

COURSE SCHEME AND SYLLABUS

FOR

B.E. (COE)



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

2023

SEMESTER-I

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCB009	Chemistry	BSC	3	0	2	4
2.	UES103	Programming for Problem Solving	ESC	3	0	2	4
3.	UES013	Electrical & Electronics Engineering	ESC	3	1	2	4.5
4.	UEN008	Energy and Environment	OTH	2	0	0	2
5.	UMA010	Mathematics – I	BSC	3	1	0	3.5
		TOTAL					18

SEMESTER-II

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UPH013	Physics	BSC	3	1	2	4.5
2.	UES101	Engineering Drawing	ESC	2	4	0	4
3.	UHU003	Professional Communication	HSS	2	0	2	3
4.	UES102	Manufacturing Processes	ESC	2	0	2	3
5.	UMA004	Mathematics–II	BSC	3	1	0	3.5
		TOTAL					18

SEMESTER-III

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCS303	Operating System	PCC	3	0	2	4
2.	UTA018	Object Oriented Programming	PCC	3	0	2	4
3.	UCS301	Data Structures	PCC	3	0	2	4
4.	UCS405	Discrete Mathematical Structures	PCC	3	1	0	3.5
5.	UTA016	Engineering Design Project I (2 self-effort hours)	ESC	1	0	2	3
6.	UMA021	Numerical Linear Algebra	BSC	3	0	2	4
7.	UHU050	Evolutionary Psychology (1 Self Effort Hour)	HSS	1*	0	0	1
		TOTAL					23.5

Note: *Alternate week

SEMESTER-IV

S. No.	Course Code	Course Name	CODE**	L	T	P	Cr
1.	UCS415	Design and Analysis of Algorithms	PCC	3	0	2	4
2.	UCS310	Database Management Systems	PCC	3	0	2	4
3.	UES021	Engineering Materials	PCC	3	0	2	3
4.	UCS411	Artificial Intelligence	PCC	3	0	2	4
5.	UMA401	Probability and Statistics	BSC	3	1	0	4
6.	UTA024	Engineering Design Project II	PCC	1	0	4	3
7.	UTD002	Employability Development Skills	HSS	2	0	0	2
		TOTAL					24

Generic Elective

S.No.	Course No.	Course Name	L	T	P	Cr
1	UHU016	Introductory Course In French	2	0	0	2.0
2	UHU017	Introduction To Cognitive Science	2	0	0	2.0
3	UHU018	Introduction To Corporate Finance	2	0	0	2.0
4	UCS002	Introduction To Cyber Security	2	0	0	2.0
5	UPH064	Nanoscience And Nanomaterials	2	0	0	2.0
6	UEN006	Technologies For Sustainable Development	2	0	0	2.0
7	UMA069	Graph Theory And Applications	2	0	0	2.0
8	UBT510	Biology For Engineers	2	0	0	2.0

Total Credit Score for specific Nature of course/s

Nature of the course	CODE	Total Credits	Semester and Course Name
Basic Science Courses	BSC	27	1, Applied Chemistry (4) 1, Mathematics – I (3.5) 2, Applied Physics (4.5) 2, Mathematics–II (3.5) 3, Numerical Linear Algebra (4) 4, Probability and Statistics (3.5) 6, Optimization Techniques (4)
Engineering Science Courses	ESC	18.5	1, Programming for Problem Solving (4) 1, Electrical & Electronics Engineering (4.5) 2, Engineering Drawing (4) 2, Manufacturing Processes (3) 3, ENGINEERING MATERIALS (3)
Humanities and Social Science Courses	HSS	9	2, Professional Communication (3) 7, Humanities for engineers (3) 3, Evolutionary Psychology 4, Employability Development Skills
Professional Core Courses	PCC	58	3, Operating System (4) 3, Object Oriented Programming (4) 3, Data Structures (4) 3, Discrete Mathematical Structures(3.5) 4, Design and Analysis of Algorithms (4) 4, Database Management Systems (4) 4, Software Engineering (4) 4, Computer Architecture and Organization (3) 4, Computer Graphics (3) 5, Computer Networks (4) 5, Machine Learning (4) 5, Cognitive Computing (2) 5, Artificial Intelligence (3) 5, Theory of Computation (3.5) 6, Quantum Computing (4) 7, Compiler Construction (4)
Professional Elective Courses	PEC	12	5, EFB-I(3) 6, EFB-II (3) 6, EFB-III (3) 7, EFB-IV (3)
Open Elective Courses	OEC	5	6, Innovation and Entrepreneurship (3) 6, Generic Elective (2)
Project	PRJ	29	5, Engineering Design Project-1 (3) 6, Engineering Design Project-II (3) 7, Capstone Project (8) 8, Project Semester (15)
Others	OTH	2	1, Energy and Environment (2)
Total		160.5	

UES103: Programming for Problem Solving				
	L	T	P	Cr
	3	0	2	4.0
<p>Course Objectives: This course is designed to solve and explore the problems using the art of computer programming with the help of C Language. Students will be able to apply these problem solving concepts in real life applications.</p>				
<p>Syllabus</p> <p>Introduction to Computer Fundamentals- Computer Memory Hierarchy, Types of Software Binary number system, Algorithm, Flowchart, Formulate simple algorithms for logical and arithmetic problems.</p> <p>Basics of C Programming: Structure and Life cycle of a C Program, Data types, Identifiers, Variables, Keywords, Constants, input/output statements, Operators, Type conversion and type casting. Translate the algorithms to code snippets.</p> <p>Decision Making and Iterative Statements-Decision making- if, if-else, Nested if-else, Multiple if, else if, switch, Ternary Operator, Loops- (while, do-while, for), Nesting of Loops, break, continue and goto. Implement the switch () to solve the basic functions of scientific calculator.</p> <p>Functions: Function prototype, Definition and Call, Type of Functions, Scope of variables in (Block, Function, Program, File), Storage classes (Auto, Register, Static and Extern), Recursion (with the introduction of Stack), Implementation of recursion to solve the problem of Tower of Hanoi.</p> <p>Arrays and Strings- One-dimensional array its operations (Traversal, Linear Search, Insertion, Deletion, Bubble Sort), Two-dimensional and its operations (Addition, Transpose and Multiplication), Passing of array into a function (row and entire array), Input and output of a string, string inbuilt functions, 2-D Character array.</p> <p>Pointers: Introduction to Pointers, Pointer arithmetic, Passing arguments to a function using pointer (understanding of call by value and call by reference), Accessing arrays using pointers Dynamic memory allocation (malloc(), calloc(), realloc() and free()), Pointer and Functions.</p> <p>Structures and Union: Structure declaration, Initialization of structures, Structure variables, Accessing structure elements using (.) operator, Array of structure variables, Passing structure variable to a function (individual and entire structure), Structure pointer, Comparison of Structure and Union.</p> <p>File Handling: Introduction of Files (streams in C), using File (Declaring, Opening and Closing), Operations on File (Reading, Writing and appending), and Random Access of a</p>				

