of Analysis Tools: Advanced analysis tools such as Fourier transforms, Power spectrum, Correlation methods, Windowing and filtering and their applications in signal and image processing, Motion Control.

Additional Topics: System buses, Interface buses: PCMCIA, VXI, SCXl, PXI, etc.

Laboratory Work : Components of Lab VIEW, Celsius to Fahrenheit conversion, Debugging, Sub-VI, Multiplot charts, Case structures, ASCII files, Function Generator, Property Node, Formula node, Shift registers, Array, Strings, Clusters, DC voltage measurement using DAQ

Course Learning Outcomes (CLO):

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

1. demonstrate the working of LabVIEW.
2. explain the various types of structures used in LabVIEW.
3. analyze and design different type of programs based on data acquisition.
4. demonstrate the use of LabVIEW for signal processing, image processing etc.

Text Books:

1. *Johnson, G., LabVIEW Graphical Programming, McGraw–Hill (2006).*
2. *Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).*
3. *Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).*

Reference Book:

1. *Gupta, S. and Gupta, J.P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America (1988).*

Evaluation Scheme:

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

SEMESTER – VIII

UEI892: PROJECT

L	T	P	Cr
-	-	-	20.0

Course Objectives

The project semester is aimed at developing the undergraduate education programme in Instrumentation 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.

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 ram 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 the basic renewable energy sources like solar, wind ,biomass etc
2. Explain various advantages and disadvantages of renewable energy sources.
3. Familiarization with different standalone, off grid energy sources
4. Explain different technology associate with solar, wind, biomass and other renewable energy sources.
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:

Sr. No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	40
3.	Sessionals (May include 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

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

UEI894: DESIGN PROJECT

L	T	P	Cr
-	-	-	13.0

Course Objectives

The design project is introduced in Instrumentation 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 instrumentation 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 instrumentation 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.

UEI895: STARTUP SEMESTER

L	T	P	Cr
0	0	0	**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

Fundamentals of 'Entrepreneurship & Innovation'
Opportunity identification and evaluation, Customer validation
Developing a Business Model Canvas
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.
Design thinking
Technical development
Financial management
Entrepreneurial Marketing
Interaction with existing Startups and pitching of projects,
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.

ELECTIVE – I

UEE507: ENGINEERING ELECTROMAGNETICS

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 its 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 $\vec{E}$ and $\vec{H}$, 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 and Rectangular Waveguides.

Course learning Outcomes (CLO):

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

UEI831: BIOSENSORS AND MEMS

L	T	P	Cr
3	1	0	3.5

Course Objectives: To introduce the concept of biosensors and MEMS, design and fabrication, types and their applications.

Overview of biosensors and their electrochemistry: Molecular reorganization: Enzymes, Antibodies and DNA, Modification of bio recognition molecules for Selectivity and sensitivity, Fundamentals of surfaces and interfaces

Bioinstrumentation and bioelectronics devices: Principles of potentiometry and potentiometric biosensors, Principles of amperometry and amperometric biosensors, Optical Biosensors based on Fiber optics, FETs and Bio-MEMS, Introduction to Chemometrics, Biosensor arrays; Electronic nose and electronic tongue

MEMS Technology: Introduction Nanotechnology and MEMS, MEMS design, and fabrication technology – Lithography, Etching, MEMS material, Bulk micromachining, Surface micromachining, Microactuator, electrostatic actuation, Micro-fluidics.

MEMS types and their applications : Mechanical MEMS – Strain and pressure sensors, Accelerometers etc., Electromagnetic MEMS – Micromotors, Wireless and GPS MEMS etc Magnetic MEMS – all effect sensors, SQUID magnetometers, Optical MEMS – Micromachined fiber optic component, Optical sensors, Thermal MEMS – thermo-mechanical and thermo-electrical actuators, Peltier heat pumps

Course Learning Outcomes (CLO):

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

1. explain the concept of molecular reorganization, fundamentals of surfaces and interfaces
2. elucidate the principles of different types of biosensors
3. explain the concept of MEMS design, and fabrication technology
4. explain the different types of MEMS and its applications

Text Books:

1. *Gardner, J.W., Microsensors, Principles and Applications, John Wiley and Sons (1994).*
2. *Kovacs, G.T.A., Micromachined Transducer Sourcebook, McGraw–Hill (2001).*
3. *Turner, A.P.F., Karube,I., and Wilson G.S., Biosensors–Fundamentals and Applications, Oxford University Press (2008).*

Reference Book:

1. *Trimmer, W., Micromechanics and MEMS, IEEE Press (1990)*

Evaluation Scheme:

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

UEI833: OPTICAL INSTRUMENTATION

L	T	P	Cr
3	1	0	3.5

Course Objectives: To make the students able to understand different aspects of optical instrumentation.

