DIT UNIVERSITY
DEHRADUN

DETAILED COURSE STRUCTURE & SYLLABUS
OF
B.TECH. – MECHANICAL ENGINEERING SPECIALIZATION TRACK
1. AUTOMOBILE ENGINEERING
2. ROBOTICS AND AUTOMATION ENGINEERING

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

(FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM)

Introduction

The Ministry of Human Resource Development (MHRD), Govt. of India, has initiated development of a New Education Policy (NEP) to bring out comprehensive reforms in the Indian education system.

The University Grants Commission (UGC) has subsequently initiated several steps to foster academic excellence through introduction of paradigm shift in learning and teaching pedagogy, innovation and improvement in course curricula, examination and education system.
While a majority of education institutions have started following the semester-based system of education, it has been observed that this new system is still producing graduates who lack knowledge, values, and skills and are not job ready professional. The reason for this lacking could be attributed to the rigidity of our program structures and lack of flexibility to have choices among core subject education, liberal arts, ability enhancement, skill development, etc., that is fundamental to overall development and employability of these graduates.

To make this possible, a fully flexible choice-based credit system (FFCBCS), a well-established internationally known system, is proposed. This fully flexible choice-based credit system allows students the flexibility to learn at their own pace, and register for both core subjects and a variety of courses from other areas, leading to holistic development of an individual. The FFCBCS will facilitate us to bench mark our programs with best international liberal arts based academic programs.

Advantages of the FFCBCS structure:

- Shift in focus from the teacher-centric to student-centric education. Student can curve out their program structure by choosing minimum number of credits from well-defined baskets.
- Student may undertake as many credits as they can cope with.
- FFCBCS allows students to choose courses from various baskets of inter-disciplinary, intra-disciplinary, skill oriented, ability enhancing, and from other disciplines.

Features unique to DIT University FFCBCS structure

1. A minimum of 150-160 credits has to be earned by a student to be eligible for an Under Graduate degree in Engineering. Each department will decide their total credits for each program, and it can vary across disciplines.

2. Courses are categorized into 11 baskets, and a student will have the option to choose courses in most baskets and earn ***minimum number of credits*** required in each basket for the award of his/her degree. For each basket, Engineering departments have the flexibility to identify course(s) which will be a core requirement for their program.

3. In certain disciplines, students may choose a ***Specialization*** by earning 18 credits of Discipline Elective courses towards a particular area of that discipline (interdisciplinary). In addition to this, brighter students will have the option to receive (a) a ***Certificate*** by earning *additional* 9 credits towards a particular area either inside or outside their discipline, or (b) ***Minor*** by earning additional 18 credits towards a particular area outside their discipline. Certificates and Minors can be earned through either University courses, or with MOOCs from providers as identified by the University. Each department will design the structures and eligibility conditions for registration to its certificates or minor program, which may be reviewed annually, to keep the ***Certificates*** and ***Minors*** contemporary and relevant to latest changes.

4. An FFCBCS council may be formed comprising all HoDs and one representative each from respective departments. FFCBCS council will meet at the end of every semester after the completion of Board of Examination meeting to discuss and finalize course offerings by respective departments in the upcoming semester. FFCBCS council will be chaired by the Dean Academic Affairs.

5. To provide sufficient flexibility and room during the program for additional ***Certificates***, ***Specializations, and Minors***, 8-week summer semesters (Summer 1, Summer 2, and Summer 3) may have to run. Summer semesters are critical for implementing a fully flexible system. Each department will decide *a priori* which courses to offer in the summer semester and get them finalized at the FFCBCS council meeting.

6. Project based learning has to be incorporated as a core component of evaluation in each course, and depending on the level and type of the course, the project can be of several types - Study Oriented Project, Lab Oriented Project, Design Oriented Project, Computer Oriented Project, Projects of Organizational Aspects, Research Projects, or Entrepreneurship and Start Up Projects. A Capstone Project has been introduced in the 8^{th} semester for all Bachelor of Technology students.

7. Courses under each basket may be updated on an annual basis.

8. Each student will be advised by a faculty advisor of his/her department for registration of courses from each basket in the beginning of semester, depending upon the availability of seats. A student advising centre may be formed where students will have access to department faculty advisers. Faculty advisers should have complete access to view individual student's academic transcript for advising purposes.

9. A student getting an F grade in a core course (departmental or otherwise) at the end of the semester will have to earn those credits by registering for the same course whenever it is offered in subsequent semesters. If the course is not a core course, the student may choose to register for any other course next semester in that basket as advised by the department faculty adviser. Additional fees for those number of credits may apply.

10. Students may opt for summer training/internships/industrial tours as advised by the department. However, these activities will not have credits.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

BASKETS OF FFCBCS

11 baskets of courses have been identified to provide student comprehensive exposure to a large number of areas, leading to the holistic development of an individual. These baskets are as follows:

1. **Language and Literature:** These include courses related to English or other popular languages worldwide, communication skills, and literature. These courses are of 3 credits each.
2. **Core Science:** These courses include science courses from the disciplines of Physics and Chemistry. These courses are of 5 credits each.
3. **Core Mathematics:** This basket includes courses from Mathematics department, crafted for engineering students. These courses are of 4 credits each.
4. **Engineering Sciences:** This basket includes introductory courses from various disciplines of Engineering designed to provide the student solid foundation to the domain of engineering. These courses are of 4 credits each.
5. **Discipline Core:** This basket includes compulsory courses in the discipline in which the student is admitted to the University. These courses are of 4 credits each.
6. **Discipline Elective:** This basket provides students courses other than discipline core, and are normally in certain specialized areas. These courses are of 3 credits each.
7. **Humanities and Liberal Arts:** This basket includes liberal arts courses in various disciplines like psychology, management, economics, etc., and are of 3 credits each.
8. **Skill Enhancement:** Courses in this basket are primarily hands-on and aims to allow students acquire skills required in certain disciplines that are currently in high demand in the job market. These courses are of 2 credits each.
9. **Ability Enhancement:** These courses aim to enhance knowledge and ability of an individual in certain required areas related to national and societal interest. Courses in this basket are of 2 credits each.
10. **Free Electives:** Student can register for any three courses outside their department of his/her choice. These courses can also be taken from MOOCs, and a minimum of 9 credits have to be taken by a student in this basket.
11. **Capstone Project:** Capstone project is a semester long multifaceted experimental/research assignment that serves as a culminating academic and intellectual experience for students, taken in the last semester of study. It is of 12 credits and may be done groups of not more than three students, and in three modes as follows:

- **Mode A**: Project with a department faculty.
- **Mode B**: Project as part of Industry Internship arranged only by the career and placement service of the University. Students securing this assignment on their own will not be allowed, unless the project is secured at a well-known industry, and duly approved by the department. The department's decision in all such cases will be final.
- **Mode C**: Semester long project in an academic institute/lab of National/International Importance, secured by students on their own. The department's decision to allow in all such cases will be final.

A separate rule booklet will be released for implementation of Capstone Project.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

DIT UNIVERSITY FFCBCS CREDITS

Basket	Minimum number of DIT University Credits to be taken in each basket
Language and Literature (LL)	6
Core Sciences (CoS)	10
Core Mathematics (CM)	12
Engineering Sciences (ES)	24
Discipline Core (DC)	48
Discipline Elective (DE)	18
Humanities and Liberal Arts (HL)	9
Skill Enhancement (SEC)	8
Ability Enhancement (AEC)	6
Free Electives (FE)	9
Capstone Project (PRJ)	12
Total	**162**

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

COURSE BASKETS: UNIVERSITY FFCBCS BASKETS (OTHER THAN DC/DE) FOR B. TECH PROGRAMS. A * AGAINST A COURSE MEANS IT IS A CORE COURSE FOR ALL B. TECH STUDENTS.

Course Code	FFCBCS Baskets (other than DC/DE)				
	Language and Literature (min 6 credits to be taken)	**Credits**			
	Name of Courses				
LAF181	Professional Communication*				
LAF182	Indian English Literature				
LAF183	English Language Teaching				
	Core Sciences (min 10 credits to be taken)				
	Name of Courses				
CHF101	Engineering Chemistry (For CS/IT/EE/ECE)				
CHF102	Applied Engineering Chemistry (for ME/CE/PE)				
PYF101	Wave & Optics and Introduction to Quantum Mechanics				
PYF102	Introduction to Mechanics				
PYF103	Electricity & Magnetism				
	Core Mathematics (min 12 credits to be taken)				
	Name of Courses				
MAF101	Engineering Mathematics I *				
MAF102	Engineering Mathematics II*				
MAF201	Engineering Mathematics III (EE, ME, CE)				
MAF202	Probability and Statistics (CSE, IT, ECE, PE)				
	Engineering Sciences (min 24 credits to be taken)				
	Name of Courses				
ECF101	Fundamental of Electronics Engineering.				
EEF101	Basic Electrical Engineering				
EEF143	Electrical and Electronics Engineering Practice (non EE/EECE)				
MEF101	Thermodynamics*				
CSF101	Programming for Problem Solving				
CSF102	Data Structures				
MEF102	Engineering Graphics*				
MEF103	Engineering Mechanics*				
MEF201	Mechanical Engineering Materials*				
PEF204	Fluid Mechanics				

EEF141	Electrical Engineering Materials				
ECF142	Fundamental of Semiconductor Electronics				
	Skill Enhancement (min 8 credits to be taken)				
	Name of Courses				
MEF105	Engineering Workshop Practices				
MEF204	Machine Drawing And Solid Modeling				
MEF307	Measurement Techniques in Mechanical Engineering				
MEF308	CNC Machining Technology				
MEF309	Computer aided Design & Drafting of Mechanical Components				
SWAYXXX	MOOCS Courses (as advised by the departments)				
	Ability Enhancement (min 8 credits to be taken)				
	Name of Courses				
CHF201	Environmental Science*				
LAF285	Indian Constitution*				
MEF209	Entrepreneurship and Start-ups*				
UCF201	Aptitude and Soft Skills*				
	Humanities and Liberal Arts (min 9 credits to be taken)				
	Name of Courses				
LAF281	Introduction to Psychology				
LAF381	Positive Psychology & Living				
LAF481	Application of Psychology				
LAF282	Human Values				
LAF283	Literature, Language & Society				
LAF284	Principles of Management				
LAF482	Intellectual Property Rights				
LAF382	Engineering Economics				
	Free Electives (min 9 credits to be taken)				
	Name of Courses				
ECF481	Analogue Electronics				
ECF482	Cellular Communication Network				
ECF381	Microcontroller				
ECF382	Bio Medical Instrumentation				
ECF483	Digital Image processing				

CSF381	Software Project Management				
CSF345	Introduction to Data Science				
CSF482	Introduction to Cybersecurity				
MEF381	Composites materials				
MEF481	Total Quality Management				
MEF348	Robotics Engineering				
MEF482	Renewable Energy Sources				
MEF444	Operation Research				
MEF446	Product design & Development				
PEF 381	Carbon Capture and Sequestration				
PEF 491	Polymer Technology				
PEF 492	Health, Safety and Environment in Industry				
CEF281	Properties of Materials				
CEF382	Disaster Preparedness Planning & Management				
CEF481	Environmental Management & Sustainability				
CEF482	Natural Dynamics				
CEF483	GIS				
CEF484	Resource Dynamics and Economic Implications				
	Project (12 credits)				
UCF439	Capstone Project				
	Discipline Core (48 credits)				
	Name of courses				
MEF202	Theory of Machines				
MEF203	Applied Thermodynamics				
MEF205	I.C. Engines and Automobile Engineering				
MEF206	Strength of Materials				
MEF207	Manufacturing Processes				
MEF208	Fluid mechanics and Machines				
MEF301	Design of Machine Elements				
MEF302	Industrial Engineering				
MEF303	Heat Transfer				
MEF304	Refrigeration and Air Conditioning				
MEF305	Measurement and Metrology				
MEF306	Computer Aided Design				
	Discipline Electives Basket for Mechanical Engineering (18 credits)				
	Name of courses				
MEF341	Automotive Transmission System				
MEF342	Vehicle Maintenance				

MEF343	Design of Transmission System				
MEF344	Automotive Electrical & Electronics				
MEF345	Vehicle body Engineering				
MEF346	Artificial Intelligence for Mechanical Engineering				
MEF347	Fundamental of Robot Vision				
MEF348	Robotics Engineering				
MEF349	Robotics kinematics & dynamics				
MEF350	Heat exchangers: Fundamentals and Design Analysis				
MEF351	Robotics Simulation				
MEF352	Manufacturing System Simulation				
MEF353	Computational methods in thermal and fluid engineering				
MEF354	Power Plant Engineering				
MEF441	Advanced Automobile Technology				
MEF442	Turbomachines				
MEF443	Machine Tool Design				
MEF444	Operation Research				
MEF445	Tribology				
MEF446	Product Design & Development				
MEF447	Design of Hydraulics & Pneumatics systems				
MEF448	Computer Integrated Manufacturing				
	Discipline Electives Basket for Automobile Engineering (18 credits)				
MEF341	Automotive Transmission System				
MEF342	Vehicle Maintenance				
MEF343	Design of Transmission System				
MEF344	Automotive Electrical & Electronics				
MEF345	Vehicle body Engineering				
MEF441	Advanced Automobile Technology				
	Discipline Electives Basket for Robotics and Automation Engineering (18 credits)				
MEF346	Artificial Intelligence for Mechanical Engineering				
MEF347	Fundamental of Robot Vision				
MEF348	Robotics Engineering				
MEF349	Robotics kinematics & dynamics				
MEF351	Robotics Simulation				
MEF447	Design of Hydraulics & Pneumatics systems				

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

FLOW OF ACTIONS FOR IMPLEMENTING FFCBCS EVERY SEMESTER

After release of Final Exam results, Academic Advisory Committee meets to decide & finalize course offerings in each basket

Courses are created in SAP and in LMS with required number of seats

Registrar announces the date for Registration

Students get advised and registers for courses in the Student Advising Centre

List of students gets added in LMS

Class Starts

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

UNDERGRADUATE COURSE DESCRIPTION DOCUMENT

Department offering the course	**Mechanical Engineering**
Course Code	**MEF101**
Course Title	**Thermodynamics**
Credits (L:T:P:C)	**3:1:0:4**
Contact Hours (L:T:P)	**3:2:0**
Prerequisites (if any)	**NA**
Course Basket	**E.S.**

Course Summary

This course deals with the study of energy interactions and its effects on the properties of systems. It covers the first and second law of thermodynamics and their applications. Energy, equilibrium, and entropy are the key elements of this course.