file, command line argument.
Laboratory Work To implement programs for various kinds of real life applications in C Language.
Course Learning Outcomes (CLOs) /Course Objectives (COs): On completion of this course, the students will be able to: <ol style="list-style-type: none"> 1. Comprehend and analyze the concepts of number system, memory, compilation and debugging of the programs in C language. 2. Analyze the control & iterative statements to solve the problems with C language source codes. 3. Design and create programs for problem solving involving arrays, strings and pointers. 4. Evaluate and analyze the programming concepts based on user defined data types and file handling using C language.
Text Books <ol style="list-style-type: none"> 1. C Programming Language, Brian W. Kernighan Dennis M. Ritchie, 2nd ed, 2012. 2. Programming in ANSI C, Balagurusamy G., 8th ed., 2019
Reference Books <ol style="list-style-type: none"> 1. Let Us C, Kanetkar Y., 16th ed., 2017 2. Programming with C, Byron S Gottfried, McGraw Hill Education, Forth edition, 2018

UCB009: Chemistry

L	T	P	Cr
3	0	2	4.0

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

Syllabus

Atomic and Molecular spectroscopy: Introduction to spectroscopy, principles of atomic absorption, flame emission spectrophotometry and ICP-AES (Inductively Coupled Plasma- Atomic Emission Spectroscopy), Quantification by calibration method, Jablonski diagram, fluorescence and phosphorescence, Beer-Lambert's Law, principle and applications of UV-Vis and IR spectroscopy.

Electrochemistry: Background of electrochemistry, Ionic mobility, Conductometric titrations, Modern Batteries: Pb-acid and Li ion battery, Corrosion and its protection.

Water Treatment and Analysis: Physiochemical parameters of water quality, External and internal methods of Softening of water: carbonate, phosphate, calgon and colloidal conditioning, Zeolite process, Ion exchange process, treatment of water for domestic use, Desalination of brackish water: Reverse osmosis & Electrodialysis.

Fuels: Classification of fuels, Calorific value, Cetane and Octane number, alternative fuels: biodiesel, Power alcohol, synthetic petrol, Fuel cells: H₂ production and storage, Water splitting, Rocket propellant.

Chemistry of Polymers: Classification of polymers, tacticity of polymers, molecular weight calculations, Polymers in daily life, conducting, inorganic and biodegradable polymers.

Computers in Chemistry: Introduction to SMILES (Simplified Molecular Input Line-Entry System): Methodology and encoding rules, SMILES notation-chemical structure interconversions and its applications.

Laboratory Work

Electrochemical measurements: Experiments involving use of pH meter, conductivity meter, potentiometer, Spectroscopic technique, Volumetric titrations: Determination of mixture of bases, hardness, alkalinity, chloride and iron content, Application of polymers and SMILES Language.

Course Learning Objectives (CLO)

The students will be able to:

1. recognize principles and applications of atomic and molecular spectroscopy.
2. explain the concepts of conductometric titrations, modern batteries and corrosion.
3. apply and execute water quality parameter and treatment methods.
4. discuss the concept of alternative fuels, application of polymers and SMILES.

5. execute laboratory techniques like pH metry, potentiometry, spectrophotometry, conductometry and volumetry.

Text Books

1. Engineering Chemistry, S. Vairam and S. Ramesh, Wiley India 1st ed, 2014.
2. Engineering Chemistry, K. S. Maheswaramma, and M. Chugh. Pearson, 2016.

Reference Books

1. Engineering Chemistry, B. Sivasankar, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2008.
2. Engineering Chemistry, M.J. Shulz, Cengage Learnings, 2007.
3. J. Chem. Inf. Comput. Sci., D. Weininger, Vol. 28, 1988, 31-36.

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Sessional (Includes Regular Lab assessment and Quizzes Project (Including report, presentation etc.)	30

UES013: Electrical and Electronics Engineering

L	T	P	Cr
3	1	2	4.5

Course Objective: To introduce the basic concepts of electrical and electronics UCBengineering.

Syllabus

DC Circuits: Introduction to circuit elements; rms and average values for different wave shapes, independent and dependent current and voltage sources; Kirchhoff's laws; mesh and node analysis; source transformations; network theorems: Superposition theorem, Thevenin's and Norton's theorem, Maximum power transfer theorem; star-delta transformation; steady state and transient response of R-L and R-C and R-L-C circuits.

AC Circuits: Concept of phasor, phasor representation of circuit elements; analysis of series and parallel AC circuits; concept of real, reactive and apparent powers; resonance in RLC series and parallel circuits; balanced three phase circuits: voltage, current and power relations for star and delta arrangement; analysis of balanced and unbalanced circuits; three phase power measurement using two-wattmeter and one-wattmeter methods.

Magnetic circuits: analogy between electric and magnetic circuits; series and parallel magnetic circuits; operating principles of electrical appliances: single-phase transformer and rotating machines; tests and performance of single-phase transformer.

Digital Logic Design: Digital signals, Number systems, Positive and negative representation of numbers, Signed-number representation, Binary arithmetic, Postulates and theorems of Boolean Algebra, Algebraic simplification, Sum of products and product of sums formulations (SOP and POS), Gate primitives, Logic Gates and Universal Gates, Minimization of logic functions, Karnaugh Maps, Logic implementation using Gates, Decoder, MUX, Flip-Flops, Asynchronous up/down counters.

Electronic Devices: p- n junction diode: V-I characteristics of diode, Operation of Bipolar Junction Transistor, CB and CE configuration, Transistor as a switch, Operation of SCR, DIAC and TRIAC.

Operational Amplifier Circuits: The ideal operational amplifier, the inverting, non-inverting amplifiers, Op-Amp Characteristics, Applications of Op-amp: summing amplifier, differentiator and integrator.

Laboratory Work: Kirchhoff's laws, network theorems, ac series and parallel circuit, three phase power measurement, magnetic circuit, tests on transformer, resonance in AC circuit, combinational circuits, flip flops, shift register and binary counters, asynchronous and synchronous up/down counters, BJT characteristics.

Course Learning Objectives (CLO)

The students will be able to:

1. apply various networks laws and theorems to solve dc circuits
2. compute different ac quantities with phasor representation
3. comprehend the operation in magnetic circuits, single phase transformer and rotating machines
4. recognize and apply the number systems and Boolean algebra.

5. reduce and simplify Boolean expressions and implement them with logic gates.
6. discuss and explain the working of diode, transistor and operational amplifier, their configurations and applications.

Text Books

1. Hughes, E., Smith, I.M., Hiley, J. and Brown, K., Electrical and Electronic Technology, Prentice Hall (2008) 10th ed.
2. Nagrath, I.J. and Kothari, D.P., Basic Electrical Engineering, Tata McGraw Hill (2002).
3. Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Pearson (2009).
4. Mano M. M. and Ciletti, M.D., Digital Design, Pearson, Prentice Hall, (2013).

