COURSES SCHEME

&

SYLLABUS

FOR

B.E.

MECHANICAL ENGINEERING

2015

Program Educational Objectives and Program Outcomes
B.E. (Mechanical Engineering) Program

Program Educational Objectives:

- Impart knowledge of mathematics, basic and applied sciences.
- Ability to design, analyse and realize thermal and mechanical systems, components and processes.
- Learn effective engineering communication.
- Ability to work in teams on multi-disciplinary projects in industry and research organizations.
- Develop awareness of the ethical, professional and environmental implications of work in a global and societal context.
- Ability to self-learn modern engineering tools, techniques, skills and contemporary engineering practice, necessary for engineering work.

Program Outcomes:

The students of Bachelor of Engineering in Mechanical Engineering will have the ability to

- apply knowledge of mathematics, science, and engineering.
- design and conduct experiments, as well as to analyze and interpret data.
- design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- function on multidisciplinary teams.
- identify, formulate and solve engineering problems.
- understand professional and ethical responsibility.
- communicate effectively.
- understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- recognize the need to engage in life-long learning
- attain knowledge of contemporary issues.
- use the techniques, skills, and modern engineering tools necessary for engineering practice.

COURSE SCHEME & SYLLABUS FOR B.E. (MECHANICAL ENGINEERING)

Semester I to VII of BE Mechanical Engg. - MBA integrated scheme are common with B.E. (Mech.) scheme. Students admitted in integrated program will be studying semester VIII-X at LMTSOM, Dera Bassi.

SEMESTER – I (GROUP-A)

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA003	MATHEMATICS-I	3	1	0	3.5
2	UTA007	COMPUTER PROGRAMMING - I	3	0	2	4.0
3	UPH004	APPLIED PHYSICS	3	1	2	4.5
4	UEE001	ELECTRICAL ENGINEERING	3	1	2	4.5
5	UHU004	INTRODUCTION TO PROFESSIONAL ENGINEERING#	2	0	2	3.0
6	UTA008	ENGINEERING DESIGN-I (MED)	2	4	0	4.0
TOTAL			**16**	**7**	**8**	**23.5**

FOR THE STUDENTS OF THAPAR UNIVERSITY TITLE OF THIS COURSE WILL BE WRITTEN AS 'PROFESSIONAL COMMUNICATION'

SEMESTER – II (GROUP-A)

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

* EACH STUDENT WILL ATTEND ONE LAB SESSION OF 2 HRS IN A SEMESTER FOR A BRIDGE PROJECT IN THIS COURSE (MECHANICS).

SEMESTER – III (GROUP-A)

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA031	OPTIMIZATION TECHNIQUES	3	1	0	3.5
2	UTA002	MANUFACTURING PROCESSES	2	0	3	3.5
3	UES010	SOLIDS AND STRUCTURES	3	1	2	4.5
4	UES011	THERMO-FLUIDS	3	1	2	4.5
5	UTA011	ENGINEERING DESIGN-III (BUGGY AND MORE SUCH PROJECTS) (8 SELF EFFORT HOURS)	2	0	4	8.0
6	UME306	MECHANICS OF MACHINES	3	1	2	4.5
TOTAL			**16**	**4**	**13**	**28.5**

SEMESTER – IV (GROUP-A)

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA007	NUMERICAL ANALYSIS	3	1	2	4.5
2	UES012	ENGINEERING MATERIALS	3	1	2	4.5
3	UHU005	HUMANITIES FOR ENGINEERS	2	0	2	3.0
4	UEN004	ENERGY AND ENVIRONMENT	3	0	0	3.0
5	UME409	COMPUTER AIDED DESIGN & ANALYSIS (INCLUDES 7 SELF-EFFORT HOURS)	3	1	2	8.0
6	UME408	MACHINE DESIGN	3	1	2	4.5
TOTAL			**17**	**4**	**10**	**27.5**

UMA003: MATHEMATICS – I

L	T	P	Cr
3	1	0	3.5

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

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

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

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

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UTA007: COMPUTER PROGRAMMING – I

L	T	P	Cr
3	0	2	4.0

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

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

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

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

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

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

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

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

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

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

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

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

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

1. write, compile and debug programs in C++ language.
2. use different data types, operators and console I/O function in a computer program.
3. design programs involving decision control statements, loop control statements and case control structures.
4. understand the implementation of arrays, pointers and functions and apply the dynamics of memory by the use of poiners.
5. comprehend the concepts of structures and classes: declaration, initialization and

implementation.

6. apply basics of object oriented programming, polymorphism and inheritance.
7. use the file operations, character I/O, string I/O, file pointers, pre-processor directives and create/update basic data files.

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UPH004: APPLIED PHYSICS

L	T	P	Cr
3	1	2	4.5

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

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

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

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

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

Laboratory Work:

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

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

Course Learning Outcomes (CLO):

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

1. demonstrate a detailed knowledge of oscillations, ultrasonics, electromagnetic waves, wave optics, lasers, and quantum mechanics;
2. discuss how the laws of physics have been exploited and applied in the development and design of simple engineering systems;

3. collate, analyse and formulate an experimental report with error analysis and conclusions;

Text Books:

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

Reference Books:

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

UEE001: ELECTRICAL ENGINEERING

L	T	P	Cr.
3	1	2	4.5

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

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

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

Electromagnetism: Electromagnetic induction, Dot convention, Equivalent inductance, Analysis of Magnetic circuits, AC excitation of magnetic circuit, Iron Losses, Fringing and stacking, applications: solenoids and relays.
Single Phase Transformers: Constructional features of transformer, operating principle and applications, equivalent circuit, phasor analysis and calculation of performance indices.
Motors and Generators: DC motor operating principle, construction, applications, DC generator operating principle, reversal of energy transfer, applications.