Course Objectives

- To learn about different laws and principles of thermodynamics and their applications.
- To understand the concept of energy as low and high grade and its use in exergy analysis.
- To evaluate the changes in properties of pure substances in various processes.

Course Outcomes: On successful completion of the course, students will be able to achieve the following:

CO1: Apply energy balance to systems and control volumes, in situations involving heat and work interactions.

CO2: Determine changes in thermodynamic properties of pure substances.

CO3: Analyze the performance of energy conversion devices.

CO4: Differentiate between high grade and low grade energies.

Curriculum Content

UNIT 1: Introduction to Thermodynamics

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers

UNIT 2: First Law of Thermodynamics

Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy; Demonstration that energy is a property; Various modes of energy, Internal energy and Enthalpy. First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady flow applications to system and control volume.

UNIT 3: Pure Substances

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Properties of steam; Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

UNIT 4: Second Law of Thermodynamics and Entropy

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. Clausius inequality; Definition of entropy; Demonstration that entropy is a property; Evaluation of entropy for solids, liquids, ideal gases undergoing various processes; Determination of entropy from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles.

UNIT 5: Availability and Irreversibility

Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work, Exergy balance equation, and Exergy analysis.

Text Book(s)

1. Y.A., Cengel and M.A. Boles, "Thermodynamics: An Engineering Approach", McGraw Hill Education, 8th Edition.2017.
2. Nag, P.K, Engineering Thermodynamics, McGraw Hill Education, 6th Edition.2017.

Reference Books

1. Borgnakke, C. and Sonntag, R. E., Fundamentals of Thermodynamics, John Wiley& Sons, 10^{th} edition 2019.
2. B. Jones and R.E. Duggan, Engineering Thermodynamics, Prentice-Hall of India,1st edition.1995.
3. M.J. Moran and H.N. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley and Sons, 7th edition.2010.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF103**
Course Title	**Engineering Mechanics**
Credits (L:T:P:C)	**2:1:2:4**
Contact Hours (L:T:P)	**2:2:4**
Prerequisites (if any)	**NA**
Course Basket	**ES**

Course Summary

This course covers the basic concepts of engineering mechanics. It develops the analytical skills to solve the engineering problems based on state of rest or state of motion of the bodies.

Course Objectives

- To learn the basic concepts of engineering mechanics.
- To evaluate the forces, moments and Inertia on rigid bodies.
- To analyze trusses and beams.
- To calculate centroid of different cross sections.
- To solve problems on kinematics of body.

Course Outcomes: On successful completion of the course, students will be able to achieve the following:

CO1. Identify principles of mechanics to be used for solving real life engineering problems.

CO2. Apply basic Engineering concepts based on force, shape and dimension for selection of material

CO3. Compute the action of Forces, Moments and other loads on systems of rigid bodies.

CO4. Evaluate the reactive forces and the effects that develop as a result of the external loads.

CO5. Formulate the relationship between the motion of bodies.

Curriculum Content

UNIT 1: Introduction to Engineering Mechanics

Basic idealizations - Particle, Continuum and Rigid body; Newton's laws of Force and its characteristics, types of Forces-Gravity, Lateral and its distribution on surfaces, Classification of force systems, Principle of physical independence, superposition, transmissibility of forces, Introduction to SI units.

Couple, Moment of a couple Characteristics of couple, Moment of a force, Equivalent force - couple system; Numerical problems on moment of forces and couples, on equivalent force - couple system.

UNIT 2: Equilibrium of forces

Equilibrium of forces - Definition of Equilibrant; Conditions of static equilibrium for different force systems, Lami's theorem; Numerical problems on equilibrium of coplanar – concurrent and non-concurrent force systems

Application- Static Friction in rigid bodies in contact, Types of friction, Laws of static friction, limiting friction, Angle of friction, angle of repose; Impending motion on horizontal and inclined

planes; Numerical Problems on single and two blocks on inclined planes, ladder and wedge friction.

UNIT 3: Analysis of Plane truss and Beam

Support Reaction in beams: Types of beams, Types of Loads and Supports, statically determinate beams, Numerical problems on support reactions for statically determinate beams with Point load (Normal and inclined) and uniformly distributed and uniformly varying loads and Moments.

Plane Truss: Perfect and imperfect truss Assumptions and Analysis of Plane Truss by Method of joints and Method of section.

UNIT 4: Center of Gravity, Centroids and Moment of Inertia

Introduction to the concept, Centroids of line and area, Centroids of basic geometrical figures, computing Centroids for– T, L, I, and full/quadrant circular sections. Concept of moment of Inertia, Evaluate moment of inertia for rectangular, circular, square and triangular sections.

UNIT 5: Kinetics of Particle

Newton's law of motion; Motion of bodies in Rectangular coordinates; D'Alembert's Principle.

Text Book [TB]:

1. Engineering Mechanics by S.S. Bhavikatti, New Age International Publisher, New Delhi, 3rd edition 2009.
2. Engineering Mechanics-Statics and Dynamics by A Nielson, Tata McGraw Hill Education Private Ltd, New Delhi, 2009.

Reference Books [RB]:

1. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education 2010
2. Beer FP and Johnson ER, "Mechanics for Engineers- Dynamics and Statics"- 3rd SI Metric edition, Tata McGraw Hill. - 2008
3. Shames IH, "Engineering Mechanics – Statics & Dynamics"- PHI 2006

List of Experiments:

1. Study of different types of beam.
2. Calculation and Verification of forces in truss elements.
3. Calculation and verification of equilibrium condition on beam model.
4. Calculation to find the redundant force in a truss.
5. Mechanical advantage over pulley arrangement.
6. Determining the coefficient of friction.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF105**
Course Title	**Engineering Workshop Practice**
Credits (L:T:P:C)	**0:0:4:2**
Contact Hours (L:T:P)	**0:0:4**
Prerequisites (if any)	**NA**
Course Basket	**SEC**

Course Summary

Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate.

Course Objectives

- To familiarize with the basic manufacturing processes and to study the various tools and equipment.
- They will get hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary.
- To analyze time required to fabricate and also should be able to estimate the cost of the product or job work.

Course Outcomes: On successful completion of the course, students will be able to achieve the following:

CO1: Have Capability to identify hand tools and instruments for machining and other workshop practices.

CO2: Obtain basic skills in the trades of fitting, carpentry, welding and machining.

CO3: Acquire measuring skills, using standard workshop instruments & tools.

CO4: Gain eye hand co-ordination; enhance psycho motor skills and attitude.

Curriculum Content

UNIT 1: Machine Shop

Lathe Machine Operation- To make a machined-component using lathe with mild steel round bar or hexagonal bar comprising of various turning operations; parallel and taper turning, surfacing, knurling, drilling, boring, reaming and parting-off. Machining with reference to drawing given in the manual. Any one of the following jobs

Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

Computer control machine Operation- Fundamental of CNC technology, Difference between manual machine and computer numerical control machine, coding systems and formats, Basic of NC part programming, Example- Facing, straight turning, Taper turning, grooving. Demonstration of a typical turning specimen on CNC. Demonstration of EDM process.

UNIT 2: Sheet metal and Fitting Shop

Sheet metal shop: To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs: Square tray, Scoop, Funnel

Fitting Shop-To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual. Introduction and demonstration of Tapping, cold forming operations using Power press.

UNIT 3: Welding Shop

Introduction and demonstration of Spot Welding, MIG Welding and TIG Welding process.

To prepare a welding joint with mild steel flat using Metal Arc welding machine according to the drawing provided in the manual. Any one of the following jobs. Jobs: Lap joint, Butt joint, Fillet/Corner joint

Gas & Spot Welding

To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. Sheet.

UNIT 4: Carpentry Shop

Name and use of raw materials used in carpentry shop: wood & alternative materials, Names, uses, care and maintenance of hand tools such as different types of Saws, C-Clamp, Chisels, Mallets, Carpenter's vices, marking gauges, Try-squares, Rulers and other commonly used tools and materials used in carpentry shop by segregating as cutting tools, supporting tools, holding tools, measuring tools etc. Different types of Timbers, their properties, uses & defects. Seasoning of wood. Introduction to power tools of carpentry.

To make a wooden joint with soft wood as per the drawing provided in the manual. Any one of the following jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

UNIT 5: Foundry Shop

Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry. Demo of mould preparation.

Minor Project:

To make a minor project by the students in batches comprising the operations performed in different shops

Text Book(S)

1. A course in Workshop Technology Vol I and Vol II by Prof. B.S. Raghuwanshi Dhanpat Rai & Co.(P) Ltd.
2. Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury, A.K. Hajara Choudhury & Nirjhar Roy; Media Promoters & Publishers Pvt. Ltd, Mumbai

Reference Books

1. Workshop Technology Part 1, Part2 & Part3 by W.A.J. Chapman; CBS Publishers & Distributors, New Delhi

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF201**
Course Title	**Mechanical Engineering Materials**
Credits (L:T:P:C)	**3:0:2:4**
Contact Hours (L:T:P)	**3:0:4**
Prerequisites (if any)	**NA**
Course Basket	**ES**

Course Summary

This course aims at delivering the fundamental concepts of engineering materials. The course starts with making the pupils understand the basics of crystal structures, their imperfections and associated mechanisms. The course also deliberates upon the various mechanical properties of materials and the different tests involved in evaluating them. Once the basics are set in place, then the various phase diagrams and heat treatment processes are discussed in details, which in fact are the core of this course. Towards the last, a detailed discussion about the ceramics, plastics and composites along with their properties is presented thus completing the course.

Course Objectives

- The purpose of this course is to set a solid foundation regarding the concepts of engineering materials i.e. their structures, deformities, mechanical properties and associated mechanisms.
- This course aims at making the students understand the various phase diagrams thus imparting the knowledge about the interrelationship between composition, microstructure and processing.
- This course aims at making the students understand the various heat treatment processes, commonly used to alter or strengthen the materials' structure through a heating and cooling process.
- This course also aims at deliberating the knowledge about the various latterly evolved materials such as composites, ceramics, plastics etc.

Course Outcomes: On successful completion of the course, students will be able to achieve the following:

CO1: Able to identify the structures, properties, composition and processes associated with various engineering materials.

CO2: Able to interpret the crystal parameters and microstructures of different engineering materials.

CO3: Able to characterize and evaluate the materials using phase diagrams and different heat treatment processes.

Curriculum Content

UNIT 1:

Crystal Structures: Historical perspective, importance of materials, classification of materials, unit cell, space lattice, common crystal structures, atomic packing factors, Miller indices.

Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, Microscopic examination.

UNIT 2:

Mechanical properties of materials: Young's modulus of elasticity, true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; various tests involved for evaluating these properties. Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT 3:

Alloys, substitutional and interstitial solid solutions- Phase diagrams**:** Interpretation of binary phase diagrams and microstructure development; eutectic, paratactic, peritectoidand monotectic reactions.

Iron Iron-carbide phase diagram and micro-structural aspects of ledeburite, austenite, ferrite and cementite, cast iron. Time Temperature Transformation (TTT) diagrams.

UNIT 4:

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening.

Various types of carbon steels, alloy steels and cast irons, its properties and uses. Non-ferrous metals and alloys. Diffusion: Introduction, diffusion mechanisms, Steady-state diffusion, factors that influence diffusion.

