

COURSE SCHEME

FOR

**B.E. - ELECTRONICS
(INSTRUMENTATION AND CONTROL)
ENGINEERING**

THAPAR INSTITUTE

2019

BE-Electronics (Instrumentation and Control) Engineering (2019)
I & II Semester

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



THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
Deemed to be University

BE-Electronics (Instrumentation and Control) Engineering (2019)
I & II Semester

B.E. Electronics (Instrumentation and Control) – I and II Semester

SEMESTER-I

S. No.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UPH004	APPLIED PHYSICS	CF	3	1	2	4.5
2	UMA010	MATHEMATICS-I	CF	3	1	0	3.5
3	UTA017	COMPUTER PROGRAMMING	CF	3	0	2	4.0
4	UEC001	ELECTRONIC ENGINEERING	CF	3	1	2	4.5
5	UTA015	ENGINEERING DRAWING	CF	2	0	4	4.0
6	UHU003	PROFESSIONAL COMMUNICATION	CF	2	0	2	3.0
7		ELC ACTIVITY-I		-	-	-	-
		Total		16	3	12	23.5

SEMESTER-II

S. No.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	UCB008	APPLIED CHEMISTRY	CF	3	1	2	4.5
2	UEE001	ELECTRICAL ENGINEERING	CF	3	1	2	4.5
3	UEN002	ENERGY AND ENVIRONMENT	CF	3	0	0	3.0
4	UMA004	MATHEMATICS-II	CF	3	1	0	3.5
5	UES009	MECHANICS	CF	2	1	0	2.5
6	UTA018	OBJECT ORIENTED PROGRAMMING	CF	3	0	2	4.0
7	UTA013	ENGINEERING DESIGN PROJECT-I	CF				4.0
8		ELC ACTIVITY-II		-	-	-	-
		Total		17	4	6	26.0



SEMESTER-I

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UPH004: APPLIED PHYSICS

L T P Cr
3 1 2 4.5

Course 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 - skin depth.

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

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

Laboratory Work:

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

Micro project: Students will be given physics-based projects/assignments using computer simulations, etc.

Course Learning Outcomes (CLO):

On completion of the course, the students would 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.

Text Books:

1. *Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007) 6th ed.*
2. *Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999) 3rd ed.*
3. *Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001) 4th ed.*

Reference Books:

1. *Wehr, M.R, Richards, J.A., Adair, T.W., Physics of The Atom, Narosa Publishing House (1990) 4th ed.*
2. *Verma, N.K., Physics for Engineers, Prentice Hall of India (2014) 1st ed.*
3. *Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice Hall™ (2008) 3rd ed.*

Evaluation Scheme:

S.No	Assessment	Weightage (%)
1	MST	25
2	EST	35
3	Tut/Sessional	7
4	Lab + Project	25
5	Quiz	8
Total		100

UMA010: 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, calculus of several variables and complex analysis which would enable them to devise solutions for given situations they may encounter in their engineering profession.

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: Double integral (Cartesian); Change of order of integration in double integral; Polar coordinates; graphing of polar curves; Change of variables (Cartesian to polar); Applications of double integrals to areas and volumes; evaluation of triple integral (Cartesian).

Sequences and Series: Introduction to sequences and Infinite series; Tests for convergence/divergence; Limit comparison test; Ratio test; Root test; Cauchy integral test; Alternating series; Absolute convergence and conditional convergence.

Series Expansions: Power series; Taylor series; Convergence of Taylor series; Error estimates; Term by term differentiation and integration.

Complex analysis: Introduction to complex numbers; geometrical interpretation; functions of complex variables; examples of elementary functions like exponential; trigonometric and hyperbolic functions; elementary calculus on the complex plane (limits, continuity, differentiability), Cauchy-Riemann equations; analytic functions, harmonic functions.

Course Learning Outcomes (CLO):

On completion of the course, the students would be able to:

- 1) examine functions of several variables, define and compute partial derivatives, directional derivatives and their use in finding maxima and minima in some engineering problems.
- 2) evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.
- 3) determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.
- 4) represent complex numbers in Cartesian and Polar forms and test the analyticity of complex functions by using Cauchy-Riemann equations.