Light Sourcing, Transmitting and Receiving: Concept of light, classification of different phenomenon based on theories of light, basic light sources and its characterization, polarization, coherent and incoherent sources, grating theory, application of diffraction grating, electro-optic effect, acousto-optic effect and magneto-optic effect.

Opto –Electronic devices and Optical Components: Photo diode, PIN, photo-conductors, solar cells, phototransistors, materials used to fabricate LEDs and lasers design of LED for optical communication, response times of LEDs, LED drive circuitry, lasers classification ruby lasers, neodymium lasers, CO_2 lasers, dye lasers, semiconductors lasers, lasers applications.

Interferometry: Interference effect, radiometry, types of interference phenomenon and its application, michelson's interferometer and its application refractometer, rayleigh's interferometers, spectrographs and monochromators, spectrophotometers, calorimeters, medical optical instruments

Optical Fiber Sensors: Active and passive optical fiber sensor, intensity modulated, displacement type sensors, multimode active optical fiber sensor (micro bend sensor) single mode fiber sensor-phase modulates and polarization sensors

Fiber optic fundamentals and Measurements: fundamental of fibers, fiber optic communication system, optical time domain reflectometer (OTDR), time domain dispersion measurement, frequency domain dispersion measurement.

Course Learning Outcomes (CLO):

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

1. explain the basic concepts of optical transmitting and receiving
2. describe different opto- electronic devices
3. elucidate different methods of interferometry
4. describe selection of the appropriate optical fiber sensors for industrial application

Text Books:

1. *J.Wilson&J F B Hawkes, Opto Electronics: An Introduction, Prentice Hall of India, (2011),3rd ed.*
2. *RajpalS.Sirohi , Wave Optics and its Application, (2001),1st ed.*
3. *A Yariv , Optical Electronics/C.B.S. Collage Publishing, New York, (1985)*
4. *Pollock ,Fundamentals of OPTOELECTRONICS,(1994)*

Evaluation Scheme:

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

UEI846 BIO–MEDICAL DSP

L	T	P	Cr
3	1	0	3.5

Course Objectives: To provide students with skills and knowledge in characterization of medical data like ECG, EEG etc., by filtering, data reduction, feature extraction and its interpretation

Introduction: Characteristics of medical data, Software designof digital filters, Basic electrocardiography, ECG lead system, ECG signal characteristics, Sampling basics, Simple conversion system, Conversion requirements for biomedical signals.
Adaptive filters: Principle noise canceller model, 50Hz adaptive canceling, Other applications of adaptive filtering, Basics of signal averaging, Signal averaging as digital filter, A typical average, Software for signal averaging , Limitations of signal averaging.
Data reduction techniques: Turning point algorithm, AZTECH algorithm, Fan algorithm, Huffman coding, SPIHT using wavelets and other techniques.
ECG Analysis: Power spectrum of ECG, Band pass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, ECG interpretation, ST segment analyzer, Potable arrhythmia monitor.
Neurological signal processing: Brain and its potential, EEG signal and its characteristics, EEG analysis, Linear prediction theory, Auto regressive methods, Recursive parameter estimation, spectral error measure, Adaptive segmentation, Transient detection and elimination.

Course Learning Outcomes (CLO):
After the successful completion of the course the students will be able to:
1. describe adaptive filters and their application in biomedical signal processing
2. apply data reduction techniques in biomedical signals
3. analyse ECG signals
4. analyse EEG signals
5. describe neurological signal processing

Text Books:

1. *Prokis, J.G., Digital signal processing, Prentice–Hall of India Private Limited (1997).*
2. *Tomkin, W. J., Biomedical DSP, Prentice–Hall of India Private Limited (2003).*

Reference Books:

1. *Carr, J., Biomedical instrumentation, PHI Learning Pvt. Limited (2008).*

Evaluation Scheme:

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

UEI847 ROBOTICS AND AUTOMATION

L	T	P	Cr
3	1	0	3.5

Course Objectives: To introduce the concepts of Robotic system, its components and instrumentation and control related to robotics.