UNIT 5:

Ceramics: Structure, types, properties and applications of ceramics. Rubber, Plastics: Various types of polymers/plastics and its applications. Mechanical behavior of plastics. Future of plastics. Other materials: Brief description of other material such as optical and thermal materials, concrete, Composite Materials and its uses. Brief introduction to Smart materials & Nano-materials and their potential applications.

Text Book(s)

1. W.D. Callister, Jr, - "Material Science & Engineering" Addition-Wesley Publication, 7th edition, 2007.
2. Er. R. K. Rajput, "Material Science,3rd edition, KATSON BOOKS.

Reference Books

1. Van Vlack, "Elements of Material Science & Engineering", 6th edition, John Wiley & Sons, 2010.
2. V. Raghvan "Material Science", 5th edition, Prentice Hall, 2005.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF202**
Course Title	**Theory of Machines**
Credits (L:T:P:C)	**2:1:2:4**
Contact Hours (L:T:P)	**2:2:4**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

In this course kinematic and dynamic behaviours of machine elements are studied in detail so that students can analyse the behaviour of the machine components while it is working. This course also helps to define the parameters of machine elements considering the geometry, the motion and the forces acting on the components.

Course Objectives

- To learn about mechanisms, links and machines, motion of linked mechanisms in terms of displacement, velocity and acceleration of any point in a rigid link.
- To understand the kinematics of gear trains.
- To find the power transmission through gears, belts and pulleys, frictional torque in braking systems.
- To know the balancing of machines and gyroscopic effect in airplanes, four wheelers and ships.
- To understand the importance of vibration and its impact on various machine elements.

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

CO1: Understand different mechanisms and the balancing of machines to reduce undesirable stresses in machine parts.

CO2: Design of gears and pulleys for power transmission.

CO3: Construct different types of cam profile for a given data

CO4: Analyse the importance of flywheel and construct turning moment diagram

CO5: Understand the concepts of vibration and its effect on the machine elements.

CO6: Calculate balancing mass and its position

CO7: Analyse the effect of gyroscopic couple in aeroplanes and ships.

Curriculum Content

Unit 1: Introduction to Mechanisms

Mechanisms and Machines: Link, kinematic pairs, degrees of freedom, kinematic chain, mobility of mechanism. Inversions of four bar chain and single slider crank chain.

Velocity and acceleration analysis of mechanisms (graphical method): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism by vector polygons. Concept of coriolis component of acceleration.

Unit-2: Cams: Types of cams, types of followers, displacement curves for cam profiles, follower motions including SHM, uniform velocity.
Gears: Gear terminology, law of gearing, comparison of involute and cycloidal teeth. Simple gear trains, compound gear and Epicyclic gear trains.

Unit-3: Static and Dynamic Force Analysis: Turning moment diagram, concepts and application of flywheel. Concept and laws of friction. Appreciate the role of friction in thrust bearing, pivot bearing and collars considering - Uniform pressure and Uniform wear condition.
Belt drives: Flat belt drives, ratio of belt tensions. Power transmission, centrifugal effect, initial tension in belt drive.
Brakes: Types and their function, resisting torque calculation.

Unit-4: Vibration: Free and forced vibration of single degree of freedom systems, effect of damping.
Balancing: Balancing of rotating masses in same plane and in different planes. Balancing of reciprocating masses.

Unit-5: Governor: Porter Governor, Hartnell Governors. Controlling force. Stability, sensitiveness of governor
Gyroscope: Function of gyroscope, gyroscopic couple, effect of gyroscopic couple on ship and airplane.

List of Experiments

1. To study the different types of kinematic links, kinematic pairs and inversions of mechanisms.
2. To study different types of gears and gear trains.
3. To study different types of cams and followers.
4. To perform the experiments of static and dynamic balancing on a shaft.
5. To perform the experiment on a governor and to plot the graph between ‘r’ and ‘f”.
6. To perform the experiment on the Gyroscope & prove the law of gyroscope.
7. To perform an experiment on cam dynamics apparatus.
8. To calculate the frequency of a free vibrating spring.

Text Book(s)

1. S.S. Ratan, Theory of Machines, 4th edition, MGH, Education Publisher, 2009.
2. Ghosh A and Mallick A.K, Theory of Mechanism and Machines, East West Pvt. Ltd

Reference Books

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers and Distributors, 2005.
2. Robert L Norton Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2009.
3. R.S. Khurmi and J K Gupta, Theory of Machines, S Chand publication, 2005.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF203**
Course Title	**Applied Thermodynamics**
Credits (L:T:P:C)	**3:1:0:4**
Contact Hours (L:T:P)	**3:2:0**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

This course is intended to expose the students to the applications of thermodynamics laws and principles to the fuels and combustion, gas and vapor cycles, air and steam flow through nozzles, steam turbines and reciprocating compressors.

Course Objectives

- To learn about first law applications to combustion processes.
- To learn about gas and vapour cycles and their first law and second law efficiencies.
- To understand the thermodynamic analysis of air and steam flow through nozzles.
- To understand the thermodynamic analysis of reciprocating compressors with and without intercooling.
- To analyze the performance of steam turbines and condensers.

Course Outcomes

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

CO1: Apply energy balance to reacting systems for both steady flow control volumes and fixed mass systems.

CO2: Understand various power cycles and their applications.

CO3: Determine the performance parameters of nozzles, steam turbines, steam condensers, and reciprocating compressors.

CO4: Analyze energy conversion in various thermal devices such as combustors, nozzles, steam turbines and reciprocating compressors.

Curriculum Content

UNIT 1: Fuels and Combustion

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables.

UNIT 2: Gas and Vapor power cycles

Vapour power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis, super-critical Rankine cycle, Gas power cycles- Air standard Otto, Diesel and Dual Cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapour power cycles.

UNIT 3: Flow through nozzles

Basics of compressible flow, Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- use of ideal gas tables for isentropic flow- Flow of steam through nozzle, super saturation, efficiency of nozzle and diffuser.

UNIT 4: Reciprocating Compressors

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

UNIT 5: Steam turbines and Condensers

Analysis of steam turbines, velocity, and pressure compounding of steam turbines, steam condenser, condenser efficiency, and thermodynamic analysis.

Text Book(s)

1. Y.A., Cengel and M.A. Boles, “Thermodynamics: An Engineering Approach”, McGraw Hill Education, 8th Edition.2017.
2. Rathore, M.M. “Thermal Engineering,” McGraw Hill Education, 1st Edition. 2010.

Reference Books

1. Claus Borgnakke and Richard E. Sonntag, Fundamentals of Thermodynamics, Wiley, 7th edition.2009.
2. J.B. Jones and R.E. Duggan, Engineering Thermodynamics, Prentice-Hall of India,1st edition.1995.
3. M.J. Moran and H.N. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley and Sons, 7th edition.2010.
4. P.K. Nag, Basic & Applied Thermodynamics, McGraw Hill Education, 2nd edition, 2017.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF204**
Course Title	**Machine Drawing And Solid Modeling**
Credits (L:T:P:C)	**0:0:4:2**
Contact Hours (L:T:P)	**0:0:4**
Prerequisites (if any)	**NA**
Course Basket	**SEC**

Course Summary

This course is intended to use engineering graphic skills as a means of communicating technical ideas, information, and instructions. Use of Sectional views, Part sectioning, Assembly drawings and Layouts forms a part of this learning. Student uses manual drafting and design software for this communication.

Course Objectives

- To learn about the basics of Machine drawing.
- To learn about the generation of drawings as a design process for machine assembly.
- To learn about use of datum planes to locate features and machine elements uniquely in assemblies.
- To learn about sectioning, dimensioning, notes and version control in drawings.

Course Outcomes

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

CO1. Understand part and assembly drawing concepts, machine drawing and its classification.
CO2. Represent manufacturing symbols, materials etc.
CO3. Specify dimensions, and dimensional tolerances, surface finish etc.
CO4. Develop drafting and modeling skills using design software.

Curriculum Content

UNIT 1:

Introduction to Engineering Drawing, Classification of Engineering Drawings, Machine Drawing and representation of materials, Conventional representation of materials and common machine components. Representation of geometrical and dimensional tolerance and surface roughness symbols. Fundamental concepts of G and H, No-go and Go gauges.

UNIT 2:

Representation of welded joints. Projections, Sectional views and sectioning of parts and assemblies.

UNIT 3:

Engineering Graphics Software, Co-ordinate Systems, Drafting and Modelling, Evolution of geometric modeling, Advantages of solid modeling, Definition, Advantages and disadvantages of wireframe models, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG). Computer aided Drafting: Generation of points, lines, curves, polygons, dimensioning, utility commands etc.

Solid modeling: Use of modeling software, Part model, Assembly.

UNIT 4:

Drawing of Machine Elements and simple parts: Views of any three sets of the following machine elements and parts;

a) Popular forms of Screw threads, bolts, nuts, stud bolts.
b) Keys, cotter joints and knuckle joint.
c) Shaft coupling, spigot and socket pipe joint.
d) Journal, pivot and collar and foot step bearings.
e) Rivet joints for plates

UNIT 5:

Assembly Drawings: Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions; (any one)

a) Engine parts – connecting rod, piston assembly.
b) Other machine parts - Screws jacks, Machine Vices, Plummer block, Tailstock.
c) Valves: Steam stop valve, spring loaded safety valve, feed check valve and air cock

Text Book(s)

1. Bhatt.N.D. and Panchal.V.M. Machine Drawing, Charotar Publishing House Pvt. Ltd. Anand (Gujrat), 388001, 49thEdition, 2014.
2. Dhawan R.K, A Textbook of Machine Drawing, 2006 S. Chand Publication.
3. Narayana. K.L, Kannaiah P. & Reddy K. Venkata,Machine Drawing, New Age International (P) Ltd. Publishers, 4thEdition,2012.

Reference Books

1. Sidheswar. N, Kannaiah. P, & Sastry V.V.S.,Machine Drawing, 2010 McGraw-Hill Education (India) Private Limited, New Delhi-110016,2001
2. Pohit Goutam and Ghosh Goutam, Machine Drawing with AutoCAD, Pearson Education, Delhi, 2006.
3. John. K.C, A Textbook of Machine Drawing, PHI Learning, Delhi 2010.
4. Gill P.S, A Textbook of Machine Drawing, S. K. Kataria & Sons Publishers, New Delhi-110002, 18th Edition, 2013.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF 205**
Course Title	**I.C. engines and automobile engineering**
Credits (L:T:P:C)	**3:0:2:4**
Contact Hours (L:T:P)	**3:0:4**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

This course will help the students to get fundamental knowledge in working of IC engines, and their associated systems like lubricating, cooling, fuel systems, etc. In addition, students will also get knowledge of fundamentals of automobile engineering.

Course Objectives

The course will provide basic knowledge of IC engines and automobile engineering. The students will be introduced to the working of SI and CI engines. The different types of fuel used in IC engines will be introduced. The details of engine emissions, pollution and their control will be discussed.

Course Outcomes

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

CO1: Understand the different classification of IC engines.
CO2: Apply the basic concepts of knowledge to design different automobile components.
CO3: Determine performance and combustion characteristics of SI and CI engines.
CO4: Demonstrate the developments to enhance the efficiency and performance of IC engines

Curriculum Content

Unit 1:

Introduction to I.C Engine, Engine types and their structural and operational details; classification; thermodynamic cycles. Two stroke and four stroke engines; characteristics and air capacity of engines; valve timing diagram; importance of volumetric efficiency. Characteristics of internal combustion engines, graphs and analysis.

Unit 2:

Engine Components, Material, construction and design aspects; piston assembly; connecting rod; crankshaft; cylinder head; cylinder block; flywheel, ports; valves; valve actuating mechanism; cams; camshaft drives. Multi-cylinder engines balancing concepts.

Unit 3:

Fuel Supply in SI & CI Engines: Carburetion and mixture requirements; Transfer pump; Carburetors – types, Mixture distribution and inlet manifold. The concept of multipoint fuel injection system; Injection system components; Jerk and Distributor pumps. CRDI system. Details of Stages of combustion in SI & CI engines. Knocking – Factors affecting knock

Unit 4:

Introduction to Automobiles, their classification and types. Layout of an automobile chassis. Types of body of Automobiles. Study of Automotive transmission, cooling and suspension system.

Unit- 5:

Geometry and working of steering systems, steering linkages, basic types of steering gear boxes. Classification of brakes, drum brakes and disc brakes, constructional and working details, introduction to hydraulic brake, Introduction to hybrid vehicles.

List of Practical's:

Text Book [TB]:

1. Automobile Engineering by Kripal sing vol. I, II.
2. Automotive mechanics by William course.
3. V. Ganesan, Internal Combustion Engines, II Edition, TMH, 2002.
4. R.B. Mathur and R.P. Sharma, Internal Combustion Engines.