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).
3. David Bell, Electronics Devices and Circuits, Oxford Publications (2009).

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Sessional (Includes Regular Lab assessment and Quizzes Project (Including report, presentation etc.)	30

UEN008: Energy and Environment

L	T	P	Cr
2	0	0	2.0

Course Objective: 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 need of sustainability in addressing the current environmental & energy challenges.

Syllabus

Introduction: Concept of sustainability and sustainable use of natural resources, Climate Change & its related aspects.

Air Pollution: Origin, Sources and effects of air pollution; Primary and secondary meteorological parameters; wind roses; Atmospheric stability; Source reduction and Air Pollution Control Devices for particulates and gaseous pollutants in stationary sources.

Water Pollution: Origin, Sources of water pollution, Category of water pollutants, Physicochemical characteristics, Components of wastewater treatment systems.

Solid waste management: Introduction to solid waste management, Sources, characteristics of municipal solid waste, Solid waste management methods: Incineration, composting, landfilling.

Energy Resources: Classification of Energy Resources; Non-conventional energy resources- Biomass energy, Thermo-chemical conversion and biochemical conversion route; Solar energy-active and passive solar energy absorption systems; Type of collectors; Thermal and photo conversion applications.

Course Learning Objectives (CLO)

The students will be able to:

1. comprehend the interdisciplinary context of environmental issues with reference to sustainability
2. assess the impact of anthropogenic activities on the various elements of environment and apply suitable techniques to mitigate their impact.
3. demonstrate the application of technology in real time assessment and control of pollutants.
4. correlate environmental concerns with the conventional energy sources associated and assess the uses and limitations of non-conventional energy technologies

Text Books

1. Moaveni, S., Energy, Environment and Sustainability, Cengage (2018)
2. Rajagopalan, R., Environmental Studies, Oxford University Press (2018)
3. O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).

Reference Books

1. Peavy H.S., Rowe D.S., and Tchobanoglous, G. (2013) Environmental Engineering, McGraw Hill.
2. Rao, M.N. and Rao, H.V.N. (2014) Air Pollution, McGraw Hill.
3. Metcalf and Eddy. (2003) Wastewater Engineering: Treatment and Reuse, Fourth Edition, McGraw Hill.
4. Rai, G.D. (2014) Non-conventional Energy Resources, Khanna Publishers.

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Sessional (Includes Regular Lab assessment and Quizzes Project (Including report, presentation etc.)	30

UMA010: Mathematics-I

L	T	P	Cr
3	1	0	3.5

Course Objective: 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.

Syllabus

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

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

Partial Differentiation: Functions of several variables, Limits and continuity, Chain rule, Change of variables, Partial differentiation of implicit functions, Directional derivatives and its properties, Maxima and minima by using second order derivatives.

Multiple Integrals: 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).

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 Objectives (CLO)

The students will be able to:

1. determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.
2. examine functions of several variables, define and compute partial derivatives, directional derivatives, and their use in finding maxima and minima in some engineering problems.
3. evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.
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 Churchill R.V, Complex variables and applications, McGraw Hill, (7th edition)

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Sessional (Includes Regular Lab assessment and Quizzes Project (Including report, presentation etc.)	30

UPH013: Physics

L	T	P	Cr
3	1	2	4.5

Course Objective: 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

Syllabus

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-shaped 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 Objectives (CLO)

The 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) 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 HallTM (2008) 3rd ed.

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Sessional (Includes Regular Lab assessment and Quizzes Project (Including report, presentation etc.)	30

UES101: Engineering Drawing

L	T	P	Cr
2	4	0	4.0

Course Objective: This module is dedicated to graphics and includes two sections: 2D drafting and 3D modelling of solid objects. This course is aimed at making the student understand the concepts of projection systems, learn how to create projections of solid objects using first and third angle orthographic projection as well as isometric and auxiliary projection, concept of sectioning, to interpret the meaning and intent of toleranced dimensions and to create/edit drawings using drafting software. In addition, this course shall

give an insight on the basic 3D modelling concepts like extrude, revolve, sweep, construction

of complex solids.

Syllabus

Engineering Drawing Concepts

1. Introduction to Engineering Drawing
2. Projection systems: First angle and third angle projection system
3. Orthographic Projection: Points, Lines, Solid objects
4. Isometric Projections
5. Auxiliary Projections
6. Development of surfaces
7. Section of solids
8. Limits, fits and tolerances

2D Drafting

1. Management of screen menus commands
2. Creating basic 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

3D Modelling

1. Management of screen menus commands
2. Introduction to basic 3D modelling commands such as extrude, revolve, sweep etc.
3. Creation of 2D drawings from a 3D model

Micro Projects /Assignments:

1. Completing the views - Identification and drawing of missing lines and views in the projection of objects
2. Projects related to orthographic and isometric projections Using wax blocks/soap

bars/any soft material to develop three dimensional object from given orthographic projections

3. a. 3D modelling of complex machine components
b. Development of production drawings of individual components from the model

Course Learning Objectives (CLO)

The students will be able to:

1. creatively comprehend the geometrical details of common engineering objects
2. draw dimensioned orthographic and isometric projections of simple engineering objects
3. interpret the meaning and intent of limits, fits and tolerances in the drawing
4. create/edit the engineering drawings for simple engineering objects using 2D drafting software
5. create/edit 3D models of engineering components using 3D modelling software

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).
6. *Mastering AutoCAD 2021 and AutoCAD LT 2021*, Brian C. Benton, George Omura, Sybex - John Wiley and Sons, Indiana (2021).

Evaluation Scheme

Course Component	Weightage
AutoCAD tutorials/SolidWorks/Project work*	35
MST (1.5 hours-CAD based)**	20
EST (2 hours-CAD based)**	45

***Students are required to bring their personal computers for the tutorial work.**

***Availability of institute server resources for sharing the software licences with the student community.**

****Institute computational resources in collaboration with other academic units / departments for conducting the mid semester and end semester test.**

UES102: Manufacturing Processes

L	T	P	Cr
2	0	2	3.0

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

Syllabus

Machining Processes: Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, Introduction to computerized numerical control (CNC) machines, G and M code programming for simple turning and milling operations, introduction of canned cycles.

Metal Casting: Introduction & Principles of sand casting, Requisites of a sound casting, Permanent mold casting processes, casting defects

Metal Forming: Hot & cold metal working, Forging, Rolling, Sheet Metal operations.

Joining Processes: Method of joining, type of electric arc welding processes, Methods of shielding, Power source characteristics, Resistance welding, Soldering, Brazing.

Smart Manufacturing: IoT and ML in manufacturing, Introduction to Additive Manufacturing, Robotics and Automation in manufacturing.

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. Case study related to smart manufacturing.

Micro Project: Fabrication of multi-operational jobs using the above processes as per requirement by teams consisting of 4 -6 members. Quality check should be using the equipment available in metrology lab.