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), 6th ed.*
3. *Kasana, H.S., Complex Variables: Theory and Applications, Prentice Hall India, 2005 (2nd edition).*

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).*
3. *Brown J.W and Chruchill R.V, Complex variables and applications, MacGraw Hill, (7th edition)*

Evaluation Scheme:

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

UTA017: COMPUTER PROGRAMMING

L T P Cr
3 0 2 4.0

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

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

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

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

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

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

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

Laboratory work:

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

Course Learning Outcomes (CLO):

On completion of the Course, the student would be able to:

1. comprehend concepts related to computer hardware and software, draw flowcharts and write algorithm/pseudocode.
2. write, compile and debug programs in C language, use different data types, operators and console I/O function in a computer program.
3. design programs involving decision control statements, loop control statements, case control structures, arrays, strings, pointers, functions and implement the dynamics of memory by the use of pointers.

4. comprehend the concepts of linear and Non-Linear data structures by implementing linked lists, stacks and queues.

Text Books:

1. Kernighan, B.W. and Ritchie, D.M., *The C Programming language*, (2012) 2nd ed.
2. Balagurusamy, E., *Programming in Ansi C*, TMH Publications (2019) 8th ed.

Reference Books:

1. Perry, G. and Miller, D., *C Programming Absolute Beginner's Guide*, Pearson (2013), 3rd ed.
2. Griffiths, D., and Griffiths, D., *Head First C*, O'Reilly (2012), 1st ed.

Evaluation scheme:

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

UEC001: ELECTRONIC ENGINEERING

L	T	P	Cr
3	1	2	4.5

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

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

Electronics Devices and Circuits: PN Diode as a rectifier; Clipper and clamper; Operation of Bipolar Junction Transistor and Transistor Biasing; CB, CE, CC (Relationship between α , β , γ) circuit configuration Input-output characteristics; Transistor as a switch, as an Amplifier and its frequency Response; Introduction to Field Effect Transistor and its characteristics, N and P channel MOS transistors; CMOS inverter, NAND and NOR gates; General CMOS Logic; TTL and CMOS logic families.

Operational Amplifier Circuits: The ideal operational amplifier; The inverting; non-inverting amplifiers; Op-Amp Characteristics; Applications of Op-amp.

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

Combinational and Sequential Logic: Code converters; multiplexors; decoders; Addition circuits and priority encoder; Master-slave and edge-triggered flip-flops; Synchronous and Asynchronous counters; Registers; IEEE Representation of Digital ICs.

Laboratory Work:

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

Course Learning Outcomes (CLO):

On completion of the Course, the student would be able to:

1. demonstrate the use of semiconductor diodes in various applications.
2. discuss and explain the working of transistors and operational Amplifiers, their configurations and applications.
3. recognize and apply the number systems and Boolean algebra.

4. reduce Boolean expressions and implement them with Logic Gates.
5. analyze, design and implement combinational and sequential circuits.

Text Books:

1. *Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason (2009).*
2. *M. M. Mano and M.D. Ciletti, Digital Design, Pearson, Prentice Hall, 2013.*

Reference Books:

1. *Milliman, J. and Halkias, C.C., Electronic Devices and Circuits, Tata McGraw Hill, 2007.*
2. *Donald D Givone, Digital Principles and Design, McGraw-Hill, 2003.*
3. *John F Wakerly, Digital Design: Principles and Practices, Pearson, (2000).*
4. *N Storey, Electronics: A Systems Approach, Pearson, Prentice Hall, (2009).*

Evaluation Scheme:

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

UTA015: ENGINEERING DRAWING

L	T	P	Cr
2	0	4	4.0

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

Engineering Drawing

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

AutoCAD

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

Micro Projects /Assignments:

1. Completing the views - Identification and drawing of missing lines in the projection of objects
2. Missing views – using two views to draw the projection of the object in the third view, primarily restricting to Elevation, Plan and Profile views
3. Projects related to orthographic and isometric projections
 - a. Using wax blocks or soap bars to develop three dimensional object from given orthographic projections

- b. Using wax blocks or soap bars to develop three dimensional object, section it and color the section
 - c. Use of AUTOCAD as a complementary tool for drawing the projections of the objects created in (1) and (2).
4. Develop the lateral surface of different objects involving individual or a combination of solids like Prism, Cone, Pyramid, Cylinder, Sphere etc.
 5. To draw the detailed and assembly drawings of simple engineering objects/systems with due sectioning (where ever required) along with bill of materials.e.g. Rivet joints, simple bearing, wooden joints, Two plates connected with nut and bolt etc.