Basic Concepts in Robotics: Automation and robotics, Robot anatomy, Basic structure of robots, Resolution, Accuracy and repeatability, and Classification and Structure of robots, Point to point and continuous path systems.

Robotic Systemand Control Systems: Components of robotic system,Hydraulic systems, d.c. servo motors, Basic control systems concepts and models, Control system analysis, Robot activation and feedback components. Positional and velocity sensors, actuators. Power transmission systems,

Robot arm Kinematics and Dynamics: Robot joints, The direct kinematics problem, The inverse kinematics solution, Lagrange-Euler formation ,GeneralizedD'Alembert equations of motion, DenavitHartenberg convention and its applications.

Sensors and Instrumentation in robotics: Tactile sensors, proximity and range sensors, Force and torque sensors, Uses of sensors in robotics. Vision equipment, Image processing, Concept of low level and high level vision.

Computer based Robotics: Method of robots programming, GUI based robotic arm control, Interfacing with computer, communication and data processing, Introduction to Artificial Intelligence.

Course Learning Outcomes (CLO):

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

1. explain the fundamentals of robotics and its components
2. illustrate the Kinematics and Dynamics of robotics
3. elucidate the need and implementation of related Instrumentation & control in robotics
4. illustrate the movement of robotic joints with computers/microcontrollers.
5. Explain sensors and instrumentation in robotics

Text Books:

1. *Nikku, S.B., Introduction to Robotics, Prentice–Hall of India Private Limited (2002).*
2. *Schilling. R. J., Fundamentals of Robotics: Analysis and Control, Prentice–Hall of India Private Limited (2006).*

Reference Books:

1. *Criag, J., Fundamentals of Robotics: Analysis and Control, Prentice–Hall of India Private Limited (2006).*
2. *Gonzalex, R. C. and Fu, K. S., Robotics Control Sensing, Vision and Intelligence, McGraw–Hill (2004). Koren,Y., Robotics for Engineers, McGraw–Hill (1985).*

Evaluation Scheme:

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

ELECTIVE – II

UEI401: ARTIFICIAL INTELLIGENT TECHNIQUES AND APPLICATIONS

L	T	P	Cr
3	1	2	4.5

Course Objectives: To introduce the concept of artificial intelligence, methods, techniques and applications

Overview of Artificial Intelligence: The concept and importance of AI, Human intelligence vs. Machine intelligence.

Expert Systems: Expert systems: advantages, disadvantages, Expert system architecture, Functions of various parts, Mechanism and role of inference engine, Types of Expert system, Tuning of expert systems, Role of Expert systems in instrumentation and process control.

Artificial Neural Networks: Structure and function of a single neuron, Artificial neuron models, Types of activation functions, Neural network architectures, Neural learning,Evaluation of networks, Supervised learning, Back propagation algorithm, Unsupervised learning, winner–take all networks, Application of neural networks for Classification, Clustering, Pattern associations, Function approximation, Forecasting etc.

Fuzzy Logic: Fuzzy sets and systems, Operations on Fuzzy sets, Fuzzy relations, Membership functions, Fuzzy rule generation, De–Fuzzification, Fuzzy controllers,

Genetic Algorithms: Introduction and concept, Coding, Reproduction, Cross–over and mutation scaling, Fitness, Applications, Swarm intelligence, and their applications.

Laboratory work: Use of FIS, ANFIS, Simulink, Fuzzy logic, Neural Networks and GA applications in MATLAB.

Course Learning Outcomes (CLO):

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

1. elucidate the knowledge and general concepts of artificial intelligence.
2. explain the concept of Artificial Neural Networks, Learning and Pattern Classification
3. illustratethe concept of fuzzy logic and its applications
4. illustrate the concept of geneticalgorithms and its applications

Text Books:

1. *Petterson, D.W., Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India (2007).*
2. *Zurada, J.M., Introduction to Artificial Neural Network System, Jaico Publication (2006).*
3. *Hagan, M.T., Neural network design, Prentice Hall of India .*
4. *Ross, T.J., Fuzzy logic with engineering applications, TMH*

Reference Books:

1. *Yegnanarayana, B., Artificial Neural Networks, Prentice–Hall of India Private Limited (2008).*
2. *Winston, P.H., Artificial Intelligence, Addison Wesley (1994).*

Evaluation Scheme:

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

UEI721 DIGITAL IMAGE PROCESSING

L	T	P	Cr.
3	1	2	4.5

Course Objectives: To introduce the concepts of image processing and basic analytical methods to be used in image processing. To familiarize students with image enhancement and restoration techniques, To explain different image compression techniques. To introduce segmentation and morphological processing techniques.