Course Learning Objectives (CLO)

The students will be able to:

1. identify & analyse various machining processes/operations for manufacturing of

industrial components

2. apply the basic principle of bulk and sheet metal forming operations
3. apply the knowledge of metal casting for different requirements.
4. identify and analyse the requirements to for achieving a sound welded joint apply the concept of smart manufacturing

Text Books

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

Reference Books

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

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Sessional (Includes Regular Lab assessment and Quizzes Project (Including report, presentation etc.)	30

UHU003: Professional Communication

L	T	P	Cr
2	0	2	3.0

Course Objective: The course is designed to develop the interpersonal, written, and oral as well as the non-verbal communication skills of the students. The course begins by building up on the theoretical concepts and then practicing on the applicability of the various elements. Since the course has very high applicability content, the students are advised to practice in class as well as off class. A very high level of interaction is expected of the students in the class.

Syllabus

Fundamentals of Communication: Meaning, Types and Characteristics of communication, Applicability of Transactional Analysis and Johari Window for enhancing interpersonal communication skills. Seven Cs of Effective Communication, Barriers to Effective Communication.

Effective Oral Communication: Understanding Principles of Oral communication, Formal and Informal Oral Communication, Oral Communication and Behavioral Patterns, Advantages and Disadvantages of Oral Communication.

Effective Listening: Listening vs Hearing, Active Listening techniques, Barriers to Listening.

Effective non-verbal communication: Meaning and Importance of Non-Verbal Communication, Different Types of Non-verbal Communication, Interpretation of Non-verbal Cues.

Effective written Communication: Characteristics of Good Writing, Choice of Words, Sentence Construction, Paragraph development, Forms of writing.

Business Communication: Technical Report Writing, Designing Resumes and Cover Letters for effective job application, E-mail writing and e-mail etiquette.

Organizational Communication: Directional communication: Downward, Upward and Horizontal Communication, Grapevine.

Reading: The following texts (one from each of the two categories listed below) are required to be read by the students in the semester:

Category 1: Animal Farm by George Orwell, Lord of the Flies by William Golding, Life of Pi by Yann Martel

Category 2: The Namesake by Jhumpa Lahiri, The God of Small Things by Arundhati Roy, Q&A by Vikas Swarup

Laboratory Work

1. Needs-assessment of spoken and written communication with 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 Objectives (CLO)

The students will be able to:

1. Apply communication concepts for effective interpersonal communication.
2. Speak assertively and effectively.
3. Interpret non-verbal cues in professional communication.
4. Write objectively, purposefully and effectively.
5. Design effective resumes and reports.

Text Books

1. Mukherjee H.S..Business Communication: Connecting at Work. Oxford University Press.(2013)
2. Lesikar R.V, and Flatley M.E., Basic Business Communication Skills for empowering the internet generation.(2006)
3. Raman, M.,and Singh ,P, Business Communication . Oxford . University Press (2008).

Reference Books

1. Riordan, G.R. Technical Communication. Cengage Learning India Private Ltd. (2012)
2. Butterfield, Jeff., Soft Skills for everyone, Cengage Learning New Delhi, (2013).
3. Robbins, S.P., & Hunsaker, P.L., Training in Interpersonal Skills, Prentice Hall of India, New Delhi, (2008).
4. Orwell, G., Animal Farm, Fingerprint Publishing, New Delhi, (2017).
5. Golding, W, Lord of the Flies, Faber & Faber; Export edition (1999)
6. Martel,Y., Life of Pi, RHC, New Delhi, (2012).
7. Lahiri,J., The Namesake, Harpercollins (2007)
8. Arundhati Roy,A., The God of Small Things, Penguin India, (2002).
9. Swarup,V., Q&A, Black Swan,(2009).

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Sessional (Includes Regular Lab assessment and Quizzes Project (Including report, presentation etc.)	30

UMA004: Mathematics - II

L	T	P	Cr
3	1	0	3.5

Course Objective: 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.

Syllabus

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.

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.

Course Learning Objectives (CLO)

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 eigenvalues and eigenvectors.

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), 8th edition.
2. Jain, R.K. and Iyenger, S.R.K., Advanced Engineering Mathematics, Narosa Publishing House (2011), 4th edition.

Evaluation Scheme

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25-30
2	EST	40-45
3	Sessional: (May include the following) Assignment, Sessional (Includes Regular Lab assessment and Quizzes Project (Including report, presentation etc.)	30

UCS303: Operating System				
	L	T	P	Cr
	3	0	2	4.0
Course Objective: To understand the role, responsibilities, and algorithms involved for achieving various functionalities of an Operating System.				
Syllabus Introduction and Operating System Structures: Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Computing Environments, Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Structure, System boot. Process Management: Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication, Overview of Threads, Multi-core Programming, Multithreading Models, CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling. Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock. Memory Management: Basic Hardware, Address Binding, Logical and Physical Address, Dynamic linking and loading, Shared Libraries, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Demand Paging, Page Replacement, Allocation of Frames, Thrashing. Storage Management: Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, RAID Structure; File Concept, Access Methods, Directory and Disk Structure, File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods. Protection and Security: Principles of Protection, Domain of Protection, Access Matrix, Implementation of the Access Matrix, The Security Problem, Program Threats. Process Synchronization: The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Overview of Monitors.				
Laboratory Work Learn and practice basic Linux/Unix commands to Create and manipulate files and directories; Explore about Vi Editor environment; Build .C program related to fork (), exec (), wait (), sleep () functions at Linux/Unix platform; Write .C program for message passing and shared memory; Simulate CPU scheduling algorithms using either C or C++				
Course Learning Objectives (CLO) The students will be able to:				

1. Describe the basics of an operating system, including the kernel, system calls, and computing environments.
2. Evaluate the effectiveness and trade-offs of different models of multithreading, scheduling algorithms, and methods for handling deadlocks, such as prevention, avoidance, detection, and recovery.
3. Understand components of a memory system, virtual memory and analyze different memory management techniques.
4. Evaluate the effectiveness of different Disk Management strategies, and Critique the design and implementation of File System
5. Explain the basic concepts of Concurrency, Protection and Security issues in an operating system.