Course Learning Outcomes (CLO):

On completion of the Course, the student would be able to:

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

Text Books:

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

Reference Books:

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

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1.	MST (formal written test)	25
2.	EST (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



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UHU003: PROFESSIONAL COMMUNICATION

L	T	P	Cr
2	0	2	3.0

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

Effective communication: Meaning; Barriers; Types of communication and Essentials. Interpersonal Communication skills.

Effective Spoken Communication: Understanding essentials of spoken communication; Public speaking; Discussion Techniques; Presentation strategies.

Effective Professional and Technical writing: Paragraph development; Forms of writing; Abstraction and Summarization of a text; Technicalities of letter writing; internal and external organizational communication. Technical reports and proposals.

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.

Communication Networks in organizations: Types; barriers and overcoming the barriers.

Laboratory work :

1. Needs-assessment of spoken and written communication and feedback.
2. Training for Group Discussions through simulations and role plays.
3. Technical report writing on survey based projects.
4. Project based team presentations.

Course Learning Outcomes (CLO):

On completion of the course, the students would be able to:

1. apply communication concepts for effective interpersonal communication.
2. select the most appropriate media of communication for a given situation.
3. speak assertively and effectively.
4. write objective organizational correspondence.
5. design effective resumes, reports and proposals .

Text Books:

1. *Lesikar R.V and Flatly M.E., Basic Business Communication Skills for the Empowering the Internet Generation. Tata Mc Graw Hill. New Delhi (2006).*
2. *Raman,M & Sharma, S.,Technical Communication Principles and Practice, Oxford University Press New Delhi.(2011).*
3. *Mukherjee H.S.,Business Communication-Connecting at Work,Oxford University Press New Delhi, (2013).*

Reference Books:

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

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessionals (Group Discussions; professional presentations; poster presentations ,public speaking; technical reports)	40



SEMESTER-II

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UCB008: APPLIED CHEMISTRY

L	T	P	Cr
3	1	2	4.5

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

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

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

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

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

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

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

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

Laboratory Work:

1. **Electrochemical measurements:** Experiments involving use of pH meter, conductivity meter, potentiometer.
2. **Acid and Bases:** Determination of mixture of bases.
3. **Spectroscopic techniques:** Colorimeter, UV-Vis spectrophotometer.
4. **Water and its treatment:** Determination of hardness, alkalinity, chloride, chromium, iron and copper in aqueous medium.

Course Learning Outcomes (CLO):

On completion of the Course, the student would be able to:

1. concepts of electrodes in electrochemical cells, migration of ions, liquid junction potential and conductometric titrations.

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2. atomic and molecular spectroscopy fundamentals like Beer`s law, flame photometry, atomic absorption spectrophotometry, UV-Vis and IR.
3. water and its treatment methods like lime soda and ion exchange.
4. concept of phase rule, fuel quality parameters and alternative fuels.
5. polymerization, molecular weight determination and applications as biodegradable and conducting polymers.
6. laboratory techniques like pH metry, potentiometry, colourimetry, conductometry and volumetry.

Text Books:

1. *Ramesh, S. and Vairam S. Engineering Chemistry, Wiley India (2012) 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, Cengage Learnings (2007) 1sted.*

Evaluation Scheme:

S.No	Assessment	Weightage (%)
1	MST	25
2	EST	40
3	Sessionals.....	35

UEE001: ELECTRICAL ENGINEERING

L	T	P	Cr
3	1	2	4.5

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

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

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

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

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

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

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

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

Course Learning Outcome (CLO):

On completion of the Course, the student would be able to:

1. apply networks laws and theorems to solve electric circuits.
2. analyze transient and steady state response of DC circuits.
3. signify AC quantities through phasor and compute AC system behaviour during steady state.

4. explain and analyse the behaviour of transformer.
5. elucidate the principle and characteristics of DC motor and DC generator.

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UEN002 ENERGY AND ENVIRONMENT

L T P Cr
3 0 0 3.0

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

Introduction: Natural Resources & its types, Concept of sustainability and sustainable use of natural resources, Pollution based environmental issues and case studies

Conventions on Climate Change: Origin of Conference of Parties (COPs), United Nations Framework Convention on Climate Change (UNFCCC) and Intergovernmental Panel on Climate Change (IPCC); Kyoto Protocol, instruments of protocol – CDM, JI and IET; Montreal Action Plan; Paris Agreement and post-Paris scenario.

