JD College of Engineering & Management

(An Autonomous Institute affiliated to the Dr. Babasaheb ambeddkar technological university (DBATU), Lonere, Raigad.)

At :Khandala, Post : Valni,
Near Hanuman Temple, Borgoan Phata,
Kalmeshwar Road,
Nagpur -441501, Maharashtra

Telephone and Fax. : 0712 2023003

Course Content for

B. Tech. in Mechanical Engineering

w.e.f. Session 2020-21

From 3rd Semester - 4th Semester

Vision

To be a centre of excellence of learning and research in Mechanical Engineering.

Mission

The department is making its paramount efforts,

1. To provide high quality, innovative and research environment in Mechanical Engineering.
2. To impart soft skill and hard skill to achieve institutional vision.

Graduate Attributes

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

PEO1	Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
PEO2	Graduates should excel in best post-graduate engineering institutes, reaching advanced degrees in engineering and related discipline.
PEO3	Within several years from graduation, alumni should have established a successful career in an engineering-related multidisciplinary field, leading or participating effectively in interdisciplinary engineering projects, as well as continuously adapting to changing technologies.
PEO4	Graduates are expected to continue personal development through professional study and self-learning.
PEO5	Graduates are expected to be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Program Outcomes

At the end of the program the student will be able to:

PO1	Apply knowledge of mathematics, science and engineering to analyze, design and evaluate mechanical components and systems using state-of-the-art IT tools.
PO2	Analyze problems of automobile engineering including thermal, manufacturing and industrial systems to formulate design requirements.
PO3	Design, implement and evaluate automobile systems considering public health, safety, cultural, societal and environmental issues.
PO4	Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.
PO5	Apply current techniques, skills, knowledge and computer based methods and tools to develop mechanical systems.
PO6	Analyze the local and global impact of modern technologies on individual organizations, society and culture.
PO7	Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.
PO8	Exhibit responsibility in professional, ethical, legal, security and social issues.
PO9	Function effectively in teams, in diverse and multidisciplinary areas to accomplish common goals.
PO10	Communicate effectively in diverse groups and exhibit leadership qualities.
PO11	Apply management principles to manage projects in multidisciplinary environment.
PO12	Pursue life-long learning as a means to enhance knowledge and skills.

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	No. of Lecture hours (per week)
T:	No. of Tutorial hours (per week)
P:	No. of Practical hours (per week)
C:	Total number of credits
BSH:	Basic Science and Humanity
BSC:	Basic Sciences Course
PCC:	Professional Core Course
OEC:	Open Elective Course
PEC:	Professional Elective Course
BHC:	Basic Humanity Course
ESC:	Engineering Science Course
HSMC:	Humanity Science and Management Course
LC:	Laboratory course
NCC:	National Cadet Corps
NSS:	National Service Scheme
CA:	Continuous Assessment
MSE:	Mid Semester Exam
ESE:	End Semester Exam

JAIDEV EDUCATION SOCIETY'S
J D COLLEGE OF ENGINEERING AND MANAGEMENT
An Autonomous Institute, with NAAC "A" Grade
KATOL ROAD, NAGPUR
SESSION 2020-21

3rd Semester Mechanical Engineering

Sr. No.	Category of Subject	Course Code	Course Name	Teaching Scheme			Evaluation Scheme				
				L	T	P	CA	MSE	ESE	Total	Credit
1	BSC	MET301	Applied Maths-III	3	1	0	20	20	60	100	4
2	PCC	MET302	Material Science & Metallurgy	3	0	0	20	20	60	100	3
3	ESC	MET303	Rigid Body Mechanics	3	0	0	20	20	60	100	3
4	PCC	MET304	Engineering Thermodynamics	3	1	0	20	20	60	100	4
5	PCC	MET305	Theory Of Machines-I	3	1	0	20	20	60	100	4
6	LC	MEL302	Material Science & Metallurgy Lab	0	0	2	60	0	40	100	1
7	LC	MEL303	Rigid Body Mechanics Lab	0	0	2	60	0	40	100	1
8	LC	MEL306	Machine Drawing and Computer Graphics	1	0	2	60	0	40	100	2
9	PROJECT	MEI 307	Industrial Visit/ Internship	0	0	0	0	0	50	50	1
				16	3	6	280	100	470	850	23

4thSemester Mechanical Engineering

Sr. No.	Category of Subject	Course Code	Course Name	Teaching Scheme			Evaluation Scheme				
				L	T	P	CA	MSE	ESE	Total	Credit
1	PCC	MET401	Manufacturing Engineering	3	0	0	20	20	60	100	3
2	PCC	MET402	Strength Of Materials	3	1	0	20	20	60	100	4
3	PCC	MET403	Fluid Mechanics & Fluid Machines	3	1	0	20	20	60	100	4
4	BSC	MET404	Numerical Method	3	1	0	20	20	60	100	4
5	ESC	MET405	Basic Electronic Engineering	3	0	0	20	20	60	100	3
6	LC	MEL401	Manufacturing Engineering Lab	0	0	2	60	0	40	100	1
7	LC	MEL402	Strength Of Materials Lab	0	0	2	60	0	40	100	1
8	LC	MEL403	Fluid Mechanics & Fluid Machines Lab	0	0	2	60	0	40	100	1
9	LC	MEL406	Product Design and Development Lab	0	0	2	60	0	40	100	1
10	MC	MEM408	Indian Constitution	2	0	0	0	0	0	0	**Audit**
				15	3	8	340	100	460	900	22

Course Name : **MET301- Applied Mathematics-III**
Offered In : III-Semester (Odd Semester)
Scheme and Credit : [(3-1-0); Credits: 4]
Category of Subject : BSC
Course Assessment : Continues Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	Describe Matrices, properties of Laplace transform and Z Transform, partial differential equation, Function of Complex Variables.
CO2	Illustrate the examples using Matrices, Laplace and Z Transform, Partial differential equation, Function of Complex Variables.
CO3	Apply the knowledge of Matrices, Laplace transform, Z Transform, Partial differential equation, Function of Complex Variables to real world problems.
CO4	Analyze the question on Matrices, Laplace transform ,Z Transform, Partial differential equation , Function of Complex Variables
CO5	Synthesize the knowledge of Matrices, Laplace transform, Z Transform, Partial differential equation, Function of Complex Variables to solve engineering problem.

Course Contents:

UNIT I **[07 Hours]**
MATRICES: Characteristics equation, Eigen values and Eigen vectors, Statement and Verification of Cayley Hamilton Theorem [without proof], Reduction to Diagonal form, Sylvester's theorem [without proof.]

UNIT II **[07 Hours]**
Laplace Transform1: Definition – conditions for existence; Properties of Laplace transforms; Transforms of some special functions- periodic function, Heaviside-unit step function.

UNIT III **[07 Hours]**
Laplace Transform2: Introductory remarks ; Inverse transforms of some elementary functions ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of differential equations

UNIT IV **[07 Hours]**
Z Transform: Definition , Convergence of Z-transform and Properties, Inverse Z-transform by Partial Fraction Method, Residue Method (Inversion Integral Method). Solutions of Difference Equations with Constant Coefficients by Z- transform.