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

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

1. Apply networks laws and theorems to solve electric circuits.
2. Represent AC quantities through phasor and compute AC system behaviour during steady state
3. Explain principle and characteristics of Electro-Mechanical energy conversion devices and apply them.

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UHU004: INTRODUCTION TO PROFESSIONAL ENGINEERING

L	T	P	Cr
2	-	2	3

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

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

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

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

Effective non-verbal communication: Knowledge and adoption of the right non-verbal cues of body language, interpretation of the body language in professional context. Understanding Proxemics and other forms of non-verbal communication.

Communicating for Employment: Designing Effective Job Application letter and resumes; Success strategies for Group discussions and Interviews.

Communication Networks in Organizations: Types, barriers and overcoming the barriers.

Laboratory Work:

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

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

Course Learning Outcomes (CLO):

1. Understand and appreciate the need of communication training.
2. Use different strategies of effective communication.
3. Select the most appropriate mode of communication for a given situation.
4. Speak assertively and effectively.
5. Correspond effectively through different modes of written communication.
6. Write effective reports, proposals and papers.
7. Present himself/herself professionally through effective resumes and interviews.

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UTA008: ENGINEERING DESIGN – I (MED)

L	T	P	Cr
2	4	0	4.0

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

Engineering Drawing

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

AutoCAD

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

Micro Projects /Assignments:

1. Completing the views - Identification and drawing of missing lines in the projection of objects
2. Missing views – using two views to draw the projection of the object in the third view, primarily restricting to Elevation, Plan and Profile views
3. Projects related to orthographic and isometric projections
    a. Using wax blocks or soap bars to develop three dimensional object from given orthographic projections
    b. Using wax blocks or soap bars to develop three dimensional object, section it and color the section
    c. Use of AUTOCAD as a complementary tool for drawing the projections of the objects created in (1) and (2).
4. Develop the lateral surface of different objects involving individual or a combination of solids like Prism, Cone, Pyramid, Cylinder, Sphere etc.
5. To draw the detailed and assembly drawings of simple engineering objects/systems with due sectioning (where ever required) along with bill of materials.
6. e.g. Rivet joints, simple bearing, wooden joints, Two plates connected with nut and bolt etc.

Course Learning Outcomes (CLO):

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

1. creatively comprehend geometrical details of common engineering objects
2. draw dimensioned orthographic and isometric projections of simple engineering objects.
3. interpret the meaning and intent of toleranced dimensions and geometric tolerance symbolism;
4. create the engineering drawings for simple engineering objects using AutoCAD
5. manage screen menus and commands using AutoCAD
6. operate data entry modes and define drawings geometrically in terms of Cartesian, polar and relative coordinates in AutoCAD
7. create and edit drawings making selections of objects, discriminating by layering and using entities, object snap modes, editing commands, angles and displacements using AutoCAD

Text Books:

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

Reference Books:

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

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	Mid semester test (formal written test)	30
2	End semester test (formal written test)	45
3	Sessional: (may include the following) Continuous evaluation of drawing assignments in tutorial/ regular practice of AutoCAD tutorial exercises & Individual independent project work/drawing and AutoCAD assignment	25

UMA004: MATHEMATICS – II

L	T	P	Cr
3	1	0	3.5

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

Linear Algebra: Row reduced echelon form, Solution of system of linear equations, Matrix inversion, Linear spaces, Subspaces, Basis and dimension, Linear transformation and its matrix representation, Eigen-values, Eigen-vectors and Diagonalisation, Inner product spaces and Gram-Schmidt orthogonalisation process.
Ordinary Differential Equations: Review of first order differential equations, exact differential equations, Second and higher order differential equations, Solution techniques using one known solution, Cauchy - Euler equation, Method of undetermined coefficients, Variation of parameters method, Engineering applications of differential equations.
Laplace Transform: Definition and existence of Laplace transforms and its inverse, Properties of the Laplace transforms, Unit step function, Impulse function, Applications to solve initial and boundary value problems.
Fourier Series: Introduction, Fourier series on arbitrary intervals, half range expansions, Applications of Fourier series to solve wave equation and heat equation.

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

1. Solve differential equations of first and 2nd order using various analytical methods.
2. apply methods of Laplace transform and Fourier series to solve initial and boundary value problems, respectively.
3. Solve systems of linear equations using row reduction method
4. analyze vectors algebraically and geometrically in R^n

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UTA004: COMPUTER PROGRAMMING – II

L	T	P	Cr
3	0	2	4

Course Objective: Understand fundamentals of object oriented programming in java. To help students understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.

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

Object Oriented Programming Concepts in Java: Objects and classes, declaring objects, constructors, this keyword, method overloading and constructor overloading, nested classes.