Air Pollution: Origin, Sources and effects of air pollution; Primary and secondary meteorological parameters; Wind roses; Atmospheric Stability; Inversion; Plume behavior; Management of air pollution: Source reduction and Air Pollution Control Devices for particulates and gaseous pollutants in stationary and mobile sources.

Water Pollution: Origin, Sources of water pollution, Category of water pollutants, Physico-Chemical characteristics, Components of wastewater treatment systems, Advanced treatment technologies.

Solid waste management: Introduction to solid waste management, Sources, characteristics of municipal and industrial solid waste, Solid waste management methods: Incineration, composting, Biomethanation, landfill, E-waste management, Basal convention-

Energy Resources: Classification of Energy Resources; Conventional energy resources-Coal, petroleum and natural gas, nuclear energy, hydroelectric power; Non-conventional energy resources- Biomass energy, Thermo-chemical conversion and biochemical conversion route; Generation of Biogas and biodiesel as fuels; Solar energy-active and passive solar energy absorption systems; Type of collectors; Thermal and photo conversion applications; Wind energy.

Facilitated through Online Platforms

Ecology and Environment: Concept of an ecosystem; structural and functional units of an ecosystem; Food Chain, Food Web, Trophic Structures and Pyramids; Energy flow; Ecological Succession; Types, Characteristics, Biodiversity, Biopiracy.

Human Population and the Environment: Population growth, variation among nations; Population explosion – Family Welfare Programmes; Environment and human health; Human Rights; Value Education; Women and Child Welfare; Role of Information Technology in Environment and Human Health, Environmental Ethics.

Course Learning Outcomes (CLOs):

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

1. Comprehend the interdisciplinary context with reference to the environmental issues and case studies
2. Assess the impact of anthropogenic activities on the various elements of environment and apply suitable techniques to mitigate their impact.
3. Conceptualise and explain the structural and functional features of ecological systems
4. Correlate environmental concerns with the conventional energy sources associated and assess the uses and limitations of non-conventional energy technologies

Recommended Books

1. *Moaveni, S., Energy, Environment and Sustainability, Cengage (2018)*
2. *Down to Earth, Environment Reader for Universities, CSE Publication (2018)*
3. *Chapman, J.L. and Reiss, M.J., Ecology - Principles and Application, Cambridge University Press (LPE) (1999).*
4. *Eastop, T.P. and Croft, D.R. Energy Efficiency for Engineers and Technologists, Longman and Harow (2006).*
5. *O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).*
6. *Peavy H.S. and Rowe D.R. Environmental Engineering, McGraw Hill (2013).*

Evaluation Scheme:

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

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; Convolution theorem; 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):

On completion of the course, the students would 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).*

Recommended Books:

1. *Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006), 8th ed.*
2. *Jain, R.K. and Iyenger, S.R.K , Advanced Engineering Mathematics, Narosa Publishing House(2011), 11th ed.*

Evaluation Scheme:

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

UES009: MECHANICS

L	T	P	Cr
2	1	2*	2.5

(*:Two hours Lab Once In Semester)

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

Review of Newton's law of motion and vector algebra.

Equilibrium of Bodies: Free-body diagrams; conditions of equilibrium; torque due to a force; statical determinacy.

Plane Trusses: Forces in members of a truss by method of joints and method of sections.

Friction: Sliding, belt, screw and rolling.

Properties of Plane Surfaces: First moment of area; centroid; second moment of area etc.

Shear Force and Bending Moment Diagrams: Types of load on beams; classification of beams; axial, shear force and bending moment diagrams: simply supported, overhung and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment.

Virtual Work: Principle of virtual work; calculation of virtual displacement and virtual work.

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):

On completion of the course, the students would be able to:

1. determine resultants in plane force systems
2. identify and quantify all forces associated with a static framework
3. draw Shear Force Diagram and Bending Moment Diagram in various kinds of beams subjected to different kinds of loads

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UTA018: OBJECT ORIENTED PROGRAMMING

L T P Cr
3 0 2 4.0

Course Objectives: To become familiar with object-oriented programming concepts and be able to apply these concepts in solving diverse range of applications.

Objects and Classes: Structure in C and C++, Class specification, Objects, Data hiding, Encapsulation and abstraction, namespaces, Array of objects, Passing objects as arguments, Returning object from a function, inline functions, Static data member and member function, 'const' member function.