UNIT V **[07 Hours]**
Advanced Partial Differential equations: Introduction Partial differential equation, method of separation of variables, Application of partial differential equations .(Heat equation ,wave equation , Laplace Equation)

UNIT VI **[07 Hours]**

Functions of Complex Variables : Analytic functions; Conjugate functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form, Cauchy's integral theorem; Bilinear transform Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorem without proofs)

Text Books:

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books:

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and Their Engineering Applications by Dr. B. B. Singh, Synergy . Knowledge ware, Mumbai.

Course Name : **MET302 – MATERIAL SCIENCE**
Offered In : III-Semester (Odd Semester)
Scheme and Credit : [(3-0-0); Credits: 3]
Category of Subject : PCC
Course Assessment : Continuous Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	**Define**various structure of materials, their properties, testing methodologies, equilibrium diagrams, heat treatment processes.
CO2	**Classify** the various materials on the basis of characterization and behavior, heat treatment process with respect to property requirement, nondestructive testing methods.
CO3	**Demonstration** of the various phase transformation equilibrium diagrams, destructive and nondestructive testing, specimen preparation and metallography.
CO4	**Analyze** heat treatment process for required mechanical properties.
CO5	**Evaluate** samples of different materials for metallography.
CO6	**Estimate** mechanical properties, phase diagrams and metallographic samples.

Course Content:

Unit 1: Engineering Materials and Equilibrium Diagrams [7Hrs]

Introduction to engineering materials & classification, Crystal structures & Imperfections, Equilibrium Diagram, Solid Solutions, Gibb's rule, Lever rule, Invariant Reactions, Iron-Iron Carbide Equilibrium Diagram, TTT & CCT Diagram, Transformation products of austenite.

Unit 2: Ferrous and Non-ferrous Alloys [7Hrs]

Introduction to ferrous and non-ferrous alloys & applications, Ferrous alloy: Plain carbon steel, Stainless steel, Tool steel, High speed steel, Bearing steel, White cast iron, Grey cast iron, Nodular cast iron, Malleable cast iron, Specification system for steel –EN, SAE and AISI, Non-ferrous alloy: Cu-based alloys and Al-based alloys.

Unit 3: Heat Treatment [7Hrs]

Introduction and importance of heat treatment process, Heat treatment process: Annealing, Normalizing, Hardening, Tempering, Austempering, Martempering, Patenting, Isoforming, Surface hardening: Carburizing, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening,Vacuum and plasma hardening.

Unit 4: Destructive and Non-destructive Testing [7Hrs]

Destructive testing: Engineering stress-strain curve, True stress-strain curve, Tensile test, Compression test, Bend test, Torsion test, Formability, Hardness testing, Different hardness tests-Vickers, Rockwell, Brinnel, Impact test, fatigue test, creep test, Non-destructive testing: Magnetic particle inspection, Dye penetrant inspection, Ultrasonic inspection, Radiography.

Unit 5: Metallography **[7Hrs]**

Microscopy, specimen preparation, polishing abrasives and cloths, specimen mounting, electrolytic polishing, etching procedure and reagents, electrolytic etching, optical metallurgical microscope, macroscopy, sulphur printing, flow line observations, examination of fractures, spark test, electron microscope.

Unit 6: Advanced & Smart Material **[7Hrs]**

Composites: Processing of composites, types of composites, advantages and their applications, Nano-Materials: Synthesis of nano-materials, types of nano-material, method of characterization, and nano-material applications, Smart materials: Need of smart material, properties of smart material, types and applications of smart material.

Text books:

1. V. D. Kodgire, S. V. Kodgire, "Material Science and Metallurgy for Engineers", Everest Publishing House, Pune, 24thedition, 2008.

2. S. H. Avner, "Introduction to Physical Metallurgy", Tata McGraw Hill, 2ndedition, 1997.

3. V. Raghvan, "Material Science Engineering", Prentice Hall of India Ltd., 1992.

Reference Books:

1. V. B.John, "Introduction to Engineering Materials", ELBS, 6thedition, 2001.

2. G. F.Carter,D. E.Paul, "Materials Science and Engineering", ASM International, 3rd edition, 2000.

3. T. E. Reed-Hill, R. Abbaschian, "Physical Metallurgy Principles", Thomson, 3rdedition, 2003.

4. Donald J. Leo, "Engineering Analysis of Smart Material Systems", John Wiley & Sons, Inc.

Course Name : **MEL302 – MATERIAL SCIENCE LAB**
Offered In : III-Semester (Odd Semester)
Scheme and Credit : [(0-0-2); Credits: 1]
Category of Subject : LC
Course Assessment : Continuous Assessment (60%), End Sem Exam (40%)

Course Outcome: At the end of the course, students will be able to

CO1	**Categorize** the ferrous alloy, nonferrous alloy, heat treatment process, destructive testing, nondestructive testing and advanced materials.
CO2	**Justify** the experimentation on the metallurgical microscope, heat treatment furnace and devices used for specimen preparation.
CO3	**Apply** the experimental procedures for microstructure examinations, specimen preparation and heat treatment processes.
CO4	**Analyze** the microstructure of samples and heat treatment of steel samples.

List of Practical: (Any 10)

1. Demonstration of metallurgical microscope.
2. Examine the microstructures of steel samples on the metallurgical microscope.
3. Examine the microstructures of cast iron samples on the metallurgical microscope.
4. Examine the microstructures of non-ferrous alloy samples on the metallurgical microscope.
5. Examine the microstructures of heat treated steel samples on the metallurgical microscope.
6. Preparation of specimen for metallographic analysis.
7. Performance on Jominy End Quenched Test Setup.
8. Performance of annealing and normalizing heat treatment process on steel sample.
9. Performance of hardening heat treatment process on steel sample.
10. Study of hardness testing – Rockwell, Brinell and Vickers testing.
11. Study of non-destructive techniques.
12. Study of advanced and smart materials.

Course Name : **MET303- RIGID BODY MECHANICS**
Offered In : III-Semester (Odd Semester)
Scheme and Credit : [(3-0-0); Credits: 3]
Category of Subject : ESC
Course Assessment : Continuous Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	**Define** static, dynamic, kinematic and kinetic bodies, law of transmissibility, Varignon's theorem, Lami's theorem, trusses, coulombs law, D'Alemberts principal, law of conservation of momentum.
CO2	**Interpret** conditions of body based on rest or in motion, the system of forces like concurrent or non-concurrent, types of load, moment, couple, centroid, moment of inertia.
CO3	**Apply** knowledge, facts and techniques in the applications like beams, frames, trusses, spheres, composite geometric shapes, friction in flat belts.
CO4	**Examine** the given problems using concepts such as free body diagrams and force analysis methods in equilibrium, structures and friction cases.
CO5	**Present** opinions on conservative as well as non-conservative forces systems and validate simple general rigid body motions on given criterion.
CO6	**Propose** alternative solutions on various applications of rigid body as well as create equations based on the conditions like in centroid and moment of inertia, work energy principal & impulse momentum.