Text Books

1. Operating System Concepts, Silberschatz A., Galvin B. P. and Gagne G., John Wiley & Sons Inc., 9th ed, 2013.
2. Operating Systems Internals and Design Principles, Stallings W., Prentice Hall 9th ed, 2018

Reference Books

3. Understanding the Linux Kernel, Bovet P. D., Cesati M., O'Reilly Media, 3rd ed, 2006.
4. Introduction to Operating System Design and Implementation: The OSP 2 Approach, Kifer M., Smolka A. S., Springer, 2007

UTA018: Object Oriented Programming				
	L	T	P	Cr
	3	0	2	4.0
<p>Course Objective: To become familiar with object oriented programming concepts and be able to apply these concepts in solving diverse range of applications.</p>				
<p>Objects and Classes: Structure in C and C++, Class specification, Objects, Namespaces, Overview of pillars of OOPS (Data Encapsulation, Data Abstraction, Inheritance, Polymorphism), Inline functions, Passing objects as arguments, Returning object from a function, Array of objects, Static keyword with data member, member function and object, Friend function, and Friend classes, Pointer to objects, this pointer, Dynamic Initialization, Dynamic memory allocation.</p> <p>Constructor and Destructor: Constructors and its types, Constructor Overloading, Constructors in array of objects, Constructors with default arguments, Dynamic Constructor, Destructor, 'const' keyword with data member, member function and object.</p> <p>Inheritance: Introduction to Inheritance, Forms of Inheritance (Single, Multiple, Multilevel, Hierarchical and Hybrid) with various modes (Public, Private and Protected), Inheritance with Constructor and Destructor, Benefits and Limitations of Inheritance.</p> <p>Polymorphism: Classification of Polymorphism (Compile-time and Run-time), Compile Time-Function Overloading, Operator Overloading (Unary operator and Binary operator with member function and friend function), Data Conversion (Basic to user-defined, user-defined to basic, one user-defined to another user-defined). Run-time- Pointers to derived class object, Overriding member function, Virtual functions, pure virtual functions, Abstract class.</p> <p>Exception Handling, Templates and Standard Template Library: Exception handling mechanism, Usage of template, Function templates, Overloading of Function templates, Class templates, Introduction to Standard Template Library and its components. Algorithms, Containers (Array, Vector, Stack, List and Queue) and Iterators.</p>				
<p>Laboratory Work</p> <p>To implement object oriented constructs using C++ programming language.</p>				
<p>Course Learning Objectives (CLO)</p> <p>The students will be able to:</p> <ol style="list-style-type: none"> 1. To recall the knowledge of structure and its variables to comprehend the concept of classes, objects, constructors and destructors for implementing the object oriented paradigms. 2. To apply and analyze the inheritance on real life case studies via coding competences. 3. To design and develop code snippets for polymorphism to proclaim coding 				

potential; and management of run-time exceptions.

4. To assess and interpret the knowledge of templates to appraise the standard template libraries.

Text Books

1. C++:The Complete Reference , Schildt H., Tata McGraw Hill, 4thed, 2003
2. C++Primer, Lippman B.S., Lajoie J., and MooE.B., , Addison-Wesley Professional, 5th ed, 2013

Reference Books

1. Object-Oriented Programming in C++, Lafore R., Pearson Education, 4thed, 2002
2. Object Oriented Programming with C++, E Balagurusamy, 8thed,2017
3. The C++programming language, Stroustrup B., Pearson Education India, 4thed, 2013

UCS301: Data Structures				
	L	T	P	Cr
	3	0	2	4.0
Course Objective: To become familiar with different types of data structures and their applications.				
Syllabus <p>Analysing algorithms: Basics of algorithm and its analysis, Complexity classes, order arithmetic, Time and space trade-off in algorithms.</p> <p>Linear Data Structures: Arrays, Strings and string processing, Linked lists (Singly, Doubly, Circular), Abstract data types, their implementation and applications: Stacks (using Arrays and Linked-list), Queues (using Arrays and Linked-list), Hash tables: Hash functions, collision resolution techniques, Strategies for choosing the appropriate data structure.</p> <p>Searching and Sorting: Linear Search, Binary Search. Introduction to internal and external sort, Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Merge Sort, Counting Sort, Radix Sort.</p> <p>Trees and their applications: Introduction to binary tree, tree traversal algorithms, Binary search tree, AVL Tree, B Tree etc. and common operations on these trees. Heap, Heap Sort, Priority Queue using Heap.</p> <p>Graphs and their applications: Graph Terminology and its representation, Depth and breadth first traversals, Shortest-path algorithms (Dijkstra and Floyd), Data Structures for Disjoint Sets, Minimum spanning tree (Prim and Kruskal).</p>				
Laboratory Work <p>Implementation of various data structures such as Arrays, Stacks, Queues, Lists, Binary tree traversals, BST, AVL trees, Graphs traversals, Sorting and Searching techniques.</p>				
Course Learning Objectives (CLO) <p>The students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the fundamental data structures, their implementation and some of their standard applications. 2. Select and implement appropriate searching and sorting techniques for solving a problem based on their characteristics. 3. Apply tree and graph data structures for specific applications. 4. Design and analyse algorithms using appropriate data structures for real-world problems. 				
Text Books <ol style="list-style-type: none"> 1. Introduction to Algorithms, Cormen H. T., Leiserson E. C., Rivest L. R., and Stein C, MIT Press, 3rd ed., 2009 2. Data Structures, Algorithms and Applications in C++, Sahni S., Universities Press 2nd ed. 2005 				

Reference Books

1. Data Structures and Algorithms Made Easy, Karumanchi N., Career Monk Publications, 5th ed., 2017
2. Data structures and algorithms in C++, Adam Drozdek, 4th edition.

UCS405: Discrete Mathematical Structures				
	L	T	P	Cr
	3	1	0	3.5
Course Objective: The course objective is to provide students with an overview of Discrete Mathematical Structures. Students will learn about topics such as logic and proofs, sets and functions, graph theory, boolean algebra, number theory and other important discrete math concepts.				
Syllabus Sets, Relations, and Functions: Sets: Operations on set, Inclusion-exclusion principle, Representation of Discrete Structures, Fuzzy set, Multi-set, bijective function, Inverse and Composition of functions, Floor and Ceiling functions, Growth of functions: Big-O notation, Big-Omega and Big-Theta Notations, Determining complexity of a program, Hash functions. Relations: Different types of relation and their representation, Equivalence and partial-ordered relations, Partition and Covering of a set, N-ary relations and database, Closure of relations, Warshall's algorithm, Lexicographic ordering, Hasse diagram, Lattices, Boolean algebra. Graphs Theory: Representation, Type of Graphs, Paths and Circuits: Euler Graphs, Hamiltonian Paths & Circuits; Cut-sets, Connectivity and Separability, Planar Graphs, Isomorphism, Graph Coloring, Covering and Partitioning, Application of Graph theory in real-life applications. Basic Logic: Propositional logic, Logical connectives, Truth tables, Normal forms (conjunctive and disjunctive), Validity of well-formed formula, Propositional inference rules (concepts of modus ponens and modus tollens), Predicate logic, Universal and existential quantification, Proof Techniques. Recurrence Relation: Solving linear recurrence relations, divide and conquer algorithms and recurrence relations. Algebraic Structures: Group, Semi group, Monoids, Ring, Field, Homomorphism. Number Theory: Divisibility and Modular Arithmetic, Solving Congruences, Applications of Congruences, Cryptographic applications				
Laboratory Work NA				
Course Learning Objectives (CLO) The students will be able to: <ol style="list-style-type: none"> 1. Perform operations on various discrete structures such as set, function, and relation. 2. Apply basic concepts of asymptotic notation in the analysis of the algorithm. 3. Illustrate the basic properties and algorithms of graphs and apply them in modelling and solving real-world problems. 4. Comprehend formal logical arguments and translate statements from a natural language into their symbolic structures in logic. 5. Identify and prove various properties of rings, fields, and groups. 				