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

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

Building GUI in Java: Introductions to Applets, Building Java GUIs Using the Swing API, Describe the JFC Swing technology, identify the Swing packages, Describe the GUI building blocks: containers, components, and layout managers, examine top-level, general-purpose, and special-purpose properties of container, examine components, examine layout managers, describe the Swing single-threaded model, painting, using images, performing animations, borders, icons, Introduction to Event handling, implementation of Listeners for event handling.

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

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

1. comprehend the concepts of Object Oriented Computing in Java.
2. implement decision statements and looping statements.
3. grasp the concepts of input and output handling from console, files and internet in Java.
4. create frames, windows, containers, GUI components in Java and handle events for building GUI.
5. develop GUI applications

Text Books:

1. *Deitel H. and Deitel P., JAVA - How to Program, Pearson Education (2003).*
2. *Hortsmann CS., Cornell G., Core Java Volume I-Fundamentals, Prentice Hall, (2012).*

Reference Books:

1. *Naughton P., Schildt H., JAVA2 – The Complete Reference, Tata McGraw Hill (2002).*

Evaluation Scheme:

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

UES009: MECHANICS

L	T	P	Cr
2	1	0	2.5

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

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

Course Learning Outcomes (CLO):
The students will be able to:
1. Determine resultants in plane force systems
2. Identify and quantify all forces associated with a static framework
3. Solve problems in kinematic and dynamic systems

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

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

Evaluation Scheme:

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

UEC001: ELECTRONIC ENGINEERING

L	T	P	Cr
3	1	2	4.5

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

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

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

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

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

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

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

Laboratory Work:

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

Course Learning Outcomes (CLO):

The student will be able to:

1. analyze characteristics of semiconductor junctions.
2. differentiate between bipolar and unipolar devices.
3. reduce SOP and POS equations.
4. understand differences between logic families TTL and CMOS
5. analyze, design and implement combinational and sequential circuits.

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UCB008: APPLIED CHEMISTRY

L	T	P	Cr
3	1	2	4.5

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

Atomic Structure and Bonding: Chemical change; elements, compounds and mixtures, Atomic structure, dual nature of electron, concept of atomic orbitals, Pauli`s Exclusion principle, Concept of chemical bonding: covalent, ionic, metallic, hydrogen bond, Vander Waal`s, Hybridization and shapes of molecule, electronic structure and periodic table.
Chemical Equilibrium: Law of mass action, Factors that influence the position of equilibrium. Ionic equilibria: ionic equilibria in aqueous solutions; strong and weak acids and bases; buffer solution and indicators.
Electrochemistry: Migration of ions, Transference number, Specific, equivalent and molar Conductivity of electrolytic solutions, Conductometric titrations, Electrode potential and types of electrodes, Introduction to galvanic and concentration cells, Liquid junction potential.
Colligative Properties of Dilute Solutions: Depression of freezing point and elevation of boiling point.
Phase Rule: States of matter, Phase, Component and Degree of freedom, Gibbs phase rule, One component and two component systems.
Water Treatment and Analysis: Hardness and alkalinity of water: Units and determination, External and internal method of Softening of water: Lime-soda Process, Ion exchange process, Desalination of brackish water.
Fuels: Classification of fuels, Calorific value, Cetane and Octane number, fuel quality, Comparison of solid liquid and gaseous fuel, properties of fuel, alternative fuels: biofuels, Power alcohol, synthetic petrol.
Application of Atomic and Molecular Spectroscopic Methods: Structure determination of certain model compounds of industrial importance.

Assignments based on working and applications of advanced instruments will be given in the tutorial class.

Laboratory Work:
Electrochemical measurements: Experiments involving use of pH meter, conductivity meter, potentiometer.
Acid and Bases: Determination of mixture of bases
Spectroscopic techniques: Colorimeter, UV-Vis spectrophotometer.
Kinetics: Kinetics of oxidation of iodine ion by peroxydisulphate ion.
Thermochemistry: Cloud point and pour point determination
Water and its treatment: Determination of hardness, alkalinity, chloride, chromium, iron and copper in aqueous medium.

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

1. analyse trends in periodic table with electronic and atomic structure.
2. interpret phase diagrams of pure and binary substances.
3. demonstrate the working of electrodes and their applications.
4. calculate various parameters defining water and fuel quality
5. identify the various functional groups through IR spectra.

6. carry out basic experimental procedure and to emphasize need for safety and safety procedure in laboratory.

Text Books:

1. *Ramesh, S. and Vairam S. Engineering Chemistry, Wiley India (2012).*
2. *Jain, P.C. and Jain, M. Engineering Chemistry, Dhanpat Rai Publishing Co. (2005).*
3. *Puri, B.R., Sharma and L.R., Pathania, M.S. Principles of Physical Chemistry, Vishal Publishing Co. (2008).*

Reference Books:

1. *Brown, Holme, Chemistry for engineering students, Thompson.*
2. *Shulz, M.J. Engineering Chemistry, Cengage Learnings, (2007).*

Evaluation Scheme:

MST	EST	Sessional (May include Project/Quizes/Assignments/Lab Evaluation))
25	35	40

UTA010: ENGINEERING DESIGN – II

L	T	P	Cr
1	0	2	5

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

Breakup of lecture details to be taken up by MED:

Lec No.	Topic	Contents
Lec 1	Introduction	The Mangonel Project. History.
Lec 2	CDIO	Conceive Design Implement and Operate.
Lec 3	Manufacturing	Manufacturing and assembling the Mangonel.
Lec 4		
Lec 5	Materials	How to choose the right Material
Lec 6	Modelling	The Role of Modelling in Engineering Design
Lec 7	Structures	Why things fail?
Lec 8	Dynamics	Dynamics of the Mangonel
Lec 9	Structures	Designing against structural failure
Lec 10	Kinematics/Software Modelling	Simulation as an Analysis Tool in Engineering Design

Breakup of lecture details to be taken up by ECED:

Lec No.	Topic	Contents
Lec 11-15	Digital Electronics	Prototype, Architecture, Using the Integrated Development Environment (IDE) to Prepare an Arduino Sketch, structuring an Arduino Program, Using Simple Primitive Types (Variables), Simple programming examples. Definition of a sensor and actuator.

Laboratory Work:
Associated Laboratory/Project Programme:

Laboratory Title	Code
Dynamics of Mangonel - No Drag	L1
Dynamics of Mangonel - With Drag	L2
Design against failure under static actions	L3
Design against failure under dynamic actions	L4
Simulation	L5
Manufacturing components of the Mangonel	L6
Manufacturing components of the Mangonel	L7
Manufacturing components of the Mangonel	L8
Manufacturing components of the Mangonel	L9
Assembly of Mangonel	L10
Spring Test of Mangonel	L11
Distance Test of Mangonel	L12
Speed Test of Mangonel	L13
Mangonel redesign for competition	L14
Competition	L15

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 manufacturing and 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;
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.

Course Learning Outcomes (CLO):

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

1. model trajectories of masses with and without aerodynamic drag;
2. develop a software tool to allow trajectories be optimised;
3. analyse the static and dynamic stresses of elements of an engineering mechanism;
4. optimally design structural elements of an engineering mechanism;
5. perform a test to acquire an engineering material property;
6. develop and test software code to process sensor data;
7. design and construct and test an electronic hardware solution to process sensor data;
8. construct a Roman catapult "Mangonel" using tools, materials and assembly instructions;
9. operate and evaluate the "Mangonel" for functional and structural performance;
10. validate theoretical models by comparison with experiments;
11. integrate skills to innovatively redesign an element of the "Mangonel";
12. participate and cooperate in a team.

Text Books:

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

Reference Book:

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

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	-
2	EST	-
3	Sessional: Sessional: (may include the following) Regular progress evaluations of stages of the project assignment. Project (Design Report, Prototype competition, Daily diary and records) Final Presentation and viva-voce	 30 50 20

UMA031: OPTIMIZATION TECHNIQUES

L	T	P	Cr
3	1	0	3.5

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

Scope of Operations Research: Introduction to linear and non-linear programming formulation of different models.
Linear Programming: Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex method, Exceptional cases in LP, Duality theory, Dual simplex method, Sensitivity analysis.
Integer Programming: Branch and bound technique.
Transportation and Assignment Problem: Initial basic feasible solutions of balanced and unbalanced transportation/assignment problems, Optimal solutions.
Project Management: Construction of networks, Network computations, Floats (free floats and total floats), Critical path method (CPM), Crashing.
Game Theory: Two person zero-sum game, Game with mixed strategies, Graphical method and solution by linear programming.

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

1. formulate and solve linear programming problems.
2. solve the problems on networks models such as Transportation, Assignment, Shortest path, minimal spanning tree, and Maximal flow.
3. solve the problems of Project Management using CPM and PERT.

Text Books:

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

Recommended Books:

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

Evaluation Scheme:

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

UTA002: MANUFACTURING PROCESSES

L	T	P	Cr
2	0	3	3.5

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

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

Metal Casting: Principles of metal casting, Introduction to sand casting, Requisites of a sound casting, Permanent mold casting processes.

Metal Forming: Forging, Rolling, Drawing, Extrusion, Sheet Metal operations.

Joining Processes: Electric arc, Resistance welding, Soldering, Brazing.

Laboratory Work:

Relevant shop floor exercises involving practices in Sand casting, Machining, Welding, Sheet metal fabrication techniques, CNC turning and milling exercises, Experiments on basic engineering metrology and measurements to include measurements for circularity, ovality, linear dimensions, profiles, radius, angular measurements, measurement of threads, surface roughness.

Basic knowledge and derivations related to above measurements, uncertainties, statistical approaches to estimate uncertainties, Line fitting, static and dynamic characteristics of instruments will be discussed in laboratory classes.

Assignments: Assignments for this course will include the topics: Manufacturing of micro-chips used in IT and electronics industry and use of touch screens. Another assignment will be given to practice numerical exercises on topics listed in the syllabus.