Course Contents:

Unit I: Fundamentals of Rigid Body Mechanics: [07hrs]

Basics of Mechanics: Definition and classification of mechanics, static, dynamic, kinematics, kinetics, fundamental concepts of rigid bodies, rigid body mechanics, particle, mass, weight, Newton's laws of motion, fundamental units, derived units.
System of Forces: Definition of Force, system of forces, characteristics of forces, unit, axioms of forces, scalar and vector quantities, vector representation & position of forces, law of Transmissibility, triangle law of forces, parallelogram law and polygon law of forces.
Equivalent Force system: Resolution of Forces in two dimensional distributed loads, Resultant force, components of force, concurrent force system, Non-concurrent force system, Moment of force, Varignon's theorem and Couple.

Unit II: Concept of Equilibrium Force system: [07hrs]

Introduction to Equilibrium conditions: general principle and equations of equilibrium, concept of free body diagram, Lami's theorem.
Equilibrium condition in Concurrent force system: loads on spheres, flexible support and rigid members
Equilibrium condition in Non-concurrent force system: types of load, UDL, UVL, load on beams.

Unit III: Rigid Body Systems: [07hrs]

Analysis of Structures: Definition of member, structure and trusses, assumptions in trusses, equation of truss, perfect, imperfect, deficient and redundant frame, forces on members of truss, method of analysis of truss, method of joint and system.
Friction: Definition and types of friction, angle of friction, angle of repose, laws of friction, Coulombs laws of dry friction, Analysis of rigid bodies on rough inclined surfaces, wedges, ladders and application of flat belts.

Unit IV: Properties of Area: [07hrs]
Centroid & Centre of Gravity: Definitions, derivation on centre of gravity of flat plate, centroid for common geometric shapes.
Moment of Inertia: MI of composite lamina, radius of Gyration, Polar moment of inertia, perpendicular axes theorem, parallel axes theorem, second moment of inertia, product of inertia, principal moment of inertia, Mohr's circle.

Unit V: Rigid Body Dynamics: [07hrs]
Kinematics of particles: Definitions of displacement, velocity and acceleration and their relation, rectilinear motion under constant and variable acceleration, motion curves, simple relative motion between two particles.
Kinetics of particles: Kinetics of rectilinear and circular motion of a particle acted upon by a constant and variable force system, D'Alembert's principle, concept of dynamic equilibrium.

Unit VI: [07hrs]
Work-Energy Method: Work, power and energy, work-energy principle, equation for rigid bodies.
Impulse-Momentum: Definition of momentum, impulse and impact, law of conservation of momentum, elastic impacts, coefficient of restitution.

Text Books:

1. Vector Mechanics for Engineers, Vol. 1 – Statics and Vol. 2 – Dynamics, Beer andJohnson, 8th edition, Tata McGraw Hill International Edition, 2007.
2. Engineering Mechanics, Vol. 1 – Statics 4/e, 1998 and Vol. 2 – Dynamics, Merriam, 5/e, Wiley International, 2001.
3. Engineering Mechanics: Statics. 2nd Edition, by W.F. Riley and L.D. Sturges. Published by John Wiley and Sons, Inc., New York. 1996.
4. Vector Mechanics for Engineers: Statics, Sixth Edition, by F. P. Beer and E. R. Johnson, published by McGraw-Hill.
5. Engineering Mechanics: Statics, 9e, Hibbeler, 2001, Prentice Hall

References Books:

1. Engineering Mechanics – Statics and Dynamics, Irving, H., Sharmes, 4th Edition,Prentice-Hall of India Pvt. Ltd., 1996.
2. Engineering Mechanics, Vol. 1 – Statics and Vol. 2 – Dynamics, Mokoshi, V.S., TataMcGraw Hill Books, 1996.
3. Engineering Mechanics, Timo-shenko and Young, 4th Edition, McGraw Hill, 1995.
4. Engineering Mechanics, McLean, 3rd Edition, SCHAUM Series, 199

Course Name : **MEL303- RIGID BODY MECHANICS LAB**
Offered In : III-Semester (Odd Semester)
Scheme and Credit : [(0-0-2); Credits: 1]
Category of Subject : ESC
Course Assessment : Continuous Assessment (60%), End Sem Exam (40%)

Course Objectives: At the end of the course, students will be able to

CO1	**Experiment with** law of Force Polygon, law of Moments using Force Polygon, Jib crane apparatus and Simply supported type beam.
CO2	**Determine** mechanical advantage, Velocity ratio and efficiency of a Differential Axel & Wheel machine, Single and Double Purchase Crab machine.
CO3	**Evaluate** co-efficient of friction between glass, rubber, wood, inclined plane and coil friction apparatus.
CO4	**Elaborate** Centroid of irregular shaped bodies and Mass Moment of Inertia using Fly Wheel Apparatus.

List of Practical:

1. To verify law of polygonal of forces using Law of Polygon Apparatus.
2. To Determine the Forces and Verify Lami's Theorem using Jib Crane Apparatus.
3. To determine support reactions of a Simply Supported Beam experimentally and analytically.
4. To determine the coefficient of friction between two surfaces of different material on Plane Friction.
5. To determine the coefficient of friction of Coil Friction Apparatus.
6. To determine Centroid of irregular shaped bodies.
7. To determine the mass moment of inertia of a fly wheel using Fly Wheel Apparatus.
8. To determine efficiency and law of machine of Differential Axel & Wheel machine.
9. To determine efficiency and Law of machine of Single Purchase Crab machine.
10. To determine efficiency and Law of machine of Double Purchase Crab machine.

Course Name: **MET304- ENGINEERING THERMODYNAMICS**
Offered In: III-Semester (Odd Semester)
Scheme and Credit: [(3-1-0); Credits: 4]
Category of Subject: PCC
Course Assessment: Continuous Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	**Define** the four basic laws viz. zeroth law, first law, second law and third law of thermodynamics and basic concepts, properties of substances.
CO2	**Illustrate** basic concepts, properties of substances and Laws of thermodynamics.
CO3	**Apply** the Laws of Thermodynamics for various thermodynamic processes / cycles.
CO4	**Categorize** different thermodynamic processes for heat and work transfer.
CO5	**Evaluate** knowledge of thermodynamics to suggest solutions for problems.
CO6	**Design** the system using basic laws of thermodynamic.

Course Contents:

UNIT I **[07 Hours]**

Introduction to thermodynamics: Zeroth law of thermodynamics, heat and work transfer, First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy, different forms of energy, Enthalpy, PMM-I control volume. Application of first law of steady flow processes (nozzle, turbine, compressor pump, boiler, throttle valve etc.)

UNIT II **[07 Hours]**

Second law of thermodynamics: Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence, PMM of Second kind, reversibility and irreversibility, causes of irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale**.**

Entropy: Clasius theorem, the property of entropy, the inequality of Clausius, Entropy principle and its applications, Entropy change during different thermodynamic processes.

UNIT III **[07 Hours]**

Availability and Irreversibility: Available energy, availability of a closed system, availability function of a closed system availability of steady flow system, availability function of open system , Helmholtz function , Gibbs functions, Irreversibility for closed and open system, Second law efficiency.