Reference Books [RB]:

1. Automotive Technology by Sethi, TMH, New Delhi
2. Automobile Engineering by K.K. Ramalingam, Scitech Publication, Chennai – 2001

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF206**
Course Title	**Strength of Materials**
Credits (L:T:P:C)	**2:1:2:4**
Contact Hours (L:T:P)	**2:2:4**
Prerequisites (if any)	**NA**
Course Basket	**D.C.**

Teaching and Learning Strategy
All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle.

Course Summary
This course is intended to understand the application of Strength of Materials in the analysis of stresses and strains in designing of structures, columns, beams and machine parts for safe load working conditions and good performance.

Course Objectives
- To understand the concept of simple stresses and strains.
- To know about compound stress systems and their analysis.
- To evaluate the safe working stress for any structural part under different loading conditions.
- To study theories of Failure in any loaded system.

Course Outcomes
On successful completion of the course, students will be able to achieve the following:
CO1: Evaluation of stresses and strains in machines and structural parts.
CO2: Calculation of allowable stress in designing of machine or structural parts.

Curriculum Content
UNIT 1: Introduction to Stress & Strain: Introduction and definitions; Stress, Hooke's law; true and engineering stress-strain curves; axial stress; thermal stress and strain. Compound stresses, state of plane stress; stress on an inclined plane; Principal stresses and Principal planes; Mohr's stress circle.

UNIT 2: Properties of Sections: Centre of gravity and moment of inertia of commonly used cross sections as T, I, L cross sections of structural members
Stresses in Beams:
Shear force and bending moment diagrams; bending stresses in beams; shear stresses in beams.

UNIT 3: Torsion of circular shaft: Torsion equation; Power developed by shafts, series and parallel combinations in shafts.

Combined Stresses: Combined bending and torsion; Combined bending and axial thrust.
Strain energy: Concept and applications. In Torsion, bending and axial loadings

UNIT 4: Deflections of Beams: Introduction; differential equation of the deflected beam; Macaulay's method; Moment area method.
Column and strut: Euler's theory of buckling of column for different end conditions; limitations of Euler's formula; Rankine's formula.

UNIT 5: Thin cylinders & Shells: Hoop and axial stresses strain; volumetric strain.
Thick cylinders: Radial, axial and circumferential stresses in thick cylinders subjected to internal and external pressures.
Theories of failure: Application to two dimensional (plane stress) cases.

Text Book(S)

1. Sadhu Singh, "Strength of Materials"; 10th Edition, Khanna Publishers New Delhi.
2. Ramamrutham, S. and Narayanan, R., "Strength of Materials"; Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 17th Edition.

Reference Books

1. Stephen P. *Timoshenko.*, "Elements of Strength of Materials", 5th edition, East West, 2003.
2. Egor P. Popov, "Mechanics of Materials, 2nd edition, Pearson Education India, 2015.
3. James M. Gere, Stephen P. *Timoshenko.* "Mechanics of Materials, 2nd edition, CBS, 2006.

Teaching and Learning Strategy
All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Lab Experiments:
1. Tension test
2. Bending tests on simply supported beam.
3. Hardness tests
4. Compression test
5. Impact test
6. Torsion test

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF 207**
Course Title	**Manufacturing Processes**
Credits (L:T:P:C)	**3:0:2:4**
Contact Hours (L:T:P)	**3:0:4**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

This course is intended to provide the students to the basic fundamental knowledge of various manufacturing processes. This course also provides the study of casting, forming, metal cutting, welding and different unconventional machining operations.

Course Objectives

- To learn about basics of manufacturing processes.
- To learn about casting process and its associated terms.
- To gain knowledge about metal forming processes like rolling, forging, drawing, and extrusion.
- To gain knowledge about various welding processes.
- To learn about different non-traditional machining processes.

Course Outcomes

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

CO1: Apply the knowledge of metal casting for various requirements.
CO2: Analyze the different forming operations used by the industries.
CO3: Analyze the metal cutting and different machining operations.
CO4: Examine the appropriate welding process used in the various industrial applications.
CO5: Analyze the various unconventional manufacturing processes like EDM, ECM, USM, LBM etc.

Curriculum Content

Unit 1: Conventional Manufacturing Process

Classification of Manufacturing Processes
Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Unit 2: Forming Process

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending).
Presses and their classification Compound vs. Progressive die, forging equipment and methods: hand, drop and die forging.

Unit 3 Metal cutting:

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool

materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Unit-4 Joining/fastening processes:

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Arc welding: Power sources and consumables. TIG & MIG processes and their parameters, Resistance welding-spot, seam projection friction welding etc. Defects in welds and their remedies, HAZ, Adhesive bonding, Powder Metallurgy- Introduction.

Unit- 5: Unconventional Machining Processes:

Study of Machining processes, Process parameters, and relations: EDM, ECM, LBM, EBM, PAM, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining.

Additive manufacturing: Rapid prototyping and Rapid tooling

List of Experiments

1. To perform experiment on punching, blanking and drawing operation on sheet metal.
2. To prepare a sheet metal product (square container).
3. Pipe bending operation.
4. Experiment based upon rolling and extrusion operation.
5. Study of jigs and fixtures.
6. To study and observe various stages of casting through demonstration of sand casting process.
7. To make an S-hook from a given round rod, by following hand forging operation.
8. To make a square rod from a given round rod, by following hand forging operation.
9. To prepare a sand mould, using the given single piece pattern.
10. To prepare a sand mould, using the given Split-piece pattern.
11. Compression strength test for moulding sand.
12. Sieve analysis to find grain fineness number of base sand.

Text Books:

1. S. Kalpakjian and S. Schemid (2001), Manufacturing, Engineering and Technology, Addison Wesley.
2. A. Ghosh and A. K. Malik (2010) Manufacturing Science, East West Press Private Limited New Delhi.

Reference Books:

1. MP Groover, “Fundamentals of Modern Manufacturig”, John Wiley & Sons 2002
2. PN Rao, “Manufacturing Technology”, Tata Mcgraw Hill, 2017.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF208**
Course Title	**Fluid mechanics and Machines**
Credits (L: T:P:C)	**2:1:2:4**
Contact Hours (L: T: P)	**2:2:4**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary: The course provides theoretical and practical knowledge of fluid mechanics and various fluid machines and their performance.

Course Objectives

- To understand the kinematic and dynamic behavior of fluid
- To understand the theory of boundary layer
- To learn about governing equations of fluid mechanics and machines
- To learn and understand the working and performance characteristics of various hydraulic machines.

Course Outcomes

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

CO1: Remembering principles of fluid mechanics to be used for real life engineering problems.
CO2: Understand the principle of floatation of objects in fluid.
CO3: Understand the working of floatation of objects in fluid.
CO4: Analyzing the governing equations for the working of different turbines, pumps, and their components.
CO5: Apply dimension analysis in formation of correlations.

Curriculum Content

UNIT 1: Introduction to Fluid Mechanics

Definition of fluid, Newton's law of viscosity, Units and Dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility, and surface tension. Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications, Archimedes principle, buoyancy.

UNIT 2: Laminar Flow and Boundary Layer

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular Annuli-Darcy Weisbach equation, friction factor, ~~Moody's diagram~~, concept of boundary layer – measures of boundary layer thickness.

UNIT 3: Dimension analysis

Need for dimensional analysis – methods of dimension analysis, similitude, types of similitude Dimensionless parameters, application of dimensionless parameters, Model analysis.

UNIT 4: Hydraulic Pumps

Euler's equation – theory of rotodynamic machines, various efficiencies, velocity components at entry and exit of the rotor, velocity triangles.

Centrifugal pumps – working principle, work done by the impeller, Cavitation in pumps.

Reciprocating pump – working principle.

UNIT 5: Hydraulic Turbines

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, governing of turbines.

List of experiments:

1. Verify Bernoulli's theorem (law of conservation of energy)
2. Determine Metacentric height using Buoyancy setup
3. Determine the coefficient of discharge for the venture meter
4. Determine the coefficient of discharge for the orifice meter
5. To calibrate given V-notch by establishing a relationship between flow rate and head over notch
6. To calibrate given Rectangular notch by establishing relationship between flow rate and head over notch
7. To calibrate given Trapezoidal notch by establishing relationship between flow rate and head over notch
8. Determine Darcy friction Coefficient and friction coefficient for different diameters of pipes
9. To Study Laminar and Turbulent flow using Reynolds apparatus.
10. Verify the impulse momentum principle for impact of jet on a Flat Vane
11. Verify the impulse momentum principle for impact of jet on a Hemispherical Vane
12. Verify the impulse momentum principle for impact of jet on a Inclined Vane
13. Study the performance and obtain the characteristic curves of Pelton wheel on Constant Head
14. Study the performance and obtain the characteristic curves of Pelton wheel on Constant Speed
15. Study the performance and obtain the characteristic curves of a Francis turbine on Constant Head
16. Study the performance and obtain the characteristic curves of a Francis turbine on Constant Speed
17. Obtain the efficiency of a Reciprocating pump at different speed
18. Obtain the efficiency of a single acting Centrifugal pump at different speed.

Text Book(S)

1. F M White "Fluid Mechanics" McGraw-Hill Series in Mechanical Engineering, 2011

Reference Books

1. Bansal, R.K., “Fluid mechanics and hydraulic machine”, Laxmi publication, 9th edition, New Delhi, 2014.
2. Yunus A. Çengel, “Fluid Mechanics”, Tata McGraw-Hill Education, 2010.
3. Modi P.N and Seth S. M., “Hydraulics and Fluid Mechanics”, Standard Book House, New Delhi.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF301**
Course Title	**Design of Machine Elements**
Credits (L:T:P:C)	**3:1:0:4**
Contact Hours (L:T:P)	**3:2:0**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

This course covers the topics of machine design such as such as static and fatigue failure theories, the analysis of shafts, fasteners, gears etc. Students will examine a number of design case studies, reviewing critical material properties in design, such as stress, strength, and the coefficient of thermal expansion.

Course Objectives

- To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components
- To illustrate to students, the variety of mechanical components available and emphasize the need to continue learning.
- To determine forces on transmission shaft and design of transmission shaft.
- To determine the endurance strength and design of components subjected to fluctuating loads
- To determine the forces in welds and riveted joints and formulate design solution for size of weld and size of rivet
- To determine forces on power screw and bolted joints and formulate design solution for size of power screw and size of bolt.

Course Outcomes

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

CO1: Understand the basics of design and selection criteria and their applications in various mechanical engineering components like joints, gears, springs etc.

CO2: Understand safety, reliability concepts in static & dynamic load conditions.

CO3: Implement the design theories for designing various mechanical components along with the material selection for static or dynamic load conditions.

CO4: Solve variety of problems (basic and advanced as well) related to design of bolts, keys, couplings, gears and springs.

Curriculum Content

UNIT 1:

Introduction: Definition, Methods, standards in design & selection of preferred size. Limits, fits and tolerances. Introduction Stress Concentration, Fatigue loads and Failure BIS system of designation of steels. Design against static load: Modes of failure, Factor of safety, theories of failure, Simple & Compound stresses in machine elements. Fatigue failure, endurance limit,

design for finite & infinite life, Soderberg & Goodman criteria, Modified Goodman criteria, S-N curve, Design of shafts under static and fatigue loadings.

UNIT 2:

Design of Joints: Welded joint, Riveted joints, threaded fasteners, Bolted/Screwed Joints. Pre-loaded bolts. Shaft, keys & coupling.

UNIT 3:

Mechanical springs: Design of Helical and leaf springs, Stress analysis in springs, Design against static & fatigue loading.

UNIT 4:

Design of transmission elements Basics of Spur Gear: Terminology, Classification, System of gear teeth, contact ratio, Interference, Backlash, Selection of gear materials, Design considerations. For gear pairs: spur, helical & bevel gears.

UNIT 5:

Analysis and design of sliding and rolling contact bearings systems, Sommerfeld Nos, Boyd Raimondi Charts Simple analysis and application of Power Screws.

CASE STUDY: Engineering of Type 800 /1000 cc Vehicle Clutch, Brake, Gear Box, and Differential systems.

Text Books

1. Shigley, J.E. and Mischke, C.R., “Mechanical Engineering Design”, Fifth Edition, McGraw Hill Intern; 2011.
2. V. B. Bhandari, “Design of Machine Elements”, McGraw-Hill, Inc., 2005.

Reference Books

1. Sharma & Agarwal, “Design of Machine Elements”, S.K. Kataria & Sons, 2013.
2. Sharma & Purohit, “Design of Machine Elements”, Prentice-Hall of India, 2004.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF302**
Course Title	**Industrial Engineering**
Credits (L:T:P:C)	**3:1:0:4**
Contact Hours (L:T:P)	**3:2:0**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

This course is intended to provide the students to the basic fundamental knowledge of industrial engineering and management. This course also provides the study of production, productivity, plant location, plant layout, production planning & control, inspection, quality control and basics of managements.

Course Objectives

- To learn about production, productivity and work study.
- To learn about plant location section and various plant layout.
- To gain knowledge about production planning and control.
- To gain knowledge about statistical quality control.
- To learn about basics of management and their activities.