Introduction: Fundamentals of Image formation, components of image processing system, image sampling and quantization.

Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters.

Image restoration: A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the image enhance in frequency domain.

Image Compression: Need of image compression, image compression models, error-free compression, lossy predictive coding, image compression standards.

Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, basic morphologic algorithms, The Hit-or-Miss Transformation

Image Segmentation: Detection of discontinuous, edge linking and boundary detection, thresholding, Hough Transform Line Detection and Linking, region–based segmentation.

Object Recognition: Patterns and patterns classes, matching, classifiers.

Course Learning Outcomes (CLO):

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

1. Explain the fundamentals of digital image and its processing
2. Perform image enhancement techniques in spatial and frequency domain.
3. Elucidate the mathematical modelling of image restoration and compression
4. Apply the concept of image segmentation.
5. Describe object detection and recognition techniques.

Text Books:

1. *Digital Image Processing, RafealC.Gonzalez, Richard E.Woods, Second Edition, Pearson Education/PHI.*

Reference Books

1. *Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle, Second Edition, Thomson Learning.*

2. *Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology*
3. *Computer Vision and Image Processing, Adrian Low, Second Edition, B.S.Publications*
4. *Digital Image Processing using Matlab, RafealC.Gonzalez, Richard E.Woods, Steven L. Eddins, Pearson Education.*

Evaluation Scheme:

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

UCS740 DATASTRUCTURES AND ALGORITHMS

L	T	P	Cr
3	1	2	4.5

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

Linear Data Structures: Arrays, Records, Strings and string processing, References and aliasing, Linked lists, Strategies for choosing the appropriate data structure, Abstract data types and their implementation: Stacks, Queues, Priority queues, Sets, Maps.
Basic Analysis: Differences among best, expected, and worst case behaviours of an algorithm, Asymptotic analysis of upper and expected complexity bounds, Big O notation: formal definition and use, Little o, big omega and big theta notation, Complexity classes, such as constant, logarithmic, linear, quadratic, and exponential, Time and space trade-offs in algorithms, Recurrence relations, Analysis of iterative and recursive algorithms.
Searching and Sorting: Linear Search, Binary Search, Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Heap Sort, Merge Sort, Counting Sort, Radix Sort.
Algorithmic Strategies with examples and problem solving: Brute-force algorithms with examples, Greedy algorithms with examples, Divide-and-conquer algorithms with examples, Recursive backtracking, Dynamic Programming with examples, Branch-and-bound with examples, Heuristics, Reduction: transform-and-conquer with examples.
Non-Linear Data Structures and Sorting Algorithms: Hash tables, including strategies for avoiding and resolving collisions, Binary search trees, Common operations on binary search trees such as select min, max, insert, delete, iterate over tree, Graphs and graph algorithms, Representations of graphs, Depth- and breadth-first traversals, Heaps, Graphs and graph algorithms, Shortest-path algorithms (Dijkstra and Floyd), Minimum spanning tree (Prim and Kruskal)
Problem Clauses: P, NP, NP- Hard and NP-complete, deterministic and non-deterministic polynomial time algorithm approximation and algorithm for some NP complete problems. Introduction to parallel algorithms, Genetic algorithms, intelligent algorithms.
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):
After the completion of the course, the student 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. *Cormen H. T., Leiserson E. C., Rivest L. R., and Stein C., Introduction to Algorithms, MIT Press (2009) 3rd ed.*
2. *Sahni S., Data Structures, Algorithms and Applications in C++, Universities Press (2005) 2nd ed.*

Reference Books:

1. *Karumanchi N., Data Structures and Algorithms Made Easy, CareerMonk Publications (2017) 5th ed.*

Evaluation Scheme:

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

UEI720: ANALYTICAL INSTRUMENTATION

L	T	P	Cr
3	1	2	4.5

Course objectives: To introduce the concept of analytical Instrumentation, methods, techniques and applications

Introduction: Introduction to instrumental analysis-classification and its advantages, Sampling systems for gas analysis and liquid analysis.
Spectrometry: Introduction to atomic absorption spectrometer, emission spectrometer UV-visual spectrometer, infrared spectrometer, excitation sources: arc and spark, Nuclear magnetic resonance spectrometer, Mass spectrometry, biomedical applications of spectrometry.
Chromatography: Introduction to Chromatographic techniques, Liquid chromatography, Gas chromatography, Applications of chromatography. Introduction to optical Techniques and their Working, turbidimetry, Nephelometry, Polarimetry, Refractometry.
X-ray Analytical Methods: Introduction to X-ray spectral analysis, Fluorescence X-ray spectrometer Wavelength dispersive devices, Energy dispersive devices, Detectors, Scanning electron microscope, X-ray diffractometer, X ray absorption spectrometer Applications of X ray analytical methods in biomedical, industrial applications.
Potentiometry : Potential and standard potential, ion selective electrode, Glass electrode, Gas sensing electrode. Application of potentiometry.

Course Learning Outcomes (CLO):

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

1. explain the concept of spectrometry and optical techniques
2. elucidate the working of chromatography, elemental analyser
3. illustrate the working of X- ray diffractometer and scanning electron microscope
4. explain the concept of potentiometry and its applications

Text Books:

1. *Braun, R.D., Introduction to Instrumental Analysis, Mc-Graw Hill (2008).*
2. *Khandpur, R.S., Handbook of Biomedical Instrumentation, Tata McGraw–Hill (2000)*
3. *Mathur, R.P., Water and Waste Water Testing Laboratory Manual, Nem Chand and Brothers (1982).*
4. *Patranabis D. Principles of Industrial & Instrumentation, Tata McGraw–Hill (1998)*

Evaluation Scheme:

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

UCS739: OBJECT ORIENTED PROGRAMMING AND APPLICATIONS

L	T	P	Cr
3	1	2	4.5

Course Objective: To understand fundamentals as well as advanced topics of object oriented programming.

Classes & Objects: specifying a class, creating class objects, accessing class members, access specifiers – public, private, and protected, classes, objects and memory, static members, the const keyword and classes, the static objects, friends of a class, empty classes, nested classes, local classes, abstract classes, container classes, bit fields and classes.

Console Based I/O: concept of streams, hierarchy of console stream classes, input/output using overloaded operators >> and << and memberv functions of i/o stream classes, formatting output, formatting using ios class functions and flags, formatting using manipulators.

Constructors & Destructors: Need for constructors and destructors, copy constructor, dynamic constructors, destructors, constructors and destructors with static members, initializer lists.

Operator Overloading & Type Conversion: Defining operator overloading, rules for overloading operators, overloading of unary operators and various binary operators, overloading of new and delete operators, type conversion - basic type to class type, class type to basic type, class type to another class type.

Inheritance: Introduction, defining derived classes, forms of inheritance, ambiguity in multiple and multipath inheritance, virtual base class, object slicing, overriding member functions, object composition and delegation, order of execution of constructors and destructors.

Pointers & Dynamic Memory Management: understanding pointers, accessing address of a variable, declaring & initializing pointers, accessing a variable through its pointer, pointer arithmetic, pointer to a pointer, pointer to a function, dynamic memory management - new and delete operators, pointers and classes, pointer to an object, pointer to a member, this pointer, self-referential classes, possible problems with the use of pointers - dangling/wild pointers, null pointer assignment, memory leak and allocation failures.

Virtual functions & Polymorphism: Concept of binding - early binding and late binding, virtual functions, pure virtual functions, abstract clasess, virtual destructors & polymorphsim.

Exception handling: Review of traditional error handling, basics of exception handling, exception handling mechanism, throwing mechanism, catching mechanism, rethrowing an exception, specifying exceptions.

Templates and Generic Programming: Function templates, class templates, class templates and nontype parameters, templates and inheritance, templates and friends, templates and static members.

Managing Data Files: File streams, hierarchy of file stream classes, error hadnling during file operations, reading/writing of files, accessing records randomly, updating files, data formatting in memory buffers.