Thermodynamic Relationships: Maxwell's equations, T-ds equations, difference in heat capacities, coefficient of Volume expansion and isothermal compressibility, adiabatic compressibility, ratio of specific heat, energy equations, Joule-Kelvin effect, Clausius-Clapeyran equation

UNIT IV **[07 Hours]**

Equation of state: Ideal gas equation of state, deviation of Real gas from ideal gas, van der waal's equation of state, correction for the intermolecular attractions, correction for finite size of molecules, evaluation of constants a and b, virial expansions, limitations of the van der waal's equation, Reduced coordinates, compressibility factor, the law of corresponding states as per van der waal's principle.

Mixture of perfect gases: Mass Fraction, Mole fraction , Dalton's Law of additive pressure, Amagat-Leduc of additive volumes , Properties of mixture of ideal non-reactive gases –gas constant, molecular weight, specific heat, internal energy, enthalpy and entropy.

UNIT V **[07 Hours]**

Properties of Pure substances: Thermodynamic properties of pure substances in solid, liquid and vapour phases, Phase Transformations, dryness fraction, Triple point, critical state, p-v, p-T, T-s, h-s diagrams, P-V-T surfaces,– Properties and processes in ideal vapour, use of steam tables and Mollier's diagram in determination of steam properties, energy interaction and entropy calculations.

UNIT VI **[07Hours]**

Vapor and Gas Power Cycles: Carnot cycle, ideal Rankine cycle, Reheat and Regeneration, Stirling cycle, Joule-Brayton cycle. Calculation of thermal efficiency, specific steam/fuel consumption, work ratio for above cycles.

Text Books:

1. Thermodynamics- An Engineering Approach – Cengal & Boles – McGraw Hill

2. Engineering Thermodynamics – P.K. Nag – TMH Publishers

3. Thermodynamics – C.P. Arora – TMH Pub.

4. Thermodynamics & Thermal Engineering – J. Selwin Rajadurai – New Age, Delhi

Reference Books:

1. Fundamental of engineering thermodynamics- R. Yadav , CPH, Allahabad

2. Thermal Science & Engineering – D.S. Kumar – S.K. Kataria & Sons

3. Fundamental of Thermodynamic- Claus Borgnakke, Richard E. Sonntag, Wiley, Delhi

4. An Introduction to Thermodynamics- Y. V. C. Rao University Prass, Hyderabad

5. Engineering Thermodynamics- M. Achuthan –PHI- New Delhi

Course Name: **MET305-THEORY OF MACHINE -I**

Offered In: III-Semester (Odd Semester)
Scheme and Credit: [(3-1-0); Credits: 4]
Category of Subject: PCC
Course Assessment: Continuous Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	**Define** various types of mechanisms, velocity and acceleration images, cam and follower, Laws of friction, clutches and brakes, gear terminology and gear trains.
CO2	**Explain** the concepts of simple mechanism, velocity and acceleration images, types of cam and follower, theory of friction, clutches, brakes & dynamo meters, gear kinematics with gear train.
CO3	**Compute** the degree of freedom,velocity and acceleration in simple mechanisms and cam and follower, power lost due to friction for clutches, braking torque, efficiency of various gears and gear trains.
CO4	**Analyze** various mechanisms, cams and follower, clutches and brakes,gears and gear trains.
CO5	**Design t**he various mechanisms,cam and follower, clutches and breaks,gears and gear trains for specific application.

Course Contents:

Unit -I Basic Concept of Mechanism: **[07 Hours]**

Basic concept of mechanisms, links, kinematic pairs, kinematic chain, mechanisms, machine, Types of mechanisms, Degree of freedom of link and planer mechanism, Classification of four-bar chain (Class I and Class II) Inversion of four bar chain, Slider crank chain and double slider crank chain. Study of various mechanisms such as approximate straight line mechanisms, pantograph, Geneva mechanism, steering gear mechanisms and Hooke's joint.

Unit -II Kinematic Analysis of Mechanisms: **[07Hours]**

Velocity, acceleration analysis of planer mechanism by graphical method using relative velocity/ acceleration. Concept of velocity and acceleration image, Coriollis component of acceleration, Instantaneous centre of rotation, body and space centrodes, body centrodes and their applications, Kennedy's theorem and its applications. Velocity and acceleration of slider crank mechanism by analytical method and Klein's construction.

Unit-III Cam Mechanisms: **[07Hours]**
Types of cams, follower and applications. Synthesis of cam for different types of follower motion like constant velocity, parabolic SHM, cycloidal etc. With velocity and acceleration.

Unit -IV Friction: **[07 Hours]**

Laws of friction, Friction of inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction-uniform pressure and uniform wear.

Clutches, Brakes & Dynamo meters:

Single, multiple and cone clutch, Shoe brake, Band brake, Band and Block brake, Absorption and transmission type dynamo meters.

Unit V:-Toothed Gear **[07 Hours]**

Classification of gears, Terminology of spur gears, Conjugate action, Involute and cycloidal profiles, Path of contact, Contact ratio, Interference, Undercutting, Effect of centre distance variations, Friction between gear teeth, Internal gears. Helical gear terminology, Normal and transverse module, Virtual number of teeth, Torque transmitted by helical gears, Tooth forces and geometric relationship, Torque capacities.

Unit VI: - Gear Train **[07 Hours]**

Velocity ratios, Types of gear trains like Simple, Compound, Reverted and Epicyclic gear train.

Text Book:-

1. S. S. Rattan, “Theory of Machines”, Tata McGraw Hill Publications, New Delhi.
2. Thomas Beven, “Theory of machines”, CBS Publishers, Delhi, 1984.
3. A. Ghosh, A. K. Malik, “Theory of Mechanisms and Machines”, Affiliated East-West Press Pvt. Ltd., New Delhi.

Reference Book:

1 J. E. Shigely, J. J. Uicker, “Theory of Machines and Mechanisms”, Tata McGraw Hill Publications, New York, International Student Edition, 1995.
2. Rao J.S., Dukki Patti R.V “Mechanisms & Machines Theory,”, New age Int, 2nd
3. Sandor G.N., Erdman A.G “Theory of Machines”, Prentice Hall Publications, 1984 .

Course Name: **MEL306- Machine Drawing and Computer Graphics**
Offered In: III-Semester (Odd Semester)
Scheme and Credit: [(1-0-2); Credits: 2]
Category of Subject: LC
Course Assessment: Continuous Assessment (60%), End Sem Exam (40%)

Course Outcome: At the end of the course, students will be able to

CO1	**Define** sectional views, limits, fits, tolerances, machine component& symbols along with proper application and processes.
CO2	**Illustrate** sectional views, limits, fits, tolerances, symbols, machine component& assemblies for appropriate application.
CO3	**Construct**different sectional views, machine element, and assemblies.
CO4	**Classify** different sectional views, machine elements & assemblies.

Course Contents:

Unit 1: Sectional views, Conventional symbols, Limit, Fits & Tolerances [08 Hours]

Full Section, Half Section, Partial Section, off-Set Section, Revolved Sections, Removed Sections Auxiliary Section, Guidelines for Hatching, and Examples on all above types of Sections of Machine Elements, material, machine & welding symbols, limit, fits, & tolerances.

Unit2: Machine Components [08 Hours]

Study of simple machine elements and components such as screwed fasteners, riveted, bolted, and welded joints, screw jack, tool post, knuckle joint, cotter joint, shaft couplings, bearings etc.