Course Outcomes

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

CO1: Explain the production, productivity and work study.
CO2: Apply the knowledge about selection of plant location and layout.
CO3: Analyze the functions of production planning and control.
CO4: Analyze the roles of inspection and statistical quality control in industrial engineering.
CO5: Identify the role of management and their functions in an organisation.

Curriculum Content

UNIT 1: Production, Productivity and Work Study

Definition of production, Types of production systems, Definition of productivity, Application and advantages of productivity, Improvement tools, Reasons for increase and decreases in productivity.

Introduction of work study, Importance and advantages of work study, Work study procedure.

UNIT 2: Location Selection and Plant Layout

Nature of location decision, Importance of plant location, Dynamic nature of plant location, Choice of site for selection, State regulations on location, Government policies on decentralization, Industrial estates, Economic survey of site selection. Principles of plant layout and its types, Factors affecting layout, Flow pattern and factors governing flow pattern, Travel chart, Analytical tools of plant layout.

UNIT 3: Production Planning and Control

Definition of production planning and control (P.P.C), Functions and objectives of P.P.C, Product design and development including standardization and simplification, Sales forecasting and its different techniques, Sequencing, Loading and scheduling, Techniques and their selection, Line of balance, Assembly line balancing, Dispatching, and Progress control.

UNIT 4: Inspection and Statistical Quality Control

Inspection– functions, Types, Objectives and benefits, Quality control– principles, Concepts of quality circles, Total quality management, Quality assurance, Quality audit, ISO, and Six sigma. SQC concept, Variable and attributes, Normal distribution curves and its property charts for variable and attributes and their applications and interpretation (analysis) process capability, Acceptance sampling, sampling plans, OC curves and AOQ curves.

UNIT 5: Basics of Management

Definition of management, Functions of management– Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision making. Principles of management, Administration and management, Nature of management, Levels of management, Managerial skills, Managerial roles, Styles of management. Forms of organization– Line, Staff, Line-staff, Forms of ownership – Partnership, Joint stock, Cooperative society, Govt. sector etc.

Text Book(s)

1. Riggs, “Production System, Planning, Analysis and Control”, Wiley, 3rd ed. 1991.
2. Mahajan, “Industrial Engineering and Production Management”, Dhanpat Rai & Co., 2005.
3. Martand Telsang, “Industrial Engineering and Production Management”, S Chand & company, 2nd ed., 2006.

Reference Books

1. Banga and Sharma, “Industrial Engineering and Production Management”, Khanna publishers.
2. Shankar, “Industrial Engineering and Management”, Galgotia Publications Pvt. Ltd, 1st ed. 2000 (Reprint 2006).
3. Khanna, “Industrial Engineering and Management”, Dhanpat Rai Publications, 17th edition 2010.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF303**
Course Title	**Heat Transfer**
Credits (L:T:P:C)	**2:1:2:4**
Contact Hours (L:T:P)	**2:2:4**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

This course is designed to provide the detailed understating of heat transfer modes and their applications. The students will also have hands-on experience on heat transfer experiments.

Course Objectives

- To formulate and solve one-dimensional steady and unsteady heat conduction problems.
- To apply empirical correlations for natural and forced convection to different problems.
- To Study the basic principles of heat exchanger analysis and thermal design.
- To understand the principles of boiling and condensation
- To study the radiation heat transfer for black and gray bodies.

Course Outcomes

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

CO1: Solve the problems involving any of the three modes of heat transfer.

CO2: Examine heat transfer through fins and unsteady state heat conduction problems.

CO3: Determine convective heat transfer in cases of internal flow, external flow, boiling and condensation.

CO4: Analyze heat exchanger devices.

CO5: Analyze radiative heat exchange between black and gray surfaces.

Curriculum Content

UNIT 1: Introduction to Heat Transfer

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness.

UNIT 2: Fins & Transient Conduction

Heat transfer through fins of uniform cross-section, lumped system approximation and Biot number-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

UNIT 3: Convective Heat Transfer

Heat convection, basic equations, boundary layers, forced convection, external and internal flows, Natural convective heat transfer, Dimensionless parameters for forced and free convection heat transfer, Correlations for forced and free convection, estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

UNIT 4: Boiling, Condensation &Heat Exchangers

Boiling and condensation heat transfer, pool boiling curve, types of heat exchangers, analysis and design of heat exchangers using both LMTD and ε-NTU methods.

UNIT 5: Radiation Heat Transfer

Basic radiation concepts, definitions of radiative properties, radiation laws, black and gray body radiation, shape factor, black-body radiation exchange, radiation exchange between non-blackbodies in an enclosure, Infinite parallel Planes, radiation shields.

List of experiments:

1. To determine the thermal conductivity of metal rod.
2. To determine the thermal conductivity of insulating powder.
3. To determine the effectiveness and efficiency of pin fin.
4. To determine the heat transfer coefficient in natural convection.
5. To determine the heat transfer coefficient in forced convection.
6. To determine emissivity of the radiating surface.
7. To determine the Stefan-Boltzmann constant.
8. To determine the effectiveness of heat exchanger.

Text Book(s)

1. Cengel, Y.A. and Ghajar, A.J. “Heat and Mass Transfer”, Tata McGraw Hill Co.Ltd, 4th, edition, 2013.
2. Incropera, F.P., “Fundamentals of Heat & Mass Transfer”, Wiley Publication, 6th edition, 2013.

Reference Books

1. Kreith, F. and Bohn, M.S., “Principles of Heat Transfer”, Brooks/Cole, 6th edition, 2006.
2. Holman, J.P., “Heat Transfer”, TataMcGraw-Hill Publishing Company Limited, 6th edition, 2008.
3. Thirumaleswar, M., “Fundamentals of Heat and Mass Transfer”, Pearson Education, 1st edition, 2013.
4. Bejan, A., “Heat Transfer John Wiley”, 1993.
5. Massoud K., “Principles of Heat Transfer”, John Wiley, 2002.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF304**
Course Title	**Refrigeration and Air-conditioning**
Credits (L:T:P:C)	**2:1:2:4**
Contact Hours (L:T:P)	**2:2:4**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

This course is designed to make the students familiar with the theory of refrigeration and air-conditioning and their applications. The analysis and design of refrigeration and air-conditioning systems will also be discussed.

Course Objectives

- To learn about air refrigeration systems.
- To learn about single stage vapour compression systems.
- To learn about multi-stage vapour compression systems and vapour absorption systems.
- To learn about psychrometry and its applications.
- To estimate the cooling load of air-conditioned space.

Course Outcomes

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

CO1: Apply thermodynamics and heat transfer concepts to analyze the refrigeration systems.
CO2: Understand the working and design aspects of refrigeration components.
CO3: Performance characteristics of different refrigerants.
CO4: Cooling load estimation and understanding of different air-conditioning processes.

Curriculum Content

UNIT 1: Introduction: Principles and methods of refrigeration; reverse Carnot cycle; unit of refrigeration; coefficient of performance (COP)

Air refrigeration system: Classification; Bell Coleman cycle; Open and closed air refrigeration cycles; Simple, Boot-strap, reduced ambient and regenerative cooling systems; Dry air rated temperature (D.A.R.T).

UNIT 2: Vapour compression system (single stage): Vapour compression cycle, p-h and t-s diagrams; deviations from theoretical cycle; Effects of sub-cooling and super heating, condenser and evaporator pressure on system performance.

Refrigerants: Nomenclature & classification; desirable properties; common refrigerants-comparative study; leak detection methods; Secondary refrigerants; Environment friendly & CFC free refrigerant.

UNIT 3: Vapour compression system (multi stage): Removal of flash gas; multiple expansion & compression with flash inter cooling.
Vapour absorption system: Theoretical and practical systems such as aqua-ammonia, Lithium bromide-water & Electrolux absorption systems.

UNIT 4: Psychrometry: Psychrometric properties and their definitions; psychrometric processes: sensible heating and cooling, evaporative cooling, cooling and dehumidification, adiabatic dehumidification, heating and humidification; adiabatic saturation temperature; mixing of air stream, sensible heat factor (SHF), apparatus dew point (ADP), bypass factor of coil; **Applied Psychrometry**: Air washer, cooling tower.

UNIT 5: Principle of air conditioning: Requirements of comfort air conditioning; thermal analysis of human body; human comfort, effective temperature & chart.
Air-conditioning loads: Basic knowledge of summer & winter air conditioning load; calculation of supply air rate & its condition; ventilation and infiltration, room sensible heat factor (RSHF), grand sensible heat factor (GSHF), effective sensible heat factor (ESHF).

List of experiments:

1. Experiment on refrigeration test ring and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. To study air washers.
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant.
10. Visit of cold storage.

Text Book(s)

1. Arora, C.P., “Refrigeration & Air-Conditioning,” McGraw-Hill Education (India) Private Limited, 3rd Edition, 2008.

Reference Books

1. Colin R. Ferguson, Allan Thomson Kirkpatrick, “Internal combustion engines: Applied Thermosciences” John Wiley & Sons, 2nd edition, 2000.
2. Arora, S.C. and Domkundwar, S. “Refrigeration & Air-Conditioning,” Dhanpat Rai & Co. (P) Ltd., 2013.
3. Roy J. Dossat. “Refrigeration & Air-Conditioning,” Pearson Education India, 4th edition, 2002.
4. Stoecker, W., Jones, J., “Refrigeration & Air-Conditioning,” McGraw-Hill Education, 2nd edition, 1983.

Teaching and Learning Strategy
All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF305**
Course Title	**Measurement and Metrology**
Credits (L:T:P:C)	**3:0:2:4**
Contact Hours (L:T:P)	**3:0:4**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

Engineering measurement and metrology is the use of measurement science in manufacturing. This course is designed to impart the knowledge to develop measurement procedures, conduct metrological experiments, and obtain and interpret the results. A laboratory demonstration is also induced to enhance the learning process

Course Objectives

- Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements & comparators.
- Acquire knowledge of measurement systems and methods with emphasis on different transducers, intermediate modifying and terminating devices.
- Understand the measurement of Force, Torque, Pressure, Temperature and Strain.

Course Outcomes

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

CO1: Understand the objectives of metrology, methods of measurement, selection of measuring instruments, standards of measurement and calibration of end bars**.**

CO2: Describe slip gauges, wringing of slip gauges and building of slip gauges, angle measurement using sine bar, sine center, angle gauges, optical instruments and straightness measurement using Autocollimator.

CO3: Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design.

CO4: Describe functioning of force, torque, pressure, strain and temperature measuring devices.

Curriculum Content

UNIT 1: Introduction to measurements

Definition and Significance of measurement, Methods of measurements, generalized measuring system, Standards of measurements, Factors in selecting the measuring instruments, Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic and Random error.

UNIT 2: Measuring instruments

Introduction, working principle, method of reading, least count for Vernier Calipers, Micrometers, Thread measurements: Thread gauge micrometer, Angle measurements: Bevel protractor, Sine Bar, Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge, Comparators:

Characteristics of comparators, Types of comparators, Surface finish -Definition, Terminology of surface finish.

UNIT 3: Measurement of force, torque, and pressure

Introduction, Force measurements: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Hydraulic dynamometer; Pressure measurement: McLeod gauge.

UNIT 4: Introduction to Metrology

Introduction to Metrology: Definition, objectives and concept of metrology, Need of inspection, Limit: Maximum limit, Minimum limit, Basic size, Nominal size, Fit: Types of fits-Hole basis and Shaft basis system, Tolerance: Basic terminology, unilateral and bilateral tolerance, Interchangeability and selective assembly.

UNIT 5: Machine tool metrology

Testing instruments for machine tools, alignment testing, Checking Parallelism, Straightness: testing by straight edge, spirit level & Autocollimators, flatness testing by dial gauge, run out, alignment testing of machine tool as per IS standard procedure.

List of experiments:

1. Study and working of Experimental set up for calibration of Vernier calliper
2. Measurement of angle using sine bars, slip gauges and dial indicator
3. Measurement of strain in a beam using strain gauge
4. Adjustment of spark plug using a feeler gauge
5. Study and angular measurement using bevel protector
6. Study and working of experimental set up for Micro meter calibration.

Text Book(s)

1. Sawhney A. K., “Mechanical Engineering Measurements”; Dhanpat Rai & Sons, New Delhi.
2. Bewoor Anand K., Kulkarni V., “Metrology & Measurement”; Tata McGraw hill New Delhi 2009.