6. Illustrate and apply the division algorithm, mod function, and Congruence.

Text Books

1. Discrete Mathematics and its Applications, Rosen H. K., McGraw Hill, 7th ed., 2011
2. Discrete Mathematical Structures with Applications to Computer Science, Tremblay P. J. and Manohar, R., Tata McGraw Hill, 2008.

Reference Books

1. Contemporary Abstract Algebra, Gallian A. J., Cengage Learning, 9th ed., 2017
2. Discrete Mathematics, Lipschutz S., Lipson M., McGraw-Hill, 3rd ed., 2007

UMA021: Numerical Linear Algebra

L	T	P	Cr
3	0	2	4.0

Course Objectives: The goal of this course is to give students an introduction to numeric and algorithmic techniques used for the solution of a broad range of mathematical problems, with an emphasis on computational issues and linear algebra. In addition, students will become familiar with numeric programming environments Matlab.

Contents:

Roots of Non-Linear Equations: Mathematical preliminaries, bisection, fixed-point, Newton's method and its extension to system of equations.

Interpolation and Integration: Lagrange and Newton basis of polynomials and interpolation problems, divided difference interpolation, forward and backward differences, trapezoidal and Simpson's rules, method of undetermined coefficients.

Matrix Algebra: Gauss elimination method, pivoting strategies, matrix factorization, Jacobi and Gauss Seidel methods, matrix norm and conditioning, linear least square problems.

Matrix Computations: Orthogonal and orthonormal basis, Gram-Schmidt process, orthogonal matrices and similarity transformations, power method for eigen-value and eigen-vector, QR algorithm, singular value decomposition.

Laboratory Work:

Lab experiments will be set in consonance with materials covered in the theory and the implementation of numerical methods will be done using MATLAB

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. Make use of iterative methods to solve nonlinear equations.
2. Approximate the functions using interpolating polynomials and apply to definite integrals.
3. Evaluate solution of system of linear equations and least square problems.
4. Perform matrix computations and evaluate eigen-values and eigen-vectors.

Text Books

1. Richard L. Burden, J. Douglas Faires, and Annette Burden, Numerical Analysis, Cengage Learning, 10th edition, 2015.
2. Gilbert Strang, Linear Algebra and its Applications, Cengage Learning, 4th edition, 2005.
3. J. Desmond Higham and Nicholas J. Higham, MATLAB Guide, Third Edition, Society for Industrial and Applied Mathematics, 2016.

Reference Books

3. Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, McGraw-Hill Higher Education, 6th edition, 2010.

4. E. Ward Cheney and David R. Kincaid, Numerical Mathematics and Computing, Cengage Learning, 7th edition, 2012.
5. Endre Suli and David F. Mayers, An Introduction to Numerical Analysis, Cambridge University Press, 2003

Evaluation Scheme:

Sr. No.	Evaluation elements	Weightage (%)
1	MST	25
2	EST	45
3	Sessionals (Assignments/Quizzes/Lab Evaluation)	30

UCS415: DESIGN AND ANALYSIS OF ALGORITHMS				
	L	T	P	Cr
	3	0	2	4.0
Course Objective To provide students with the knowledge and skills necessary to design and analyse algorithms for solving computational problems.				
Syllabus: <p>Introduction and Complexity Analysis: Analysing algorithms, Complexity classes, Time and space trade-offs in algorithms, Recurrence relations, Analysis of iterative and recursive algorithms, Amortized Analysis.</p> <p>Algorithm Design Techniques and Analysis</p> <p>Divide and Conquer: Fundamentals of divide and conquer strategy, Applications such as The maximum subarray problem, Strassen's algorithm for matrix multiplication, merge sort, quick sort etc.</p> <p>Greedy Algorithms: Elements of greedy strategy, Applications such as activity selection, Huffman Coding, job sequencing, fractional knapsack problem, etc.</p> <p>Dynamic Programming: Elements of dynamic programming, Memorization and tabulation approaches, Applications such as matrix multiplication, 0/1 knapsack, Longest common subsequence, Optimal binary search tree, etc.</p> <p>Backtracking: Introduction, Applications such as N queen problem, sum of subsets, graph coloring, etc.</p> <p>Branch and Bound Algorithm: General method, Applications such as 0/1 knapsack problem, Traveling salesperson problem etc.</p> <p>Graphs & Algorithms: Introduction to graphs, Paths and Circuits, Euler Graphs, Hamiltonian graphs, Cut-sets, Connectivity and Separability, Covering and Partitioning, Strongly connected component, Topological sort, Max flow: Ford Fulkerson algorithm, max flow- min cut.</p> <p>String Matching Algorithms: Suffix arrays, Rabin-Karp, Knuth-MorrisPratt (KMP), Boyer Moore algorithm.</p> <p>Problem Classes: P, NP, NP-Hard and NP-complete, deterministic and non-deterministic polynomial time algorithm approximation, Randomized algorithms.</p> <p>Laboratory Work (if applicable): Implementation of various algorithmic techniques for solving common computational/engineering problems.</p> <p>Course Learning Objectives (CLO) The students will be able to:</p> <ol style="list-style-type: none"> 1. Analyse the complexity of algorithms and implement it in a specific scenario. 2. Apply common algorithmic techniques such as greedy, dynamic programming etc. to standard computational problems 3. Design solutions by using appropriate data structures or applying algorithms such as string matching, randomized, approximation and graph. 				

4. Develop efficient algorithms for various computational challenging problems solving in computing.

Text Books

1. Cormen H. T., Leiserson E. C., Rivest L. R., and Stein C., Introduction to Algorithms, MIT Press (2009) 3rd ed.
2. Horwitz E., Sahni S., Rajasekaran S., Fundamentals of Computers Algorithms, Universities Press (2008) 2nd ed.

Reference Books

1. Levitin A., Introduction to the design and analysis of algorithms, Pearson Education (2008) 2nd ed.
2. Aho A.V., Hopcraft J. E., Dulman J. D., The Design and Analysis of Computer Algorithms, Addison Wesley (1974) 1st ed.
3. Sedgewick R. and Wayne K., Algorithms, Addison-Wesley Professional (2011), 4th ed.