Unit3: Computer Aided Drafting [08 Hours]

Introduction to Computer Aided Design and Drafting, Advantages of CADD,Study of Preliminary Autodesk Fusion 360 Commands Like Drawing, Dimensioning, Viewing, Extruding, Revolving Commandsetc.

List of practical's

1. One full imperial sheet on material, machine, & welding symbols.
2. One full imperial sheet on limits, fits, & tolerances along with its application.
3. One full imperial sheet for assembly drawing (screw jack, tool post, knuckle joint, cotter joint, shaft couplings, bearings).
4. One full imperial sheet fordetailed parts of the component (screw jack, tool post, knuckle joint, cotter joint, shaft couplings, bearings).
5. Design components and assembly using fusion 360.
6. Construct sectional views of two mechanical components using fusion 360.

Text Books

1. Machine Drawing by K.L. Narayana, P. Kannaiah, new Age International Third edition.
2. Engineering Drawing by N. D. Bhatt, Charotar Fifth edition.

Reference Books

1. Machine Drawing by K. C. John, PHI Learning second edition.
2. Engineering Drawing by Bansat Agrawal, McGraw Hill second edition.

Course Name: **MEI307- Industrial Visit/ Internship**
Offered In: III-Semester (Odd Semester)
Scheme and Credit: [(0-0-0); Credits: 1]
Category of Subject: Project
Course Assessment: 50 marks

Course Outcome

This subject aims at giving practical exposure to students and to provide opportunities for acquiring knowledge regarding manufacturing and service industries/organizations and to acquaint them with industrial culture. Upon completion of this course, students will be able to describe the usage of different technologies/tools/concepts related to Design process, operation of various machines, mechanical drives, manufacturing processes, machining processes, various process equipments, production techniques, quality control, maintenance practices, automation in industries, management etc.

Course Contents:

Students shall visit different industries (at least two). Students shall be preferably divided into small groups to tour around the industry. After each visit, each batch of students is required to submit a written report and shall give a brief oral presentation.

Course Name: **MET401-MANUFACTURING PROCESS**

Offered In: IV -Semester (Even Semester)
Scheme and Credit: [(3-0-0); Credits: 3]
Category of Subject: PCC
Course Assessment: Continuous Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	**Define** different castings, forming, joining& machining processes also it's working principles and applications.
CO2	**Classify** different castings, forming, joining& machining processes.
CO3	**Identify** working principles and applications of castings, forming, welding & machining processes including brazing and soldering.
CO4	**Categorize** different operation performed in castings, forming, joining & machining processes.
CO5	**Choose** different job using different operation performed in castings, forming, joining & machining processes.

Course Contents:

Unit 1: Introduction and Casting Processes **[08 Hours]**
What is manufacturing? Selection of manufacturing processes, Introduction to casting:Brief History, Advantages and Limitations, Applications. Pattern making: Types, materials used, Pattern making allowances, colour codes scheme, moulding sand: Types of sands, composition &properties of sand. Metal casting processes: Introduction, classification, Conventional Molding process, Chemical sand molding process & Permanent-mold casting.

Unit II: Gating system design **[07 Hours]**
Elements of gating systems, pouring time, and riser design, Melting furnaces – Types of furnace, Cupola-construction & operation. Cleaning, inspection & casting defects. Special casting processes such as investment Casting, Centrifugal Casting.

Unit III: Metal Forming **[07 Hours]**
Introduction to Rolling; Flat-rolling Process: Roll Force, Torque, and Power Requirements, Rolling Mills; Introduction to forging: Open-die forging; Impression-die and Closed-die forging, Forgeability of Metals, Introduction to Extrusion Process; Hot Extrusion, Cold Extrusion, Introduction to Wire Drawing & Deep Drawing.

Unit IV: Joining Processes **[07 Hours]**
Introduction to Welding; Oxy-fuel-gas Welding; Arc-Welding Processes: Shielded Metal-arc Welding, Submerged-arc Welding, Gas Metal-arc Welding; Electrodes for Arc Welding; Introduction to solid state welding: Friction Welding, Resistance Welding: Spot, Seam. Introduction to brazing and soldering; Brazing: Brazing Methods, Soldering: Types of Solders and Fluxes.

Unit V: Machining Processes **[07 Hours]**

Introduction to Machining – Purpose, Principle and Definition; Machine tool, cutting tool materials, nomenclature and tool geometry of single point cutting tool, tool materials properties. Lathes: Introduction,Types of Lathes, Lathe Components, Work holding Devices and Accessories, Lathe Operations, Design Considerations and Guidelines for Turning Operations. Introduction of Drilling Machines.

Unit VI: Milling, Shaper & Planer **[06 Hours]**

Introduction to milling, Milling and Milling Machines: Peripheral Milling, Face Milling, End Milling, Other Milling Operations and Milling Cutters, Design and Operating Guidelines for Milling, Shaper & Planer: Introduction, type, specification, description of machines.

RECOMMENDED BOOKS:

- **TEXT BOOKS:**

1. Manufacturing Science – Ghosh & Malik.

3. Manufacturing Technology (Foundry Forming & Welding) – P N Rao.

4. Workshop Technology (Volume I), Hajra Chaudhary, Media Promoters &Publishers.

- **REFERENCE BOOKS:**

1. Milkell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons, New Jersey, 4th edition, 2010.

2. Paul DeGarmo, J.T. Black, Ronald A. Kohser, "Materials and Processes in Manufacturing", Wiley, 10th edition, 2007.

Course Name: **MEL401- MANUFACTURING PROCESS LAB**
Offered In: IV Semester (Even Semester)
Scheme and Credit: [(0-0-2); Credits: 1]
Category of Subject: LC
Course Assessment: Continuous Assessment (60%), End Sem Exam (40%)

Course Outcome: At the end of the course, students will be able to

CO1	**Make use of** various manufacturing process for preparation of pattern, moulding, casting, joining and machining.
CO2	**Categorize** the various manufacturing process as per application of industry.
CO3	**Justify** the various operations of pattern making, machining process and joining process.

Attempt any 10 Experiment

1. Performance of Pattern Making on wood material.
2. Illustration of Various Moulding Process. (V-lab/ Industry).
3. Demonstration of various Casting Process (V-lab/ Industry).
4. Construction and working of Cupola Furnace.
5. Demonstration of forging process (V-lab/ Industry).
6. Identification of various Extrusion process. (V-lab/ Industry).
7. Performance of Various Joining Process.
8. Study of Mechanics of metal cutting.
9. Development of butt joint on Mild steel plates using arc welding.
10. Performing a job with various types of tool on a Centre lathe.
11. Development of job by using Drilling & Shaper Machine.
12. Manufacturing/Fabricating the spur gear on milling machine.