Constructor and Destructor: Constructors, Parameterized Constructors, Constructor Overloading, Constructors in array of objects, Constructors with default arguments, Dynamic Initialization, Pointer to objects, this pointer, Dynamic memory allocation, Array of pointer to objects, Copy Constructor, Static objects, Friend function, and Friend classes.

Operator Overloading and Type Conversion: Syntax of operator overloading, Overloading Unary operator and Binary operator, overloading arithmetic operator, relational operator, Overloading Unary operator and Binary operator using friend function, Data conversion, Overloading some special operators like (), []

Inheritance: Derived Class declaration, Public, Private and Protected Inheritance, friend function and Inheritance, Overriding member function, Forms of inheritance, virtual base class, Abstract class, Constructor and Inheritance, Destructor and Inheritance, Advantage and disadvantage of Inheritance.

Polymorphism: Classification of Polymorphism, Compile time and Run time Polymorphism, Pointers to derived class object, Virtual functions, Pure virtual functions.

File handling: Formatted I/O, Hierarchy of file stream classes, Opening and closing a file, Working with multiple files, file modes, file pointers, Text vs Binary Files.

Templates: Need of template, Function templates, Function template with non-type parameter, Overloading function templates, Class templates, Class template with non-type parameter.

Exception Handling: Exception handling mechanism, Multiple Catch Blocks, Catch All exceptions, Throw an exception, Exception Specification.

Standard Template Library: Fundamental idea about string, iterators, hashes and other types, The String and Vector classes vs C-style pointers

Laboratory work:

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

Course Learning Outcomes (CLOs):

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

1. Understand the basic concept of Classes, objects and Object Orientation, with basic layout of an object oriented program.
2. Comprehend the concept of constructors and destructors.
3. Demonstrate the prime concepts viz. overloading, polymorphism, abstraction and Inheritance of an object oriented paradigm.
4. Grasp the File handling concepts and be able to use files.
5. Use template and Exception handling in an object oriented programming.

Text Books:

1. *Schildt H., C++: The Complete Reference, Tata Mcgraw Hill (2003) 4th ed.*
2. *Lippman B. S., Lajoie J., and Moo E. B., C++ Primer, Addison-Wesley Professional (2013) 5th ed.*

Reference books:

1. *Lafore R., Object-Oriented Programming in C++, Pearson Education (2002) 4th ed.*
2. *E Balagurusamy, Object Oriented Programming with C++ (2017) 7th ed.*
3. *Stroustrup B., The C++ programming language, Pearson Education India (2013) 4th ed.*

Evaluation scheme

Sr. No.	Evaluation Elements	Weights (%)
1.	MST	25
2.	EST	45
3.	Sessional (May include Assignments/ Quiz/Lab evaluations)	30

UTA013: ENGINEERING DESIGN PROJECT-I

L T P Cr
- - - 4.0

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

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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 &	The Role of Modelling in Engineering Design.

Breakup of lecture details to be taken up by ECED:

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

Tutorial Assignment / Laboratory Work:

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

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

Innovative redesign of the Mangonel and its testing by group	W3
Innovative redesign of the Mangonel and its testing by group	W4
Final inter group competition to assess best redesign and understanding of the “Mangonel”.	W5

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

1. the assembly of a Mangonel from a Bill Of Materials (BOM), detailed engineering drawings of parts, assembly instructions, and few prefabricated parts;
2. the development of a software tool to allow the trajectory of a “missile” to be studied as a function of various operating parameters in conditions of no-drag and drag due to air;
3. a structural analysis of certain key components of the Mangonel for static and dynamic stresses using values of material properties which will be experimentally determined;
4. the development of a micro-electronic system to allow the angular velocity of the throwing arm to be determined;
5. testing the Mangonel;
6. redesigning the throwing arm of the Mangonel to optimise for distance without compromising its structural integrity;
7. an inter-group competition at the end of the semester with evaluation of the group redesign strategies.

Course Learning Outcomes (CLO):

On completion of the Course, the student would 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	30
	Assessment of Mechanical contents in Lectures and Tutorials and Electronics contents in Lectures and Practical.	30
	Project (Assembly of the “Mangonel”, innovative redesign with reflection, prototype competition, Final Presentation and viva-voce	10 30