UCS310: Database Management Systems				
	L	T	P	Cr
	3	0	2	4.0
Course Objective: Emphasis is on the need of database systems. Main focus is on E-R diagrams, relational database, concepts of normalization and de-normalization and SQL commands.				
Syllabus <p>Introduction: Data, data processing requirement, desirable characteristics of an ideal data processing system, traditional file-based system, its drawback, concept of data dependency, Definition of database, types of database, database management system, 3-schema architecture, database terminology, benefits of DBMS.</p> <p>Relational Database: Relational data model: Introduction to relational database theory: definition of relation, keys, relational model integrity rules, introduction to Relational Algebra.</p> <p>Database Analysis: Conceptual data modeling using E-R data model -entities, attributes, relationships, generalization, specialization, specifying constraints, Conversion of ER Models to Tables, Practical problems based on E-R data model.</p> <p>Database Design: Functional Dependency, Canonical Covers, Candidate Key Identification, Normalization- 1NF, 2NF, 3NF, BCNF, 4NF and 5NF. Concept of De-normalization and practical problems based on these forms.</p> <p>Transaction Management and Concurrency control: Concept of Transaction, States of Transaction and ACID properties, Need of Concurrency control, concept of Lock, Two phase locking protocol.</p> <p>Recovery Management: Need of Recovery Management, Concept of Stable Storage, Log Based Recovery Mechanism, Checkpoint.</p> <p>Database Implementation: Introduction to SQL, DDL aspect of SQL, DML aspect of SQL – update, insert, delete & various form of SELECT- simple, using special operators, aggregate functions, group by clause, sub query, joins, co-related sub query, union clause, View, exist operator. PL/SQL - cursor, stored function, stored procedure, triggers, error handling, and package.</p>				
Laboratory Work <p>Students will perform SQL commands to demonstrate the usage of DDL and DML, joining of tables, grouping of data and will implement PL/SQL constructs. They will also implement one project.</p> <p>Project: It will contain database designing & implementation, should be given to group of 2-4 students. While doing projects emphasis should be more on back-end programming like use of SQL, concept of stored procedure, function, triggers, cursors, package etc. Project should have continuous evaluation and should be spread over different components.</p>				
Course Learning Objectives (CLO) <p>The students will be able to:</p>				

1. Analyze the Information Systems as socio-technical systems, its need and advantages as compared to traditional file-based systems.
2. Analyze and design database using E-R data model by identifying entities, attributes and relationships.
3. Apply and create Relational Database Design process with Normalization and Denormalization of data.
4. Comprehend the concepts of transaction management, concurrence control and recovery management.
5. Demonstrate use of SQL and PL/SQL to implementation database applications.

Text Books

1. Database System Concepts, Silverschatz A., Korth F. H. and Sudarshan S., Tata McGraw Hill, 6th ed, 2010
2. Fundamentals of Database Systems, Elmasri R. and Navathe B. S., Pearson, 7th ed, 2016

Reference Books

1. SQL, PL/SQL the Programming Language of Oracle, Bayross I., BPB Publications, 4th ed, 2009
2. Modern Database Management, Hoffer J., Venkataraman, R. and Topi, H., Pearson, 12th ed 2016
3. Simplified Approach to DBMS, Parteek Bhatia and Gurvinder Singh,
4. Database management systems. Vol. 3. Raghu Ramakrishnan and Johannes Gehrke
5. FOR SQL/RA, New York: McGraw-Hill,

UMA401: PROBABILITY AND STATISTICS

L	T	P	Cr
3	0	2	4.0

Course Objectives: This course shall make the students familiar with the concepts of Probability and Statistics useful in implementing various computer science models. One will also be able to associate distributions with real-life variables and make decisions based on statistical methods.

Introduction to Statistics and Data Analysis: Introduction to Statistical Inference, Samples, Populations and Experimental Design, Collection of Data, Measures of location and variability, Graphical representation of data.

Probability: Sample space, Events, Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Baye's Theorem.

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quantiles, Markov inequality, Chebyshev's inequality, Function of a random variable.

Special Distributions: Discrete uniform, binomial, geometric, negative binomial, Poisson, continuous uniform, exponential, gamma, normal, lognormal, inverse Gaussian, Cauchy, double exponential distributions, reliability of series and parallel systems.

Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation and regression, independence of random variables, bivariate normal distribution.

Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions.

Estimation: Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions.

Testing of Hypotheses: Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample and two sample problems for normal populations, tests for proportions, Chi-square goodness of fit test and its applications.

Laboratory Work:

Implementation of statistical techniques using statistical packages viz. SPSS/R including evaluation of statistical parameters and data interpretation, regression analysis, covariance, hypothesis testing and analysis of variance.

Course Learning Outcomes (CLOs) / Course Objectives (COs):

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

1. Analyze the data using different descriptive measures and present graphically.
2. Compute the probabilities of events along with an understanding of the random variables.
3. Comprehend the concept of statistical distributions, their properties and relevance to real-life data.
4. Understand the estimation of mean and variance and their respective hypothesis tests.

Text Books:

1. Probability & Statistics for Engineers & Scientists by R.E. Walpole, R.H. Myers, S.L. Myers & Keying Ye, Prentice Hall, (2016), 9th edition.
2. An Introduction to Probability and Statistics by V.K. Rohatgi & A.K. Md. E. Saleh, Wiley, (2008), 2nd edition

Reference Books:

1. Miller and Freund's – Probability and Statistics for Engineers by R. A. Johnson, Person Education, (2017), 9th edition.
2. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross, Elsevier, (2014), 4th edition.

UCS411: ARTIFICIAL INTELLIGENCE

L	T	P	Cr
3	0	2	4.0

Course Objectives: To be familiar with the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, machine learning, knowledge acquisition and learning methods in solving particular engineering problems.

Overview: foundations, scope, problems, and approaches of AI.

Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents.

Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.

Knowledge Representation and Reasoning: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.

Planning: Planning as search, partial order planning, construction and use of planning graphs, existing expert systems like MYCIN, RI, Expert system shells.

Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications. Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.

Machine Learning and Knowledge Acquisition: learning from memorization, examples, explanation, and exploration. Learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications.

Languages for AI problem solving: Introduction to PROLOG syntax and data structures, representing objects and relationships, built-in predicates. Introduction to LISP- Basic and intermediate LISP programming.

Expert Systems: Architecture of an expert system.

Laboratory work:

Programming in C/C++/Java/LISP/PROLOG: Programs for Search algorithms- Depth first, Breadth first, Hill climbing, Best first, A* algorithm, Implementation of games: 8-puzzle, Tic-Tac-Toe, tower of Hanoi and water jug problem using heuristic search, Designing expert system using logic in PROLOG, Implementing an intelligent agent.

Course Learning Outcomes (CLOs) / Course Objectives (COs):

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

1. Learn the basics and applications of artificial intelligence and categorize various problem domains, basic knowledge representation and reasoning methods.
2. Analyze basic and advanced search techniques including game playing, evolutionary search algorithms, and constraint satisfaction.
3. Learn and design intelligent agents for concrete computational problems.
4. Understand and implement the basic concepts of programming languages like Prolog and LISP.
5. Acquire knowledge about the architecture of an expert system and design new expert systems for real life applications.

Text Books:

1. Rich E., Knight K. and Nair B. S., Artificial Intelligence, Tata McGraw Hills (2009) 3rd ed.
2. Luger F. G., Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education Asia (2009) 6th ed.