Course Name: **MET 402- STRENGTH OF MATERIAL**
Offered In: IV-Semester (EVEN Semester)
Scheme and Credit: [(3-1-0); Credits: 4]
Category of Subject: PCC
Course Assessment: Continuous Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	**Define** the basic definitions of axial load, eccentric load, different types of stresses and strain in different conditions, elastic properties of materials and different theories of failure.
CO2	**Explain** the stress state (tension, compression, bending, shear, etc.) and calculate the value of stress developed in the component of axial, eccentric, static and impact load cases.
CO3	**Solve** problems on uniaxial, multiaxial stress situation, principal stresses, stresses on oblique plane, shear force-bending moment and deflection in case of different beam conditions.
CO4	**Analyze** given beam for calculations of SF and BM, slope and deflection at a point on cantilever, simply supported beam using different methods such as double integration, Macaulay's, Area-moment and superposition.
CO5	**Evaluate**materials, sizes and sections for various applications such as beams, shafts, pressure vessels, columns, etc. and justify the selection.
CO6	**Design** basic elements of structures like beams, shafts, key etc.

Course Contents:

UNIT I

stress, strain and deformation of solids **[07hrs]**

Simple Stresses and strains – Elastic constants – Relationship between elastic constants – Stress Strain Diagram – Ultimate Stress – Yield Stress – hoop stress, analysis of tapered rod and composite section,Thermal Stress- Volumetric strain,

Unit –II

Shear force and bending moment **[07hrs]**

Relation between load, shear force and bending moment, Shear force and bending moment diagrams for different types of beams subjected to different types of loads, point of contra flexure

UNIT III

Deflection of beams **[07hrs]**

Concept and definition, relation between B.M., slope and deflection slope and deflection by double integration method (McCauley's method)

Slope and Deflection in determinate beams by Moment Area method

UNIT IV

Stresses in beams & columns **[7hrs]**

Combined axial and flexural loads, middle third rule, Kernel of section, load applied off the symmetry

pure bending, theory of simple bending with assumption and expression for bending stresses, derivation of bending equation, bending stresses in symmetrical sections, section modulus for various shapes of beam sections.

UNIT V **[07hrs]**

Principle stresses and strains

Deformation of axially loaded member – Composite Bars – State of Stress in two dimensions – Stresses on inclined planes – Principal Stresses and Principal Planes – Maximum shear stress – Mohr's circle method.

Theories of Failure:

Maximum principal stress theory, maximum shear stress theory, Total strain energy theory, shear strain energy theory, graphical representation and derivation of equation for each and their application to problems relating to two dimensional stress systems only

UNIT VI **[07hrs]**

Torsion of circular shaft

Theory of torsion of shafts of circular, cross section. Assumptions, Derivation of torsion formulae, stresses strains and deformation in determinate and indeterminate shafts of hollow, solid, homogeneous circular cross section subjected to twisting moments, stresses due to combine torsion & bending

Axially loaded columns

Concept of critical load and buckling, derivation of Euler's formulae for buckling load with hinged ends, concept of equivalent length for various end conditions. Rankine's formulae, safe load on column, Limitations of Euler's formulae.

Text Books

1. "Strength of Materials" By S. Ramamrutham & R Narayanan, Dhanpat Rai publication, New Delhi.
2. Strength of Materials by S.S. Rattan, McGraw-Hills Education (India) Publication, India
3. Strength of Materials by S.S. Bhavikatti, Vikas Publishing house, Noida, India.

Reference Books:

1. Mechanics of materials by Timoshenko and Gere, CBS Publisher.
2. Strength of Materials by F. L. Singer, Harper and row Publication.
3. Mechanics of Materials by Hibbeler R.C., Pearson publisher.

Course Name: **MEL 402- STRENGTH OF MATERIAL**
Offered In: IV-Semester (EVEN Semester)
Scheme and Credit: [(0-0-2); Credits: 1]
Category of Subject: LC
Course Assessment: Continuous Assessment (60%), End Sem Exam (40%)

Course Outcome: At the end of the course, students will be able to

CO 1	**Experiment with** tension, compression, shear ,torsion and impact test for different materials.
CO 2	**Analyze** the stress and strain relationship under different loading conditions for various metals such as mild steel , aluminum , cast iron etc.
CO 3	**Examine** the experimental procedure to measure material properties used in industry and construction purpose.
CO 4	**Develop** appropriate method for testing of the material as per the application.

LIST OF PRACTICAL

1. Demonstration of universal testing machine.
2. Performance of tension test on Mild Steel and Aluminum.
3. Performance of Shear test on Mild Steel and Aluminum.
4. Performance of Torsion test on Mild Steel and Cast-Iron.
5. Illustrate the strain energy and impact loading.
6. Performance of Impact test on Mild Steel, Aluminum and Cast-Iron.
7. Performance of Hardness test on Mild Steel, Aluminum and Cast iron.
8. Analysis of stress, strain by using advance tools.
9. Deflection test on mild steel and wooden beam specimen.
10. Graphical solution method for principal stress problems.

Course Name: **MET403- FLUID MECHANICS & FLUID MACHINES**
Offered In: IV-Semester (Even Semester)
Scheme and Credit: [(3-1-0); Credits: 4]
Category of Subject: PCC
Course Assessment: Continuous Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	**Define** terms like viscosity, vapor pressure, compressibility, surface tension, capillarity, meta-centre and meta-centric height, Path line, Stream Line, Streak line, TEL, HGL, Degree of reaction etc.
CO2	**Classify** various types of fluid, fluid flow, energy losses, water turbines and pumps
CO3	**Apply** Pascal's law, Hydrostatic law, Bernoulli's theorem and Dimensional analysis
CO4	**Analyze** the hydrostatic force acting on various plane, meta-centric height of ship model, velocity & acceleration of a fluid particle, energy losses through pipe, performance of turbo machines
CO5	**Evaluate** the performance of various turbo machines such as pelton wheel turbine, Kaplan turbine, Francis turbine, centrifugal pump & reciprocating pump
CO6	**Design** simple hydraulic systems using the basic principles of fluid mechanics and turbo machinery

Course Contents:

UNIT I **[07 Hours]**

Fluid Properties: Definition of fluid, fluid properties such as viscosity, vapor pressure, compressibility, surface tension, capillarity.

Fluid Statics: Pressure at a point in the static mass of fluid, Pascal's law, Hydrostatic Law, Hydrostatic forces on the plane and curved surfaces, centre of pressure, Buoyancy, centre of buoyancy, stability of floating bodies, meta-centre and meta-centric height its application in shipping.

UNIT II **[07 Hours]**

Fluid Kinematics: Types of fluid flow, Continuity equation in Cartesian co-ordinate form, Velocity component, Convective and Local acceleration of fluid particle, Rotational and irrotational flow, Path line, Stream Line, Streak line, Laplace's equation in velocity potential and Poisson's equation in stream function, flow net.

UNIT III **[07 Hours]**

Fluid Dynamics: Momentum equation, development of Euler's equation, Introduction to Navier-Stokes equation, Integration of Euler's equation to obtain Bernoulli's equation, Bernoulli's theorem, Application of Bernoulli's theorem such as venturimeter, orifice meter, pitot tube etc.

UNIT IV **[07 Hours]**

Flow through pipes: Energy losses through pipe, Darcy-Weisbach equation, Moody diagram, and Minor losses in pipes, TEL, HGL, Pipes in series and parallel, Siphons and Transmission of power.

Dimensional Analysis: Dimensional homogeneity, Raleigh's method, Buckingham's theorem, Model analysis, similarity laws and dimensionless numbers.