Event Driven Programming: Graphics programming, Frame, Components, Basics of event handling, event handlers, adapter classes, actions, mouse events, AWT event hierarchy, Introduction to Swing.

Standard Template Library (STL): Programming model of stl – containers, algorithms, iterators, description of containers – vector, list and map containers.

Brief introduction to Python and its salient features in comparison to C++, Java.

Laboratory Work:

Main focus is on implementing basic concepts of object oriented programming in Java, C++, Python etc and to enhance programming skills to solve specific problems.

Course learning outcomes (CLOs):

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

1. Understand the importance and need of object oriented programming paradigm and its advantages over procedural programming paradigm.
2. Understand and apply the basic programming constructs of object oriented programming like class, object, constructor, destructor, member functions.
3. Implement major principles of object oriented programming like inheritance, polymorphism, abstraction, data hiding.
4. Apply the concepts to real world problem solving using file handling, templates operator overloading and other principles of OOPS.

Text Books:

1. *Lippman, S.B. and Lajoie, J., C++Primer, Pearson Education (2005) 4th ed..*
2. *Stroustrup, Bjarne, The C++ Programming Language, Pearson Education (2000)3rd ed.*

Reference Books:

1. *Eills, Margaret A. and Stroustrup, Bjarne, The Annonated C++ Reference Manual, Pearson Education (2002).*
2. *Rumbaugh, J.R., Premerlani, W. and Blaha, M., Object Oriented Modeling and Design with UML, Pearson Education (2005) 2nd ed.*
3. *Kanetkar, Yashvant, Let us C++, Jones and Bartlett Publications (2008) 8th ed.*

Evaluation Scheme:

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

UEI719 EMBEDDED CONTROL SYSTEMS

L	T	P	Cr
3	1	2	4.5

Course Objectives: This course is intended to explain the various concepts used in embedded control systems. Students will also familiarize with real time operating systems.

Introduction: Introduction to Embedded Systems, Its Architecture and system Model, Introduction to the HCS12/S12X series Microcontrollers, Embedded Hardware Building Block.

HCS12 System Description and Programming: The HCS12 Hardware System ,Modes of Operation, The B32 Memory System , The HCS12 DP256 Memory System, Exception Processing–Resets and Interrupts, Clock Functions, TIM, RTI, Serial Communications, SPI-Serial Peripheral Interface, I2C, HCS12 Analog-to-Digital Conversion System.

Basic Input /Output Interfacing Concepts: Input Devices, Output Devices and their Programming, Switch Debouncing, Interfacing to Motor, LCDs, Transducer, The RS-232 Interface and their Examples.

Development tools and Programming: Hardware and Software development tools, C language programming, Codewarior tools- Project IDE, Compiler, Assembler and Debugger, JTAG and Hardware Debuggers, Interfacing Real Time Clock and Temperature Sensors with I2C and SPI bus.

Real-time Operating Systems (RTOS): Basic concepts of RTOS and its types, Concurrency, Reentrancy, Intertask communication, Implementation of RTOS with some case studies.

Laboratory Work:

Programming of HCS12 with Code warrior for Interrupts, Clock Functions, TIM, RTI, SPI, LCD interfacing, Use of JTAG and Hardware Debuggers, Interfacing Keypad, ADC, DAC, LCD, Real Time Clock and Temperature Sensors with I2C and SPI bus.

Course Learning Outcomes (CLO):

The student will be able to

1. Explain the concept of embedded Systems and its architecture
2. Elucidate the concept of programming for different interfacing devices
3. Analyze various software and hardware tools
4. Explain real-time operating systems

Text Books:

1. *Barrett, S.F. and Pack, J.D., Embedded Systems, Pearson Education (2008).*
2. *Haung, H.W., The HCS12 / 9S12: An Introduction to Software and Hardware Interfacing, Delmar Learning (2007).*

Reference Books:

1. *Fredrick, M.C., Assembly and C programming for HCS12 Microcontrollers, Oxford University Press (2005).*
2. *Ray, A.K., Advance Microprocessors and Peripherals – Architecture, Programming and Interfacing, Tata McGraw–Hill (2007).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessionals (May include Assignments/Projects/Tutorials/Quizzes/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 (CLO):

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.

Course Content:

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 (CLO):
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 (CLO):

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