Reference Books:

1. Patterson W. D., Introduction to Artificial Intelligence and Expert Systems, Pearson (2015) 1st ed.
2. Russel S., Norvig P., Artificial Intelligence: A Modern Approach, Prentice Hall (2014) 3rd ed.

UTA016: ENGINEERING DESIGN PROJECT – I

(including 2 self-effort hours)

L	T	P	Cr
1	0	2	3.0

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 teamwork 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
Lec1	INTRODUCTION	The Mangonel Project, History, Spreadsheet.
Lec2	PROJECTILE MOTION	No DRAG, Design spreadsheet simulator for it.
Lec3	PROJECTILE MOTION	With DRAG, Design spreadsheet simulator for it.
Lec4	STRUCTURES FAILURE	STATIC LOADS
Lec5	STRUCTURES FAILURE	DYNAMIC LOADS
Lec6	REDESIGNING THE MANGONEL	Design constraints and limitations of materials for redesigning the Mangonel for competition as a group.
Lec7	MANUFACTURING	Manufacturing and assembling the Mangonel.
Lec8	SIMULATION IN ENGINEERING DESIGN	Simulation as an Analysis Tool in Engineering Design.
Lec9	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
Lec1-5	Digital	Prototype, Architecture, Using the Integrated Development Environment

	Electronics	(IDE) to Prepare an Arduino Sketch, structuring an Arduino Program, Using Simple Primitive Types (Variables), Simple programming examples. Definition of a sensor and actuator.
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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 intergroup 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 (CLOs) / Course Objectives (COs):

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 Box all, Arduino Workshop – A Hands-On Introduction with 65 Projects, No Starch Press (2013).

UTA024: ENGINEERING DESIGN PROJECT – II (Buggy Lab)

L	T	P	Cr
1	0	4	3.0

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

Hardware overview of Arduino:

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

Sensors and selection criterion:

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

Active and passive components:

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

Programming of Arduino:

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

Basics of C#:

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

Laboratory Work:

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

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

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

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

Course Learning Outcomes (CLOs) / Course Objectives (COs):

The student will be able to:

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

Text Books:

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

Reference Book:

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

UES021: ENGINEERING MATERIALS

L	T	P	Cr
3	1	2	4.5

Course Objectives: 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 eutectic phase diagram, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

Electrical and magnetic materials: Conducting and resistor 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 semiconductor crystal.
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 (CLOs) / Course Objectives (COs):

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, Prentice Hall India, 1996.

UHU006: INTRODUCTORY COURSE IN FRENCH

L	T	P	Cr
2	0	0	2.0

Course Objectives:

The objectives of the course are 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/Us/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 (CLOs):

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

UCS001: INTRODUCTION TO CYBER SECURITY

L	T	P	Cr
2	0	0	2.0

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

Introduction: Introduction to Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, and Cryptography, Authentication, Access Control, Cryptography

Programs and Programming: Unintentional (Non-malicious) Programming Oversights, Malicious Code—Malware, Countermeasures

Web Security: User Side, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks

Operating Systems Security: Security in Operating Systems, Security in the Design of Operating Systems, Rootkit

Network Security: Network Concepts, Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service Strategic Defenses: Security Countermeasures, Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management

Cloud Computing and Security: Cloud Computing Concepts, Moving to the Cloud, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS

Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where the Field Is Headed

Management and Incidents: Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster

Legal Issues and Ethics: Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, Incident Analysis with Ethics

Emerging Topics: The Internet of Things, Economics, Computerized Elections, Cyber Warfare.

Course Learning Outcomes (CLOs):

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

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

Recommended Books:

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

Information Security Management: Concepts and Practice. New York, McGraw-Hill, (2013).

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

Evaluation Scheme:

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

UTD001: EMPLOYABILITY DEVELOPMENT SKILLS

L	T	P	Cr
2	0	0	2.0

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

UEN004: TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT

L	T	P	Cr
2	0	0	2.0

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

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

UHU008: INTRODUCTION TO CORPORATE FINANCE

L	T	P	Cr
2	0	0	2.0

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

Introduction to corporate finance: Finance and corporate finance. Forms of business organizations, basic types of financial management decisions, the goal of financial management, the agency problem; the role of the financial manager; basic types of financial management decisions.

Financial statements analysis: Balance sheet, income statement, cash flow, fund flow financial statement analysis Computing and interpreting financial ratios; conducting trend analysis and Du Pont analysis.

The time value of money: Time value of money, future value and compounding, present value and discounting, uneven cash flow and annuity, discounted cash flow valuation.

Risk and return: Introduction to systematic and unsystematic risks, computation of risk and return, security market line, capital asset pricing model.

Long-term financial planning & Financial Decisions: Various sources of long term financing, the elements and role of financial planning, financial planning model, percentage of sales approach, external financing needed. Cost of capital, financial leverage, operating leverage. Capital structure, theories of capital structure net income, net operating income & M&M proposition I and II.

Short-term financial planning and management: Working capital, operating cycle, cash cycle, cash budget, short-term financial policy, cash management, inventory management, credit management.

Capital budgeting : Concepts and procedures of capital budgeting, investment criteria (net present value, payback, discounted payback, average accounting return, internal rate of return, profitability index), incremental cash flows, scenario analysis, sensitivity analysis, break-even analysis,

Dividend policy: Dividend, dividend policy, Various models of dividend policy (Residual approach, Walter model, Gordon Model, M&M, Determinants of dividend policy.

Security valuation: Bond features, bond valuation, bond yields, bond risks, stock features, common stock valuation, and dividend discount & dividend growth models. Common stock yields, preferred stock valuation.

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

UHU017: INTRODUCTION TO COGNITIVE SCIENCE

L T P Cr

2 0 0 2.0

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

UPH064: NANOSCIENCE AND NANOMATERIALS

L	T	P	Cr
2	0	0	2.0

Course Objective:

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 outcomes:

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, Weinheim, Germany (2007)

Evaluation Scheme:

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

UMA066: GRAPH THEORY AND APPLICATIONS

L	T	P	Cr
2	0	0	2.0

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: Planar 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 (CLOs):

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

UMA070: ADVANCED NUMERICAL METHODS

L	T	P	Cr
2	0	0	2.0

Course Objectives:

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:

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

UBT509: BIOLOGY FOR ENGINEERS

L	T	P	Cr
2	0	0	2.0

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, archaea 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. Explain the characteristic features of living-systems and differentiate them from non-living systems
2. Broaden the application of engineering knowledge of their branch by applying concepts of living systems.
3. Demonstrate familiarity with special properties of biological macromolecules
4. Upgrade their understanding about biological systems by drawing parallel with thermodynamics system and develop interface between an engineering specialization and living systems.
5. Design engineering products inspired by living creatures.
6. Plan application of computational tools in bioinformatics.

Recommended Books:

1. Nelson, D.L., Cox, M.M., Lehninger: Principles of Biochemistry, WH Freeman (2008) 5th ed.
2. Dharmi, 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