UNIT V **[07 Hours]**

Water Turbines: Theory of turbo machines and their classification, Elements of hydro-electric power plant, Impulse Turbine:- principle, constructional features, Installation of Pelton Turbine, Velocity

Diagram and Analysis, Working proportions, Design parameters, Performance characteristics.Reaction or pressure Turbine:- principles of operation, Degree of reaction, comparison over Pelton Turbine, Classification, Draft tube, Francis Turbine, Propeller Turbine, Kaplan Turbine:- Types, Constructional features, Installations, Velocity Diagram and analysis, Working proportions, Design parameters, Performance characteristics.

UNIT VI **[07 Hours]**

Hydrodynamic pumps: Classification and Applications, Centrifugal pumps:- Principle of operation, Classification, Component of Centrifugal Pump installation, Priming methods, Fundamental equation, Various heads, Velocity heads, Velocity triangles and their analysis, slip factor, Effect of outlet blade angle, Vane shapes, Losses and Efficiencies of pumps, Multi staging of pumps, Design Consideration, Working proportions, N.P.S.H.

Positive Displacement Pumps: Basic principle, Classification, Reciprocating Piston / Plunger Pumps:- Types, Main Components, Slip, Work Done, Indicator Diagram, Air vessels, Gear pump, Screw pump, Vane pump.

Text Books:

1. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar– Kataria & Sons, New Delhi
2. Fluid Mechanics & Hydraulics Machines- R. K. Bansal- Laxmi Publications., Delhi
3. Fluid mechanics- R C Hibbeler, Pearson
4. Engineering Fluid Mechanics –K.L. Kumar, Eurasia Publication House, Delhi
5. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas- TMH, Delhi

Reference Books:

1. Mechanics of Fluid – B.S. Massey – English Language Book Society (U.K.)
2. Fluid Mechanics- Yunush A. Cengel, John M. Cimbala- TMH, Delhi
3. Hydraulics and Fluid Mechanics Including Hydraulic Machine- P. N. Modi & S. M. Seth-Standard, Delhi
4. Theory and Application of Fluid Mechanics- K. Subramanya-TMH Delhi

Course Name: **MEL403- FLUID MECHANICS & FLUID MACHINES LAB**
Offered In: IV-Semester (Even Semester)
Scheme and Credit: [(0-0-2); Credits: 1]
Category of Subject: LC
Course Assessment: Continuous Assessment (60%), End Sem Exam (40%)

Course Outcome: At the end of the course, students will be able to

CO1	**Experiment with** metacentre, meta-centric height, head loss, Impulse Momentum Principle, Bernoulli's Theorem, performance parameter of hydraulic machines
CO2	**Analysis** of venturi-meter, orifice meter, water turbines and hydraulic pumps.
CO3	**Evaluate** performance parameters of various hydraulic turbines and hydraulic pumps.

List of Experiments: (At least ten experiments are to be performed by each student)

1. To determine the meta-centric height for ship model.
2. To determine head loss in various pipe fittings.
3. To determine coefficient of discharge of an orifice-meter.
4. To determine coefficient of discharge of Venturi-meter.
5. Verification of Impulse Momentum Principle.
6. Verification of Bernoulli's Theorem.
7. Performance testing of Pelton wheel turbine.
8. Performance testing of Francis turbine.
9. Performance testing of Kaplan turbine.
10. Performance testing of centrifugal pump.
11. Performance testing of reciprocating pump.
12. Illustrate the velocity distribution in pipe and to compute the discharge by integrating velocity profile.

Course Name : MET404- Numerical Method in Mechanical Engineering
Offered In : IV-Semester (Even Semester)
Scheme and Credit : [(3-1-0); Credits: 4]
Category of Subject : BSC
Course Assessment : Continues Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	Describe the concept error analysis, algebraic equation, root of equation, ODE, numerical integration, Interpolation, Curve Fitting .
CO2	Illustrate the concept of various Numerical Techniques Bisection methods, Newton Raphson method, Gauss- Elimination Method, Euler's Method, Runge–Kutta Method,Trapezoidal and Simpsons Rule, Interpolation , Curve fitting.
CO3	Solve the given Engineering problem using the suitable Numerical Technique Bisection methods, Newton Raphson method, Gauss- Elimination Method, Euler's Method, Runge–Kutta Method Trapezoidal and Simpsons Rule, Interpolation, Curve fitting..
CO4	Analyze the question on algebraic equation, root of equation ,ODE, numerical integration, Interpolation, Curve Fitting
CO5	Develop the computer programming based on the Numerical Technique of algebraic equation, root of equation, ODE, numerical integration, Interpolation, Curve Fitting.

Course Contents:

UNIT I [06 Hours]
Error Analysis
Significant figures, round-off, precision and accuracy, approximate and true error, truncation error and Taylor series, machine epsilon, data uncertainties, error propagation, importance of errors in computer programming

UNIT II [07Hours]
Roots of Equations
Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineering applications.

UNIT III [06 Hours]
Numerical Solution of Algebraic Equations and ODE
Motivation, Cramer's rule, Gauss- Elimination Method, pivoting, scaling, engineering applications, Heun's method, Runge–Kutta Method, engineering applications.
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UNIT IV [08 Hours]
Numerical Integration and Differentiation
Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, engineering applications Numerical differentiation using Finite divide Difference method

UNIT V [08 Hours]
Curve Fitting and Interpolation

Motivation, Least Square Regression: Linear Regression, Polynomial regression. Interpolation: Newton's Divide Difference interpolation, engineering applications. Euler's and Modified Euler's Method

UNIT VI **[08 Hours]**

Computer Programming

Overview of programming language, Algorithms and Flowchart of method based on each unit, Development of at least one computer program based on each unit.

Text Books:

1. Steven C Chapra, Reymond P. Canale, "Numerical Methods for Engineers", TataMcGraw Hill Publications, 2010.
2. E.Balagurusamy, "Numerical Methods", TataMcGraw Hill Publications,1999.
3. "Numerical Methods for Engineers" by Richard W. Hamming
4. Numerical Method for ordinary System By J.D. Lambert

Reference Books:

1. V. Rajaraman, "Fundamental of Computers", Prentice Hall of India,NewDelhi,2003.
2. S. S. Sastri,"IntroductoryMethodsofNumericalMethods",PrenticeHallofIndia,NewDelhi, 3rdedition,2003.
3. K. E. Atkinson, "An Introduction to Numerical Analysis",Wiley,1978.
4. M.J. Maron, "Numerical Analysis: A Practical Approach", Macmillan, New York, 1982

Prof.Leena Bhoyar	Prof.Sagar Kathalkar	Prof.U. V.Rothod	Dr. Amit Gupta
Subject Teacher	Subject Coordinate	Academic Incharge	HOD FY

Course Name: **MET405- BASICS ELECTRONICS ENGINEERING**
Offered In: IV-Semester (Even Semester)
Scheme and Credit: [(3-0-0); Credits: 3]
Category of Subject: ESC
Course Assessment: Continuous Assessment (20%), Mid Sem Exam (20%), End Sem Exam (60%)

Course Outcome: At the end of the course, students will be able to

CO1	**Define** semiconductor, Energy band diagram, diffusion component diode, DC circuit, BJT & FET amplifier.
CO2	**Illustrate** semiconductor material, energy band diagram, DC circuit, BJT & FET amplifier, Bipolar transistor & various semiconductor devices.
CO3	**Develop** energy band diagram, diffusion current circuit, Bipolar transistor amplifier circuit using BJT & FET.
CO4	**Analyze** semiconductor material, diffusion current component, electronic circuit, BJT & FET amplifier circuit.
CO5	**Interpret** electronic circuit, simple amplifier circuit.
CO6	**Design** electronic circuit & amplifier circuit using BJT & FET.