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

Course Learning Outcomes (CLO):

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

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

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UES010: SOLIDS AND STRUCTURES

L	T	P	Cr
3	1	2	4.5

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

ELASTIC PLASTIC BEHAVIOR

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

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

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

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

Deformations

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

Laboratory Work:

Experimental Project Assignment: Students in groups of 4/5 will do projects:

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

Course Learning Outcomes (CLO):

The student will be able to:

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

Text Books:

1. *Popov, E.P. and Balan, T.A., Engineering Mechanics of Solids, Prentice Hall of India (2006).*
2. *Singh, D.K., Mechanics of Solids, Pearson Education (2002).*

Reference Books:

1. *Shames, I. H. and Pitarresi, J. M., Solid Mechanics, Prentice Hall of India (1999).*
2. *Crandall, S.H., Dahl, N.C. and Lardner, T.J., An Introduction to Mechanics of Solids, McGraw Hill International, Tokyo, (1994).*

Evaluation Scheme:

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

UES011: THERMO-FLUIDS

L	T	P	CR
3	1	2	4.5

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

FLUID MECHANICS

Introduction: Definition of a fluid and its properties.

Hydrostatics: Measurement of pressure, thrust on submerged surfaces.

Principles of Fluid Motion: Description of fluid flow; continuity equation; Euler and Bernoulli equations; Pitot total head and static tubes, venturi-meter, orifice-meter, rotameter; Momentum equation and its applications.

Pipe Flow: Fully developed flow; laminar pipe flow; turbulent pipe flow, major and minor losses; Hydraulic gradient line (HGL) and total energy line (TEL).

Boundary Layer: Boundary layer profile; displacement, momentum and energy thickness.

THERMODYNAMICS

Introduction: Properties of matter, the state postulate, energy, processes and thermodynamic systems;

Properties of Pure Substances: property tables, property diagrams, phase change, equations of state (ideal gas);

Energy: Energy transfer by heat, work and mass;

First Law of Thermodynamics: Closed system, open system, steady-flow engineering devices;

Second Law of Thermodynamics: Statements of the Second Law, heat engines, refrigeration devices, reversible versus irreversible processes, the Carnot cycle.

Laboratory/Project Programme:

10% Weightage of total marks shall be given to the continuous assessment of the practical and on the technical reports of the experiments

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

Sample List of Micro-Projects:

Students in a group of 10 members will be assigned a micro project. 10% weightage of the total marks shall be given to the execution, technical report writing and presentation of the completed project.

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

Research Assignments:
Besides the interactive tutorial sessions, students in a group of 4/5 will submit a research assignment on a related topic. The research assignment should be submitted in the form of a technical report followed by a power point presentation. 10% weightage of the total marks shall be given to this assignment.

Course Learning Outcomes (CLO):

1. Knowledge of basic principles of fluid mechanics
2. Capability to analyze, generate mathematical models, solve problems, and communicate the solutions of simple fluid based engineering problems including pressures and forces on submerged surfaces
3. Ability to analyze fluid flow problems with the application of the mass, momentum and energy equations
4. Ability to evaluate practical problems associated with pipe flow systems
5. Ability to conceptualize and describe practical flow systems such as boundary layers and their importance in engineering analysis
6. Capability to evaluate fluid properties and solve basic problems using property tables, property diagrams and equations of state
7. Ability to analyze, generate mathematical models, solve problems, and communicate the solutions to practical closed systems and steady-flow devices by applying the conservation of energy principle
8. Knowledge of the limitations of engineering devices and systems based on the 2nd law of thermodynamics
9. Knowledge of the concept of thermal efficiency and coefficient of performance and the environmental and socio-economic implications

Text Books:

1. *Munson, Young, Okiishi, Huebsch, Fundamentals of Fluid Mechanics, Wiley.*
2. *Cengel and Boles, Thermodynamics: An Engineering Approach, McGraw-Hill.*

Reference Books:

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

Evaluation Scheme:

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

UTA011: ENGINEERING DESIGN – III
(INCLUDES PROJECT WITH 8 SELF EFFORT HOURS)

L	T	P	Cr
2	0	4	8.0

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

Arduino Microcontroller: Features of Ardunio Microcontroller, Architecture of Arduino, Different boards of Arduino, Arduino Interfacing and Applications, Anatomy of an Interactive Device like Sensors and Actuators, A to D converters and their comparison, Blinking an LED, LCD Display, Driving a DC and stepper motor, Temperature sensors, Serial Communications, Sending Debug Information from Arduino to Your Computer, Sending Formatted Text and Numeric Data from Arduino, Receiving Serial Data in Arduino, Sending Multiple Text Fields from Arduino in a Single Message, Receiving Multiple Text Fields in a Single Message in Arduino. Light controlling with PWM.
Introduction to ARM Processor: Features of ARM processor, ARM Architecture, Instruction set, ARM Programming
Programming of Arduino: The Code designing step by step. Taking a Variety of Actions Based on a Single Variable, Comparing Character and Numeric Values, Comparing Strings, Performing Logical Comparisons, Performing Bitwise Operations, Combining Operations and Assignment, Using Embedded techniques to program Arduino microcontroller, Understanding the libraries of Arduino programming language and applying for circuit design.

Laboratory Work: Introduction to Arduino board. Programming examples of Arduino board. Interfacing of LED, seven segment display, ADC and DAC with Arduino board. Introduction to ARM processor kit.

Projects: Arduino and ARM based projects to be allocated by concerned faculty.

Course Learning Outcomes (CLO):
The student should be able to:

1. understand of features of Arduino board.
2. analyze of internal Architecture of Arduino board.
3. apply Arduino board programming concepts.
4. design and implement Buggy project based on different goals and challenges defined.