Reference Books

1. “Engineering Metrology” by R.K.Jain, Khanna Publishers, New Delhi.
2. “Instrumentation measurement and analysis” by B.C.Nakara, K.K.chaudary; 2nd Edition, Tata McGraw hill.
3. Rajput R.K., Mechanical Measurement and Instrument, S.K. Kataria & Sons, New Delhi.
4. “Engineering Metrology & Measurements” by N V Raghavendra, L Krishnamurthy: Oxford Publication.
5. “Principles of Engineering metrology” by Rega Rajendra; Jaico publishers-2008
6. Engineering Metrology by K.J. Hume; Macdonald & Co. Ltd., London

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF306**
Course Title	**Computer Aided Design**
Credits (L:T:P:C)	**3:0:2:4**
Contact Hours (L:T:P)	**3:0:4**
Prerequisites (if any)	**NA**
Course Basket	**DC**

Course Summary

The course is designed to teach basic concepts of CAD, modelling, and finite element methods.

Course Objectives

- To provide an overview of analytical treatment on of the use of computers in design.
- To understand the fundamental principles of hardware and software requirements in CAD.
- To design and draft simple and complex machine parts using CAD through wireframe and surface modelling.

Course Outcomes

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

CO1: Apply the knowledge of computer applications in Product Design and Development Process.

CO2: Understand the prevalent display technologies.

CO3: Understand the modelling of CAD geometric elements.

CO4: Design and conceive new concepts of the state of art.

Curriculum Content

Unit 1:

Fundamentals of CAD: Introduction, Reasons for implementing a CAD system, Computer Aided Process application, conventional design vs. CAD.

Computer graphics: Graphics input devices-cursor control devices, digitizers, scanners and touch panels.

Graphics display devices: CRT, Color CRT monitors, DVST, Flat panel display, graphics output devices.

Unit 2:

Line Drawing algorithms: Bresenham's line drawing and Mid-Point Circle algorithms.

Geometric Modeling of Curves Types of mathematical representation of curves, wire frame models, wireframe entities, and parametric representation of synthetic curves- her mite cubic splines, Bezier curves, B-splines rational curves.

Unit 3:

Introduction to Geometric Modeling of Surfaces and Solids Surface entities utilized in CAD. Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid

Geometry (CSG).
Graphics Standards: PHIGS, IGES, PDES. Standards in CAD.

Unit 4:
Geometric transformations: Introduction, Transformation of Geometric Models, Translation, Scaling, Reflection, Rotation, Homogeneous Representation, Concatenated Transformation.

Unit- 5:
CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards.

List of Experiments:

1. Introduction to CAD, CAE and Creo; Concepts: - Modelling, Parametric, Associative, Feature and Graphic
2. User Interface of Creo Parametric, Sketcher, line center line and rectangle. (Practice module 1 and 2)
3. Circle: using centre and point, concentric circles, 3-point circle, 3 tangents circle, Ellipse: axis end ellipse, center and axis, Arc: 3-point/Tangent end, center and ends, 3 tangents, concentric, conic (Practice module 3)
4. Dimensioning the sketch: Normal dimensions, reference dimensions, perimeter and baseline dimensions
5. Fillets & trim: Circular and elliptical, Chamfer: chamfer and chamfer trim Spline, Point, Coordinate system, text, Palette (practice module 4)
6. Part Modelling: Part mode, setting units, creating reference sketch, extrude: Blind, side1, side2, symmetric, to next, through next, to selected (Practice module 5 & 6)
7. Revolve: selecting axis, thin features, Sweep: Selecting profile and path, free and merge ends, thin protrusion, surface sweep, Helical Sweep: defining path and profile, Draft: selecting draft surface, hinges, pull direction, draft angle. split draft, draft sides independently, first side only, second side only, Hole: placement of hole, sketched holes, standard holes (practice module 7 & 8)
8. Rounds: Sets, transitions, Chamfer: chamfer sets, transitions and corner chamfer (Practice module 9 &10)
9. Datum planes: normal to plane, parallel, offset, tangent constraint, Datum axis: normal, through constraint, Datum Points: on a plane or face, offset to face, intersection of three faces, centre of curve edge, Datum curves: through points, by sketching (practice module 11 & 12)
10. Shell: surface selection, Patterns, Ribs and introduction to assembly design (Practice module 13)

Text Book [TB]:

1. Ibrahim Zeid, “Mastering CAD CAM”, Tata McGraw Hill Publishing Co. 2007.
2. Rogers, D. F. and Adams, J. A., Mathematical Elements for Computer Graphics, McGraw Hill (1989).
3. Rogers, D. F., Procedural Elements for Computer Graphics, McGraw Hill (2008).
4. Rooney, J. and Steadman, P., Principles of Computer Aided Design, prentice Hall (1988).

5. Rooney, J. and Steadman, P., Computer Aided Design, Pitman/Open University (1987).
6. Mallineuse, G., Computational Concepts and Methods, Kogan Page Ltd. (1986).
7. Rayan, D. L., Computer Aided Graphical Design, Marcel Dekker (1981).
8. Radhakrishnan, P. and Kothandaraman, C. P., Computer Graphics & Design, Dhanpat Rai Publication (2005).
9. Krishnamoorathy, C. S. and Rajeev, J. S., Computer Aided Design (Software and Analysis Tools), Narosa Publication House (2005).

Reference Books [RB]:

1. W. M. Neumann and R.F. Sproul, “Principles of Computer Graphics”, McGraw Hill, 1989.
2. D. Hearn and M.P Baker, “Computer Graphics”, Prentice Hall Inc., 1992.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF341**
Course Title	**Automotive Transmission System**
Credits (L:T:P:C)	**2:1:0:3**
Contact Hours (L:T:P)	**2:1:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

This course imparts basic knowledge to students with respect to current transmission system of automobiles and impart knowledge that will enable the student to analyse the layout of drive train and controlling mechanism of power transmission from the engine to the wheels.

Course Objectives

- To learn about different types of gear trains.
- To learn about fluid coupling & torque conversion.
- To learn about automatic transmission.
- To learn about drive line.

Course Outcomes

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

CO1: Determine various types of gear boxes and its parts.
CO2: Understand phenomena of Hydrodynamics and Hydrostatic Drives.
CO3: Understand the various industrial terminology required in a transmission system.

Curriculum Content

UNIT 1: Gear Trains

Synthesis of simple, compound reverted gear trains, analysis of epicycle gear trains, problems. Necessity & function of gear boxes in Automobiles, method of calculation of gear ratios for vehicles, performance characteristics in different speeds, different types of gear boxes-sliding constant mesh, synchromesh, epi-cyclic and automatic, speed synchronizing devices, free-wheeling mechanism, overdrives, gear materials, lubrication. Planetary gearboxes, Ford T-model Wilson Gear box, determination of gear ratios, automatic overdrives.

UNIT 2: Fluid Coupling & Torque Conversion

Fluid coupling advantages & limitations, constructional details, torque capacity, slip in fluid coupling, performance characteristics, measure to reduce drag in fluid coupling. Faults & remedies. Single, multi stage and poly-phase torque converters, performance characteristics.

UNIT 3: Automatic Transmission

Relative merits and demerits when compared to conventional transmission, automatic control of gears, study of typical automatic transmissions used in Indian vehicles, Ford & Chevrolet drive.

UNIT 4: Hydrostatic Drives

Advantages and disadvantages, principles of hydrostatic drive systems, construction and working of typical hydrostatic drives, Electrical drives: advantages and limitations, Modern electric drive

UNIT 5: Drive Line

Effects of driving thrust and torque reaction. Hotchkiss drive. Torque tube drive, radius rods. Propeller shaft. Universal joints. Final drives – different types, double reaction final drive. Two speed rear axle. Rear axle construction – full floating, three quarter floating and semi-floating arrangements. Differential – conventional type, non-slip type. Differential locks.

Text Books [TB]:

1. Motor Vehicle by Newton and Steeds, Illiffee Publisher - 2000
2. Modern Transmission system by Judge AW, Chapman & Hall 2006

Reference Books [RB]:

1. Passenger Car Automotive Transmissions by Design Practices, SAE Hand book – 1994.
2. Torque converters by Heldt P.M., Chilton Book Co.-1992
3. Automotive Transmission and power trains constructions by Crouse WH, Anglin DL, McGrawHill

12. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF342**
Course Title	**Vehicle Maintenance**
Credits (L:T:P:C)	**2:0:2:3**
Contact Hours (L:T:P)	**2:0:2**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

To make the student understand the need for vehicle maintenance and its importance and to familiarize the maintenance aspects of an automobile**.**

Course Objectives

- To learn about the basic features of vehicle maintenance.
- To learn the methods and process of maintaining different systems of an automobile.
- To acquire hands on knowledge by performing some maintenance practicals.
- To learn the maintenance record keeping and knowledge of tools and techniques.

Course Outcomes

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

CO1: Inspect and diagnose the problems occurring in various components of a vehicle.
CO2: Acquire knowledge about basic maintenance principles of a vehicle.
CO3: Analyse various failure mechanisms of different components in a vehicle.
CO4: Interpret both preventive and predictive maintenance techniques for an automobile.

Curriculum Content

UNIT 1:

Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: General safety, tool safety.

UNIT 2:

Figs and Specifications of standard tools; non Standard tools; denting tools; painting equipment; testing equipment; Service station equipment; Hydraulic lift; Tyre changer; Tyre inflation gauge; Car Washer; Air Compressor; Spark Plug Cleaner and Tester; brake and transmission bleeding equipment; Grease Guns;

Hydraulic Hoist; Analyzers: CO; HC; NOx; smoke meter: Engine analyzer: Petrol and Diesel; Ignition timing light; Wheel Balancer; Wheel aligner; Headlight aligner; Cylinder boring and honing; crankshaft grinder; Brake lathe m/c; ridge cutter and boring m/c; Trolley Jacks; Engine lifting cranes

UNIT 3:

Use of compression gauge; vacuum gauge; engine analyzer; exhaust analyzer; battery tester. Adjustment of spark plugs electrodes. Valve tappet clearance. Air filter cleaning; replacement of engine oil and filter. Tyre inflation pressure; checking fuel consumption. Assembly line diagnostic link (ALDL). IAT sensor; VSS; camshaft and Crankshaft – position sensor; start signal; engine coolant temp sensor Oxygen sensor, manifold absolute pressure sensor (MAP sensor), throttle position sensor (TPS), PSP switch sensor. Catalytic Converter; Particulate filter. Tachometer.; Fuel Vapor Canister.

UNIT 4:

Tools used for engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components. Cooling system: water pump, radiator, thermostat. Lubrication system maintenance, Anticorrosion and anti-freeze additives.

UNIT 5:

Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system. Service and maintenance of brake – disc and drum brakes, steering wheel and suspension systems, wheel alignment, and vehicle body maintenance.

List of Experiments

1. Study of Automobile Repair Shop with the help of Layout.
2. Study and Preparation of Workshop Statements.
3. Experimental Study about Tools and instruments used in the maintenance shop.
4. Experiment to perform assembly and dissembly of automobile multi cylinder engine.
5. Experiment to perform cleaning and testing of spark plug.
6. Study and diagnosis of Automobile fuel systems, filters & air cleaners
7. Experiment on Wheel Balancing and adjustment of head light
8. Adjustment of pedal play in clutch brake, hand brake and steering wheel and Braking system troubleshooting.

Text Book(s)

1. Doshi, Panchal. Maniar. “Vehicle maintenance and Garage Practice”, PHI Learning Pvt ltd. Delhi 2021
2. Shrivastava, Sushil Kumar., “Industrial Maintenance Management”, S Chand & Company Ltd., 2005
3. Knott and Phil Knott, “An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles”, EMS publishing, 2010

Reference Books

1. Kholi.P.L. “Automotive Chassis and Body”, Tata McGraw-Hill Co., Ltd.,New Delhi, 1975.
2. Tim Giles, “Automotive service: Inspection, maintenance and repair”, 3rd edition, 2007
3. Service manuals of various OEMs

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF343**
Course Title	**Design of Transmission System**
Credits (L:T:P:C)	**2:1:0:3**
Contact Hours (L:T:P)	**2:1:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

To learn about the design procedures for mechanical power transmission components.

Course Objectives

- To impart the knowledge of various transmission systems i.e. belt drives chain drives & rope drives.
- To make students to understand design of different gear drives i.e. Spur, helical, bevel & worm.
- To understand the concepts of designing a gear box.
- To provide the exposure regarding the basic fundamentals of clutch & brake systems.

Course Outcomes

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

CO1: Design a transmission system having belt, rope & chain for engines and machines.
CO2: Design a multi speed gear box for automobiles & machine tools.
CO3: Design different cam profiles for machines.
CO4: Design different clutches and brakes for different machine components.

Curriculum Content

UNIT 1:

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets

UNIT 2:

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

UNIT 3:

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

UNIT 4:

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

UNIT 5:

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Text Book(s)

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Yi Zhang, Chris Mi, Automotive Power Transmission Systems, John Wiley & Sons, 31-Aug-2018

Reference Books

1. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
2. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF344**
Course Title	**Automotive Electrical & Electronics**
Credits (L:T:P:C)	**2:0:2:3**
Contact Hours (L:T:P)	**2:0:2**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

This course provides an understanding of the construction and working of batteries and their testing methods. It also provides understanding regarding the starting and charging systems used in cars. It also helps a student in understanding the working of engine management systems, different types of sensors used in automobiles and the methods adopted for safety in cars.