Course Contents:

UNIT-I **[07 hours]**

Semiconductor Diode Mechanism of Conduction in Semiconductors: Mobility and Conductivity, Electrons and holes in an intrinsic semiconductors, Donor and acceptor impurities, Fermi level, Carrier densities in semiconductor, Hall effect, Diffusion, Recombination Junction Diode PN junction characteristic and its equation, Effect of Temperature, Depletion Layer, Piecewise linear diode model, Breakdown Mechanism, Zener and Avalanche Breakdown characteristics Diode as circuit element Half wave and full wave rectifiers, capacitive filters, Zener diode as a regulator, clamper, clipper and voltage doubler, special diode- LED, Schottkey diodes

UNIT-II **[07 hours]**

BJT characteristics and circuits: Transistor Operation, CE, CB, CC configuration and their characteristics, transistor biasing circuits, stability factor, h- parameter model (low frequency), computation of Ai, Av, Ri, Ro of single transistor CE amplifier configuration.

UNIT-III **[07 hours]**

Field Effect Transistors JFET: Construction and principle of working, Drain / Transfer characteristics, basic amplifier circuits, Biasing of JFET MOSFET: Enhancement and depletion type N-channel, P-channel, Drain / Transfer Characteristics.

UNIT-IV **[07 hours]**

Switching theory & Logic gates: Number system, Conversion, Compliments, Addition and Subtraction, BCD numbers, Boolean algebra, Canonical form, Logic gates, Minimization of logical function using Karnaugh map .

UNIT-V **[07 hours]**

Operational Amplifier: Concept of ideal operational amplifier (inverting and non-inverting) and its applications, Inverter, integrator, differentiator, voltage follower, summing and differential amplifier

UNIT-VI **[07 hours]**

Industrial applications: Transducers for-Temperature, level, displacement, pressure. Range, Specifications, Limitations and applications. Block diagrams of-Digital thermometer, weighing machine. Introduction & block diagram of-Two wire transmitter, PID controller, data logger, alarm annunciator, CNC machine, PLC

Text Books:

1. Bolyested& Nashekey / Electronic Devices and Circuit Theory, PHI
2. Jacob Milliman & Halkias: Integrated Electronics , Mc Graw Hill
3. S.Salivahanan, "Electronic Devices and Circuits", Tata McGraw-Hill,2 Edition, 2008.
4. J. S. Katre: Electronics Engineering, Tech-Max Publication
5. David. A. Bell, "Electronic Devices and Circuits", PHI, New Delhi, 2004.

Reference Books:

1. Principal of Electronics by V. K. Mehta, S. Chand Publication

2. Electronics Devices & Circuits by A.P. Godse, Technical Publication

3. Digital Electronics by Anand Kumar, PHI Learning, 2009

4. Digital Electronics by J. S. Katre, Technical Publication

Course Name : MEL406- PRODUCT DESIGN AND DEVELOPMENT
Offered In : IV-Semester (Even Semester)
Scheme and Credit : [(0-0-2); Credit: 1]
Category of Subject : LC
Course Assessment : Continues Assessment (60%), End Sem Exam (40%)

Course Outcomes: At the end of the course, students will be able to

CO1	Select phases of product design, Idea Creation, Sketching of product and different commands for 2D and 3D.
CO2	Demonstrate sketching of the component, fitting of the component and interpret the manufacturing process of the component.
CO3	Identify reverse engineering concept and organize product specification data sheet for mechanical design.
CO4	Analyze the wok to meet design requirements.

List of Experiments:

1. Identification of product for appropriate application.
2. Explain the manufacturing process planning sheet and BOM for Mechanical Product.
3. Idea generation and Idea Creation
4. Listing of 15 product design ideas.
5. Detailing of any one specific Idea with specification, sketch and market research.
6. Product Specification sheet for any Mechanical Product.
7. Case study on reverse engineering concept (Failure)
8. Prepare 2D Sketch of machine component.
9. Prepare 3D Sketch of machine component.
10. Assembly of the product.

Text Books

1. Eppinger, S., & Ulrich, K.(2015). Product design and development. McGraw-Hill Higher Education.

Reference Books

1. Model Curriculum for “Product Design Engineer – Mechanical”, NASSCOM (Ref. ID: SSC/Q4201, Version 1.0, NSQF Level: 7)
2. Green, W., & Jordan, P. W. (Eds.).(1999).Human factors in product design: current practice and future trends. CRC Press.
3. Sanders, M. S., & McCormick, E. J. (1993). Human factors in engineering and design. McGRAW- HILL book company.
4. Roozenburg, N. F., & Eekels, J. (1995). Product design: fundamentals and methods (Vol. 2). John Wiley & Sons Inc.

Course Name: **MEM407- INDIAN CONSTITUTION**
Offered In: IV-Semester (Even Semester)
Scheme and Credit: [(2-0-0); Audit]
Category of Subject: MC
Course Assessment: Audit

Course Outcome: At the end of the course, students will be able to

CO1	**Define** Indian democracy functions.
CO2	What are the basic principles that lie in our constitution.
CO3	How minority can be protect against the tyranny of majority.
CO4	Functioning of Governments at central and local level.
CO5	How the judiciary keeps a check over the legislature and executive

Course Contents:

UNIT I. **[06 hours]**
Making of the Constitution: A brief analysis of National Movement. ConstitutionalDevelopment with reference to Government of India Act 1909,1919, 1935 and Indian .Independence Act 1947. The Constituent Assembly of India.

UNIT II **[06 hours]**
(a) Basic features of the Indian Constitution – the Preamble –
(b) Fundamental Rights and Basic Human Rights In Indian Constitution

UNIT III **[06 hours]**
Directive Principles of State Policy – Fundamental Duties

UNIT IV **[06 hours]**
Government of the Union
(a) The Union Executive – the President and the Vice-President – The Council of Ministers and the Prime Minister – Powers and functions
(b) The Union legislature – The Parliament – The LokSabha and the RajyaSabha, Composition, powers and functions – the role of the Speaker.

UNIT V **[06 hours]**
Government of the State.
(a) The Governor – the Council of Ministers and the Chief Minister – Powers and Functions
(b) The State Legislature – composition, powers and functions.

UNIT VI **[06 hours]**
The Indian Judicial System – the Supreme Court and the High Courts – composition, Jurisdiction and functions, Judicial review, Judicial activism, Independence of Judiciary in India.

Text Books:

1. Indian Constitution by My Pylee S. Chand Publications.
2. Introduction to the constitution of India by DD Basu.
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