***Text Books**:*

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

***Reference Books**:*

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

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	Mid Semester evaluation 1	20
2	Mid Semester evaluation 2	20
3	Mid Semester evaluation 3	20
4	End Semester Evaluation	40

UME306: MECHANICS OF MACHINES

L	T	P	Cr
3	1	2	4.5

Course Objectives: To introduce different types of mechanisms forming different subsystem of machines. To impart the knowledge of vector and matrix methods for position, velocity and acceleration analysis with software tools. To carryout force analysis of engine mechanism analytically. To impart knowledge of force analysis and balancing of rotors. To introduce fundamentals of single degree of freedom vibrating system.

Review of Mechanics: Fundamentals of rigid body mechanics, Newton's laws, D'Alembert,s principle, Free body diagrams.

Kinematics of Machines: Introduction to linkages, gears, screws and cam mechanics, belts, rope, and chain drives as subsystems of machines.

Linkage Mechanisms: Links, kinematic pairs, degree of freedom, inversions, mechanisms, transmission angle and mechanical advantage. Vector and matrix methods for position, velocity and acceleration analysis with relevant software tools.

Friction: Screw friction, clutch plate friction and bearings.

Balancing: Balancing of rotating and reciprocating masses, single cylinder and multi-cylinder in-line engines, Field balancing of rotors.

Vibrations: Introduction to free and forced single degree of freedom, undamped and damped vibrations, Equilibrium and energy methods, vibration isolation and transmissibility.

Laboratory Work:
Students shall perform experiments based on

1. Centrifugal force
2. Slider Crank mechanism.
3. Cam and follower mechanism.
4. Balancing of rotating and reciprocating masses
5. Gyroscopic effect

Micro Project: Projects for performing position, velocity and acceleration analysis of mechanisms like 4-bar chain, slider crank chain, quick return mechanism etc. to be undertaken which could be correlated to real life situations.

Experiments to be designed by students:
Students shall design and fabricate experimental set-ups. For example

1. Studying and evaluating the performance parameters of different mechanisms.
2. Studying and evaluating static and dynamic coefficient of friction for different pairs of materials.

Course Learning Outcomes (CLO):

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

1. select and analyze a set of mechanisms to achieve desired motion transformation.
2. use analytical methods and software tools for analysis of mechanisms.
3. evaluate and carry out balancing of rotors.
4. determine the unbalance and evaluate the balancing strategies in multi cylinder in-line engines.
5. formulate equations of motion, evaluate the responses of different real life vibration problems and suggest methods for vibration isolation.

Text Books:

1. *J. J. Uicker, G. R. Pennock, and J. E. Shigley, Theory of Machines and Mechanism, Oxford Press (2009).*
2. *Dam B. Marghit, Mechanisms and Robotics analysis with MATLAB, Springer (2009).*
3. *T. Bevan, The Theory of Machines, (Pearson Edu. India) CBS Publishers (1944).*

Reference Books:

1. *A. K. Ghosh and A. K. Mallik, Theory of Mechanisms and Machines, Affiliated East-West press Pvt. Ltd. (1993).*
2. *C. E. Wilson and J. P. Saddler, Kinematics and Dynamics of Machines, Pearson Publishers (2003).*
3. *B. Crossland and I. Morrison, Mechanics of Machines, Longman Publishers (1970).*
4. *J. Hannah and R. C. Stephens, Mechanics of Machines, Elementary Theory and Examples, International Ed (1970).*
5. *S. S. Rattan, Theory of Machines, Tata Mc Graw Hill (2012).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	M.S.T.	25
2	E.S.T.	35
3	Sessional (may include Minor Projects/Including carry home assignments/ Lab Experiments)	40

UMA007: NUMERICAL ANALYSIS

L	T	P	Cr
3	1	2	4.5

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

Floating-Point Numbers: Floating-point representation, rounding, chopping, error analysis, conditioning and stability.

Non-Linear Equations: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.

Linear Systems and Eigen-Values: Gauss elimination method using pivoting strategies, LU decomposition, Gauss--Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well-conditioned systems, Rayleigh's power method for eigen-values and eigen-vectors.

Interpolation and Approximations: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations.

Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss--Legendre quadrature formulae.

Differential Equations: Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order differential equations.

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

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

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

Texts Books:

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

References Books:

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

Evaluation Scheme:

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

UES012: ENGINEERING MATERIALS

L	T	P	Cr
3	1	2	4.5

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

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

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

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

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

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

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

Laboratory Work:

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

Micro Project:

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

1. Design experiments to determine various mechanical properties like strength, ductility, elastic modulus, etc. of a given specimen(s) and correlate them.

2. Design an experiment to classify the given specimens based on their electrical properties.
3. Identify the most suitable material from the given specimens for solar cell application.
4. Identify the suitability of given samples in marine, acidic and alkaline environment.
5. Design a virtual experiment to analyse / predict physical properties of a given material/composite.

Course Learning Outcomes (CLO):

Student will be able to:

1. understand structure-property correlation;
2. read phase diagrams and can predict the properties of the solid based on the phase diagram.
3. discriminate between materials based on their electrical and magnetic properties and should be able to describe temperature and field dependence of electrical and magnetic properties.
4. select materials based on their properties for a defined application.