Course Objectives

Understanding of electrical and electronic system in automobile vehicle, sensors used and safety methods adopted.

Course Outcomes

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

CO1: Understand the basic auto electrical systems.

CO2: Understand the working of engine management systems and different types of sensors used in automobiles

CO3: Understand the working of different electrical components and safety systems used in automobiles.

11. Curriculum Content

UNIT 1: Batteries and Accessories

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system.

UNIT 2: Starting and Charging System

Starting System: Condition at starting, behaviour of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, Starter motor requirements, care and maintenances of starter motor, Drive mechanisms, starter switches.

Charging System: Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cut out. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments

UNIT 3: Fundamentals of Automotive Electronics

Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, on board diagnostic system, security and warning system.

UNIT 4:

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

UNIT 5: Safety and Security Systems

Keyless entry system, Antilock braking system, Air bag restraint system, Adaptive cruise control system, Voice warning system, Seat belt system, antitheft system.

List of Experiments:

1. Study the layout of a car electrical wiring system
2. Study the layout of a three wheeler wiring system
3. Demonstration of a MPFI system.
4. Study the test rig of Electronic ignition system
5. Study the test rig of Alternator starter test bench
6. Study of battery and charging system
7. Study of starter system and alternator cut section model

Text Book(S)

1. Bechhold “Understanding Automotive Electronics”, SAE, 1998.
2. Kholi. P.L. “Automotive Electrical Equipment”, Tata McGraw-Hill Co., Ltd., New Delhi, 1975.

Reference Books

1. Crouse, W.H. “Automobile Electrical Equipment”, McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
2. Robert Bosch “Automotive Hand Book”, SAE (5th Edition), 2000.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be provided using MS Teams/website/relevant methods.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF345**
Course Title	**Vehicle Body Engineering**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

Course provides the basic knowledge about construction techniques & various types of automotive bodies under the light of aerodynamics.

Course Objectives

- To provide the basic knowledge about construction techniques in vehicles.
- To learn about various types of automotive bodies under the light of aerodynamics.
- To learn the body construction of heavy vehicles.

Course Outcomes

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

CO1: Understand the fundamentals in various automotive body construction techniques.
CO2: Interpret the concepts of aerodynamics in body engineering for better style and low drag.
CO3: Understand the various types of bus body construction, seating layout, regulations and comfort.

Curriculum Content

UNIT 1:

Car Body Details: Types: Saloon, Convertibles, Limousine, Estate van, racing and sports car. Visibility: Regulations, driver's visibility, test for visibility, Methods of improving visibility and space in cars. Safety: Safety design, safety equipment for car. Car body construction.

UNIT 2:

Vehicle Aerodynamics: Objectives, Vehicle drag and types, various types of forces and moments, Effects of forces and moments, side wind effects on forces and moments, various body optimization techniques for minimum drag. Wind tunnel testing: Flow visualization techniques, scale model testing.

UNIT 3:

Bus Body Details: Types, minibus, single decker, double decker, two level, split level and articulated bus. Bus Body Lay Out: Floor height, engine location, entrance and exit location, seating dimensions.

UNIT 4:

Constructional details: Frame construction, Double skin Construction-Types of metal section Used-Regulations-Conventional and Integral type construction.

UNIT 5:

Commercial Vehicle Details: Types of body, Flat platform, drop side, fixed side, tipper body, tanker body. Light commercial vehicle body types, Dimensions of driver's seating relation to controls, driver's cabin design. Body Materials, Trim and Mechanisms: Steel sheet, timber, plastics, GRP, properties of Materials-Corrosion anti-corrosion methods, scalation of paint and painting process, body trim items.

Text Book(s)

1. Powloski. J. Vehicle Body Engineering, Business Books Ltd.1989.
2. Giles. J. C. Body construction and design, IIIiffe Books Butterworth& Co.,1971
3. John Fenton, Vehicle Body layout and analysis, Mechanical Eng. Publication Ltd., London,1982
4. Handbook of Automotive Body Construction and Design Analysis John Fenton .ISBN: 9788126548163 464, distributed by Mehul Book Sales.

Reference Books

1. Braithwaite. J. B, Vehicle Body building and drawing, Heinemann Educational Books Ltd. London,1977.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF346**
Course Title	**Artificial Intelligence for Mechanical Engineeri**
Credits (L: T: P:C)	**3:0:0:3**
Contact Hours (L: T: P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

This course is intended to expose the students to the applications of Computers and principles of the artificial intelligence and application of various techniques of the same

Course Objectives

CO1: Appreciate the importance of Artificial intelligence in the product development.
CO2: Understand the prevalent reasoning methods.
CO3: Understand the various search techniques.
CO4: Can understand the application of agents
CO5: Students will be able to design and conceive new concepts of the state of art

Course Outcomes

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

CO1: Understanding of various aspects of artificial intelligence.
CO2: Analyze usage and application of the AI in Mechanical Engineering.

Curriculum Content

UNIT 1:

Artificial Intelligence – Definition(s), Approaches to AI, Generic Techniques & Representation, State space representation of problems, Agent, Search Space or State Space State, Problem Definition/Specification, Simulation of Sophisticated & Intelligent Behavior Source System Experimental Frame Model Simulator Intelligent Agents in Simulation, Distributed Artificial Intelligence and Simulation Agent Simulation Architectures

UNIT 2:

Expert System, Expert System Technology, Expert System Shell, Development of Expert Systems, Components and Capabilities of Expert System, Capability of Reasoning & explanation, Capability of Knowledge acquisition and update, Architecture of ES, Factual Knowledge, Heuristic Knowledge, Priori Knowledge, Posteriori Knowledge, Self-Explaining System, Benefits of Expert Systems, Applications of Expert System, Weber's Law, Machine vision, Machine hearing, Machine touch, Speech Recognition, Use of Ai For Speech Recognition, Limitations of Speech Recognition

UNIT 3:

Search Strategies, Informed / Heuristic Search Strategies, Best First Search, Hill Climbing Search , Mean Ends Analysis, Generate-and-test, Constraint satisfaction, Blind or Exhaustive or Uninformed Search Strategies, Breadth-First Search, Depth-First Search, Depth-First Iterative Deepening, Depth-Limited Search, Differences Between Depth First and Breadth First Game Playing / Adversarial Search Problems Terminology, Minimax algorithm, Pruning, Alpha Beta Pruning.

UNIT 4:

Reasoning, Default Reasoning, Non-monotonic Reasoning, Approaches to Handle Uncertainty to Take Rational Decisions, Utility Theory, Probability and Bayes theorem, EVENTS, Union of Events, Intersection of Events, Disjoint Events, Independent, Dependent & Exclusive Events, Probability of independent events, Probability of dependent events, Mutually exclusive and Exhaustive events.

UNIT 5:

Knowledge & Knowledge Representation, Need of Knowledge Representation, Types of knowledge, Procedural knowledge, Declarative knowledge, Heuristic knowledge, Meta – Knowledge, Structural Knowledge, Commonsense Knowledge, Ontological Knowledge, Relational Knowledge, Inheritable Knowledge, Inferential Knowledge, Difference between Procedural and Declarative knowledge, Key Aspects of Knowledge Representations: Components of a Good Representation, Properties of Good Knowledge Representation, Adequacy, Efficiency, Computable & Structured, Concise and Transparent

Text Book(s)

1. Winston, Patrick Henry. Artificial Intelligence. 3rd ed. Addison-Wesley, 1992.

Reference Books

1. Yip, Kenneth, and Gerald Jay Sussman. This resource may not render correctly in a screen reader."Sparse Representations for Fast, One-Shot Learning."
2. The Boosting Approach to Machine Learning: An Overview." MSRI Workshop on Nonlinear Estimation.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF347**
Course Title	**Fundamental of Robot Vision**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary: To learn about various components of vision systems and its usefulness for Robot navigation and guidance.

Course Objectives

- Extracting, characterizing and interpreting the information from sites/default/files
- To learn basic preprocessing techniques of image processing.
- To learn basic about the object recognition techniques.
- To determine the hold site and gripper orientation based on collision fronts is described
- Review of existing vision systems and a case study for Navigation is discussed

Course Outcomes: On successful completion of the course, students will be able to achieve the following:
CO1: Extracting, characterizing and interpreting the information from sites, or images.
CO2: Basic preprocessing techniques of image processing.
CO3: Object recognition techniques
CO4: To determine the hold site and gripper orientation based on collision fronts is described
CO5: Review of existing vision systems and a case study for Navigation is discussed

Curriculum Content

UNIT 1: Elements of Image Processing: Introduction, Discretization, pre-processing, Neighbourhood averaging, Median filtering. Smoothening of binary / sites / default /files. Thresholding, Edge detection.

UNIT 2: Imaging Components: Point sensor, line sensor, planar sensor, camera transfer characteristic, Raster scan, Image capture time, volume sensors, Image representation, and picture coding techniques.

UNIT 3: Object Recognition by Method of Moments: Introduction, Feature set, Recognition procedure, Mahalanobic procedure, Template - matching, structural techniques.

UNIT 4: COLLISON FRONTS ALGORITHM: Introduction, skeleton of objects. Gradients, propagation, Definitions, propagation algorithm, Thinning Algorithm, Skeleton lengths of Top most objects.

UNIT 5: Need for Vision Training and Adaptations: Review of existing systems - Binary, Gray level, structure of light, character recognition system, examples. Automatic part Recognition by SRI vision system - Automated Navigation guidance by vision system - A case study

Text Book(s)

1. P.A. Janaki Raman, Robotics and Image Processing an Introduction, Tata Mc Graw Hill Publishing company Ltd., 1995

Reference Books

1. Richard D. Klafter, Thomas. A Chmielewski, Michael Negin, Robotics Engineering an Integrated Approach, Prentice Hall of India Pvt. Ltd., 1989
2. Mikell P. Groover, Mitchell weiss, Roger N. Nagel, Nicholas G.Odrey, Industrial Robotics, Technology programming and Applications, 1986
3. John J. Craig, Introduction to Robotics Mechanics and Control, Second Edition, Addison Wesly Longman Inc. International Student edition, 1999
4. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robtics and Automation Sensor - Based integration, Academic Press, 1999
5. S.R. Deb, Robotics Technology and flexible automation, Tata Mc Graw Hill Publishing company Ltd., 1994
6. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, Robotics Control, Sensing Vision and Intelligence, Mc Graw Hill Book Company, 1987

Teaching and Learning Strategy

PPT, Assignment, Programming.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF348**
Course Title	**Robotics Engineering**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE and Free elective**

Course Summary

The Industrial Robotic subject equips graduates with the basic understanding of robotics automation, necessary skills to program, design automated production systems required for high-tech manufacturing industries.

Course Objectives

To enlighten the students about the fundamentals of robotics Engineering

Course Outcomes

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

CO1: Understanding of various aspects of Robotics
CO2: Analyze usage and application of the Robotics Engineering in the actual environment.
CO3: Identify a Robot for a specific application.
CO4: To develop student's skills in understanding sensor and allied devices.
CO5: Apply and understand the safety issues during the handling of robots.

Curriculum Content

UNIT 1: Fundamental of Robots

Fundamentals of Industrial Robot Automation, Definition, Robot anatomy, Co-ordinate systems, work envelope, types and classification, Specifications of robot, Pitch, yaw, roll, joint notations, speed of motion and pay load, Robot parts and their functions, Different applications.

UNIT 2: Robot Drives and Actuators

Robot Drives and Actuators Pneumatic drives, Hydraulic drives, Mechanical drives, Electrical drives, D.C. servo motors, stepper motor and A.C. servo motors. Salient features, applications and comparison of all these drives, piezoelectric actuators.

UNIT 3: End Effectors and Sensors

End effectors: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers, Two fingered and three fingered grippers, Internal grippers and external grippers, Selection and design considerations.

Sensors: Requirements of a sensor, principles and applications of the following types of sensors, Position sensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors), Range sensors, Proximity sensors, Touch sensors, Slip Sensors

UNIT 4: Robot Motion Analysis and Control

Introduction to manipulator kinematics, Homogeneous transformation and robot kinematics, Forward kinematics, Inverse kinematics, DH algorithm, Manipulator path control, overview of Robot dynamics.

UNIT 5: Robot Programming

Introduction, robot programming technique, on line programming, lead through programming, Walk through programming, off-line programming, overview of robot programming languages. Robot work cell- Robot cell layouts, Multiple robot and machine interference, work cell control, interlocks, error detection and recovery.

Text Book(s)

1. Industrial Robotics, Technology programming and application by Mikell P. Groover , TMH publications.2010
2. Klafter.R.D, Chmielewski.T.A and Noggins, "Robot Engineering: An Integrated Approach", Prentice Hal of India Pvt. Ltd., New Delhi, 2010.