Text Books:

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

Reference Books:

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

Evaluation Scheme:

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

UHU005: HUMANITIES FOR ENGINEERS

L	T	P	Cr
2	0	2	3

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

UNIT I: PSYCHOLOGICAL PERSPECTIVE

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

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

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

Group Dynamics and Interpersonal relationships.

Development of self and personality.

Transactional Analysis.

Culture and Mind.

Practicals:

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

UNIT II: HUMAN VALUES AND ETHICAL PERSPECTIVE

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

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

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

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

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

Laboratory Work:

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

UNIT III: ECONOMIC PERSPECTIVE

Basics of Demand and Supply

Production and cost analysis

Market Structure: Perfect and Imperfect Markets.
Investment Decisions: capital Budgeting, Methods of Project Appraisal.
Macroeconomic Issues: Gross domestic product (GDP), Inflation and Financial Markets.
Globalisation: Meaning, General Agreement on Trade and tariffs (GATT), World Trade Organisation (WTO). Global Liberalisation, and its impact on Indian Economy.

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

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

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

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

Text Books:

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

Reference Books:

1. *Atkinson, R.L., Atkinson, R.C., Smith, E.E., Bem, D.J. and Nolen-Hoeksema, S. (2000). Hilgard's Introduction to Psychology, New York: Harcourt College Publishers.*
2. *Berne, Eric (1964). Games People Play – The Basic Hand Book of Transactional Analysis. New York: Ballantine Books.*
3. *Ferrell, O. C and Ferrell, John Fraedrich Business Ethics: Ethical Decision Making & Cases, Cengage Learning (2014).*
4. Duane P. Schultz and Sydney Ellen Schultz, *Theories of Personality, Cengage Learning, (2008).*
5. *Saleem Shaikh. Business Environment, Pearson (2007).*
6. *Chernilam, Francis International Buisness-Text and Cases, Prentice Hall (2013).*
7. *Salvatore, Dominick, Srivastav, Rakesh., Managerial Economics: Principles with Worldwide Applications, Oxford, 2012.*

8. *Peterson H. Craig. and. Lewis, W. Cris. Managerial Economics, Macmillan Pub Co; (1990).*

Evaluation Scheme:

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

UEN004: ENERGY AND ENVIRONMENT

L	T	P	Cr
3	0	0	3.0

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

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

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

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

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

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

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

Course Learning Outcomes (CLO):

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

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

Text Books:

1. *Bharucha, E., Textbook of Environmental Studies, Universities Press (2005).*
2. *Chapman, J.L. and Reiss, M.J., Ecology- Principles and Application, Cambridge University Press (LPE) (1999).*
3. *Joseph, B., Environmental Studies, Tata McGraw-Hill (2006).*
4. *Eastop, T.P. and Croft, D.R. Energy Efficiency for Engineers and Technologists, Longman and Harow (2006).*

Reference Books:

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

Evaluation Scheme:

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

UME409: COMPUTER AIDED DESIGN AND ANALYSIS (WITH PROJECT)

L	T	P	Cr
3	1	2	8.0

Course Objectives: Introduce components and assemblies used in machines and use of 3D parametric CAD, CAE software for mechanical design. To provide an experiential learning environment using projects done by student groups, while applying CAD, CAE software tools to design mechanisms and structures for mechanical design evaluation, optimization of mass properties, static-stresses, deformations, etc. with experimental validation of simulation models.

Mechanical Drawing: Machining and surface finish symbols and tolerances in dimensioning.

Standards, Types, Applications and Working of:
Machine Components: Screw fasteners, Riveted joints, Keys, Cotters and joints, Shaft couplings, Pipe joints and fittings.

Assemblies: Bearings, Hangers and brackets, Steam and IC engine parts, Valves, Some important machine assemblies.

CAD: Introduction to CAD, CAM, CAE software in product life cycle.

Geometric Modeling: Parametric sketching and modeling, constrained model dimensioning, Relating dimensions and parameters. Feature and sequence of feature editing. Material addition and removal for extrude, revolve, blend, helical sweep, swept blend, variable section sweep. References and construction features of points, axis, curves, planes, surfaces. Cosmetic features, representation of welded joints, Draft and ribs features, chamfers, rounds, standard holes. Assembly modeling. Automatic drawing creation and detailing.

Productivity Enhancement Tools in CAD Software: Feature patterns, duplication, grouping, suppression. Top-down vs. bottom-up design.

CAE: Part and assembly mass property analysis. Customized analysis features. Sensitivity analysis of dimension and parameters, Automatic feasibility study and shape optimization.

Mechanism Motion Analysis: Kinematic joints used in mechanism assembly. Motion of kinematic chains, Plot coupler curve. Analysis of Mechanisms for interference, position, velocity, acceleration and bearing reactions.

Analysis of Static Stress, Deflection, Temperature etc. using software like 'Pro-Mechanica', 'SolidWorks Simulation' as a black-box. Analysis of mechanical parts and assemblies. Using shells, beams and 2D for Plane strain/ plane stress or axisymmetric simplifications.

Project: Students will undertake projects in groups to study the design of a simple mechanical system, make geometric models of the parts, assembly, evaluate the design and CAD automated drafting of production drawings of the system. CAE analysis will be used to evaluate and redesign the system to optimize it for conditions of use. Prototype fabrication, testing to validate the CAE results and a technical report presenting and discussing the learnings from the project, presentation, records and diary will be the conclusion of the project. Projects could be mechanisms, simple machines / machine tools, simple products / assemblies, structures studied in course of solids and structures / mechanics of machines, machine design etc.

Course Learning Outcomes (CLO):

The students will be able to:

1. read and recognise mechanical drawings for components, assemblies and use parametric 3D CAD software tools in the correct manner for making their geometric part models, assemblies and automated drawings.
2. use CAD software tools for assembly of mechanism from schematic or component drawing and conduct position/ path/ kinematic / dynamic analysis of a mechanism in motion.
3. evaluate design and optimize it using commercial CAD, CAE software as black box for required mass properties/ stress, deflection / temperature distribution etc. under realistic loading and constraining conditions.
4. work in a group to study, redesign and evaluate a mechanical product, to make a prototype in the mechanical workshop using fabricated and standard components for using relevant materials.
5. develop team work and communication skills through group based activity for the project.

Text Books:

1. *Singh Ajeet, Machine Drawing, The McGraw-Hill Companies (2010)*
2. *Kelley David S., Pro/ENGINEER Wildfire 5.0 Instructor, Tata McGraw Hill (2011).*
3. *Shih Randy H., Introduction to Finite Element Analysis Using Creo Simulate 1.0, SDC Publications, USA (ISBN: 978-1-58503-670-7, ISBN (Book + Software on Disk): 978-1-58503-731-5 (2011).*

Reference Books:

1. *Gill, P.S., Machine Drawing, S.K.Kataria and Sons (2013).*
2. *Dhawan, R.K., Machine Drawing, S.Chand& Company Limited (2011).*
3. *Shyam Tikku and Prabhakar Singh, Pro/ENGINEER (Creo Parametric 2.0) for Engineers and Designers, Dreamtech press (2013).*
4. *Toogood Roger Ph.D., P. Eng., Zecher Jack P.E., Creo Parametric 1.0 Tutorial and MultiMedia DVD, SDC Publications, USA (2012), ISBN: 978-1-58503-692-9, ISBN (Book + Software on Disk): 978-1-58503-730-8*
5. *Shih Randy H., Parametric Modeling with Creo Parametric 1.0-An Introduction to Creo Parametric 1.0, SDC Publications, USA (2011) ISBN: 978-1-58503-661-5, ISBN (Book + Software on Disk): 978-1-58503-729-2*
6. *Guide books in software help and online books at ptc.com*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST (Formal Test on software)	20
2	EST (Formal Test on software)	30
3	Sessional (may include the following) Project (Prototype, Presentation, Daily diary and records, Technical Report)	50

NB: Formal Tests on software will be open book examination.

UME408: MACHINE DESIGN

L	T	P	Cr
3	1	2	4.5

Course Objectives: Provide students with the ability to apply design procedure with specific design tools representing empirical, semi-empirical and analytical approaches. Using analytical and computer aided design with real world problems.

The detailed design of mechanical systems considers realistic examples from the mechanical laboratories/workshop. Design a mechanical power transmission system given the power to be transmitted, speed ratio, orientation and center distance of the shafts. Design will include:

1. Selection of materials, standard sizes of parts, for all the components.
2. Pulley with belt
3. Flexible Coupling
4. Stepped shaft and keys
5. Ball bearing
6. Gears
7. Threaded fasteners with cover plates
8. Stress concentration under static and fluctuating loading

Failure analysis, factor of safety, types of loading, selection of appropriate materials, lubrication, design for manufacturing, fits and tolerance will also be covered for the use in all the above case based designs.

NB: *Open book test and no standard design data book will be provided.*

Micro Project/ Research Assignment:
The students work in groups to redesign angle cutter/ power tool or other mechanical systems. Project activity include group formation and selection of team leader, communication, dismantling, taking measurements, preparation of questionnaire, feedback from manufacturer/consumer, redesign and reassemble the device/assembly to its original state, computer usage in modelling and drafting and analysis, presentation (at least three in a semester), final technical report and daily diary.

Research assignment will constitute collection of literature required for designing of mechanical drives/system (used in machine tools or automobiles). Design assignment should include problem formulation, material selection, force analysis, designing of components on the basis of stress analysis and production drawings. Use suitable CAD/CAE tools.

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

1. conduct a failure analysis for the design/sizing of mechanical components
2. calculate stresses involved with static/ fatigue loading
3. design and analyze a real engineering system through projects
4. represent machine elements with a free body diagram and solve for unknown reactions
5. select the suitable materials and manufacturing considerations.

Text Books:

1. *Shigley, J., Mechanical Engineering Design, McGraw Hill, New York (2014).*
2. *Bhandari, V. B., Design of Machine Elements, Tata McGraw Hill, New Delhi (2010).*

Reference Books:

1. *Norton, R.L., Machine Design: An Integrated Approach, Pearson Education, New Delhi (2009).*
2. *Juvinall, R. C. and Marshek, K. M., Fundamental of Machine Component Design, John Wiley & Sons, New York (2011).*
3. *Sharma, C. S. and Purohil, K., Design of Machine Elements, Prentice Hall, New Delhi (2009).*
4. *Spotts, M. F. and Shoup, T. E., Design of Machine Elements, Pearson Education, New Delhi (2003).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional (may include the following) Assignments/Micro Projects, Presentation, Technical Report	40