Reference Book(s)

1. Fu K.S, Gonzalez, R.C., Lee, C.S.G., "Robotics control, sensing, vision and intelligence", McGraw Hill Book Co., Singapore, Digitized 2007.
2. Craig.J.J, "Introduction to Robotics mechanics and control", Addison- Wesley, London, 2008.
3. Robotics technology and flexible automation by S.R.Deb , Mc Graw Hill publication.2006
4. Industrial automation and robotics by A.K.Gupta , University science press.2012

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF 349**
Course Title	**Robotics kinematics & dynamics**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

Robotics holds the study of those machines that can replace human beings in the execution of tasks, as regards both physical activity and decision making. In all robot applications, the realization of a task requires the execution of a specific motion prescribed to the robot. The correct execution of such motion is entrusted to the control system which should provide the robot's actuators with the commands consistent with the desired motion. Motion control demands an accurate analysis of the characteristics of the mechanical structure, actuators, and sensors. The goal of such analysis is the derivation of the mathematical (kinematic and dynamic) models describing the input/output relationship characterizing the robot components. Modelling a robot manipulator is therefore a necessary premise to develop motion control strategies.

Course Objectives

- The objective of the course is to introduce the methodological bases of the robots modeling and control, as well as the main theoretical and practical aspects of these topics.
- To reach this objective, the course presents the key ideas on robots' morphology, kinematics and dynamics, passing later to analyse the control of movements and force.
- The course contents are completed with the study of the control guided by vision concluding with practical aspects of the robot control systems architecture and programing.

Course Outcomes

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

CO1: Understanding of various types of robots and its parts.

CO2: Analyze and perform various kinds of motions performed by robots.

Curriculum Content

UNIT 1: Introduction to Robots

Historical Development, Robot Components-Link, Joint, Manipulator, wrist, End effector, Actuators, Sensors, Controller. Robot Classifications- Geometry, Workspace, Actuation Control, Application.

Introduction to Robot’s Kinematics, Dynamics and Control-Triad, Unit Vectors, Reference Frame and Coordinate System, Vector Function, Problems of Robot Dynamics.

Preview of Covered Topics Robots as Multi-Disciplinary Machines.

UNIT 2: Kinematics

Rotation Kinematics

Rotation About Global Cartesian Axes, Successive Rotation About Global Cartesian Axes,Global Roll-Pitch-Yaw Angles, Rotation About Local Cartesian Axes, Successive Rotation About Local Cartesian Axes, Euler Angles, Local Roll-Pitch-Yaw Angles, Local Axes Versus Global Axes Rotation, General Transformation, Active and Passive Transformation

UNIT 3: Orientation Kinematics

Axis-angle Rotation

Euler Parameters, Determination of Euler Parameters, Quaternions, Spinors and Rotators, Problems in Representing Rotations-Rotation matrix, Angle-axis, Euler angles, Quaternion, Euler parameters. Composition and Decomposition of Rotation.

Motion Kinematics

Rigid Body Motion, Homogeneous Transformation, Inverse Homogeneous Transformation

Compound Homogeneous Transformation-Screw Coordinates, Inverse Screw, Compound Screw Transformation, The Plucker Line Coordinate, The Geometry of Plane and Line (Moment, Angle and Distance, Plane and Line) screw and Plucker Coordinate

UNIT 4: Forward Kinematics

Denavit-Hartenberg Notation, Transformation between Two Adjacent Coordinate Frames, Forward Position Kinematics of Robots, Spherical Wrist Assembling Kinematics-Coordinate Transformation Using Screws, on Denavit-Hartenberg Methods.

Inverse Kinematics

Decoupling Technique, Inverse Transformation Technique-Iterative Technique, Comparison of the Inverse Kinematics Techniques (Existence and Uniqueness of Solution, Inverse Kinematics Techniques), Singular Configuration.

Angular Velocity

Angular Velocity Vector and Matrix (Time Derivative and Coordinate Frames) Rigid Body Velocity (Velocity Transformation Matrix), Derivative of a Homogeneous Transformation Matrix

UNIT 5: Dynamics

Acceleration Kinematics Angular Acceleration Vector and Matrix, Rigid Body Acceleration (Acceleration Transformation Matrix), Forward Acceleration Kinematics

Inverse Acceleration Kinematics (Rigid Link Recursive Acceleration).

Motion Dynamics Force and Moment**,** Rigid Body Translational Kinetics, Rigid Body Rotational Kinetics, Mass Moment of Inertia Matrix, Lagrange's Form of Newton's Equations, Lagrangian Mechanics.

Robot Dynamics Rigid Link Newton-Euler Dynamics (Recursive Newton-Euler Dynamics), Robot Lagrange Dynamics (Lagrange Equations and Link Transformation Matrices), Robot Statics

Text Book(S)

1. Prof. Reza N. Jazar, “Theory of Applied Robotics”, SPRINGER, 2nd Edition.2010.

Reference Books

1. Saha, S.K., “introduction to robotics, 2nd edition, McGraw-Hill higher education, new Delhi, 2014.
2. Niku Saeed B., “introduction to robotics: analysis, systems, applications”, PHI, New Delhi.
3. Mittal R.K. and Nagrath I.J., “Robotics and control”, Tata McGraw hill.
4. Mukherjee s., “robotics and automation”, Khanna publishing house, Delhi.
5. Craig, J.J., “introduction to robotics: mechanics and control”, Pearson, New Delhi, 2009.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF 350**
Course Title	**Heat exchangers: Fundamentals and Design Analysis**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

The course is designed to expose the students to the fundamentals and design methods of different types of heat exchangers.

Course Objectives

- Understand the basic concept and design methodology of heat exchangers.
- Determine general design requirements for different types of heat exchangers.
- Identify the important heat-exchanger design parameters.
- Perform thermal and hydraulic design and application of different heat exchanger types.
- Predict the thermal performance and pressure drop characteristics of a given type of heat exchanger.

Course Outcomes

On successful completion of the course, students will be able to achieve the following

CO1: Understand the basic design methods for sizing and rating heat exchangers.
CO2: Apply single phase forced convection correlations in designing of heat exchangers.
CO3: Apply concept of pumping power and fouling factor in designing of heat exchangers
CO4: Design double pipe and shell & tube heat exchangers.
CO5: Design phase change and compact heat exchangers and also understand its performance evaluation.

Curriculum Content

Unit 1: Basic Design Methods of Heat Exchangers

Introduction, Arrangement of Flow Path in Heat Exchangers, Basic Equations in Design, Overall Heat Transfer Coefficient, LMTD Method for Heat Exchanger Analysis, Parallel and Counter Flow Heat Exchanges, Multipass and Cross Flow Heat Exchangers, The ε-NTU Method for Heat Exchanger Analysis, Heat Exchangers Design Calculations and Methodology.

Unit 2: Forced Convection Correlations for the Single Phase Heat Exchangers

Hydrodynamically Developed and Thermally Developing Laminar Flow in Smooth Ducts, Annular, Turbulent Forced Convection, Turbulent Flow in Smooth Ducts, Heat Transfer from Smooth-Tube Bundles, Heat Transfer in Helical Coils and Spirals, Nusselt Numbers of Helical and Spiral Coils, Heat Transfer in 90° and 180° Bends.

Unit 3: Pressure Drop and Fouling Factor in Heat Exchanger

Tube-Side Pressure Drop in Circular and non-circular Cross Sectional Tubes, Pressure Drop in Tube Bundles in Cross flow, Pressure Drop in Helical and Spiral Coils, Heat Transfer and

Pumping Power Relationship.
Effect of Fouling on Heat Transfer, Effect of Fouling on Pressure Drop, Categories of fouling, Design of Heat Exchangers Subject to Fouling, Fouling Resistance, Cleanliness Factor.

Unit 4: Double Pipe Heat Exchangers and Shell-and-Tube Heat Exchangers
Double-Pipe Heat Exchangers: Thermal and Hydraulic Design of Annulus and Tubes, Finned inner tubes.
Shell-and-Tube Heat Exchangers: Baffle Type and Geometry, Shell-Side Heat Transfer and Pressure Drop, Shell-Side Heat Transfer Coefficient, Shell-Side Pressure Drop, Tube-Side Pressure Drop

Unit-5: Design of Phase Change and Compact Heat Exchangers
Shell and Tube Condenser, Evaporators for Refrigeration and Air-Conditioning, Steam Turbine Exhaust Condenser, Air-Cooled Condensers.
Compact Heat Exchanger; Heat Transfer and Pressure Drop, Heat Transfer Enhancement, Plate-Fin and Tube-Fin Heat Exchangers. Performance evaluation.

Text Book(s)

1. Kakac, S. and Liu H. “Heat Exchangers: Selection, Rating and Thermal Design”, CRC Press, 2nd edition, 2002.

Reference Books

1. Shah, R. K. and Sekulic, D. P., “Fundamentals of Heat Exchanger Design”, John Wiley & Sons, Inc., 2003.
2. Webb, R.L., and Kim, N.H., “Principles of Enhanced Heat Transfer”, Taylor and Francis, 2005.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF351**
Course Title	**Robotics Simulation**
Credits (L:T:P:C)	**2:0:2:3**
Contact Hours (L:T:P)	**2:0:2**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

This course will give the overall idea about the simulation of the industrial robotics links, which is required for the designing of the robotics manipulators.

Course Objectives: To expose the techniques for simulation of robot design and motion.

Course Outcomes

CO1- To simulate the robot functions, joint movements etc.

CO2- To learn a simulation package and how to perform a simulation with that package.

CO3- To prepare graphic animation sequences to describe the robotic action to be displayed.

CO4- Velocity, acceleration analysis of Joint and linkages. It is prerequisite for inertia force analysis.

Curriculum Content

UNIT 1: Introduction

Robotics systems, Robot movements, Quality of simulation, types of simulation, Robot applications, Robotics simulation displays. Simulation notation, Auto LISP functions. Features, Command syntax, writing design functions.

UNIT 2: Robotic Principles

Straight lines, Angles and optimal moves circular interpolation, Robotic functions Geometrical commands, Edit commands. Selecting robot views, standard Robot part, using the parts in a simulation.

UNIT 3: Robotics Simulation.

Simulation packages, Loading the simulation, Simulation editors, delay, resume commands. Slide commands, program flow control. Robot motion control, Analysis of robot elements, Robotic linkages.

UNIT 4: Robotic Motion

Solids construction, Solid animation. Types of motion, velocity and acceleration, Types of simulation motion Harmonic motion, parabolic motion, uniform motion velocity and acceleration analysis for robots.

UNIT 5: Robot Design

Linkages, Types, Transmission elements Flexible connectors, pulley-and-Belt drives, variable speed transmission. Design of Robot for particular applications - A case study.

Text Book(s)

1. Daniel L. Ryan, Robotics Simulation, CRC Press Inc., 1994
2. Richard D. Klafter, Thomas. A, Chri elewski, Michael Negin, Robotics Engineering an Integrated Approach, Prentice Hall of India Pvt. Ltd., 1989
3. Mikell P. Groorer, Mitchell welss, Roger N. Nagel, Nicholas G.D.D. Ray, Industrial Robotics, Technology programming and Applications, 1986

Reference Books

1. Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987
2. Bernard Hogcos, Industrial Robotics, Second Edition, Jaico Publishing house
3. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, Prentice Hall of India Pvt. Ltd., 2000
4. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, Prentice Hall of India Pvt. Ltd., 2001
5. John J. Craig, Introduction to Robotics Mechanics and Control, Second Edition, Addison Wesly Longman Inc. International Student edition, 1999
6. Bijay K. Ghosh, Ning XI, T.J. Tarn, Control in Robotics and Automation Sensor - Based ingegration, Academic Press, 1999
7. Carl D. crane III and Joseph Duffy, Kinematic Analysis of Robot manipulation, Cambridge University press, 1998

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF352**
Course Title	**Manufacturing System Simulation**
Credits (L:T:P:C)	**2:1:0:3**
Contact Hours (L:T:P)	**2:2:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary: This course will give the basic of the random number generation, design and evaluation of simulation experiments with simulation languages.

Course Objectives: To highlight the basic concepts and procedure for simulation of Manufacturing systems.

Course Outcomes

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

CO1: Learn Basics of simulation and its types
CO2: Apply the techniques for generation of random numbers
CO3: Design and evaluate simulation experiments
CO4: Learn Simulation languages
CO5: Simulate discrete events

Curriculum Content

UNIT 1: Introduction

Systems - discrete and continuous systems, general systems theory, models of systems- variety of modeling approach, concept of simulation, simulation as a decision making tool, types of simulation, Principle of computer modeling- Monte Carlo simulation, Nature of computer modeling, limitations of simulation, area of application**.**

UNIT 2: Random Number Generation

Techniques for generating random numbers- mid square method, mid product method, constant multiplier technique, additive congruential method, linear congruential method. Tests for random numbers- Kolmogorov-Smirnov test, the Chi-square test.

UNIT 3: Design and Evaluation of Simulation Experiments

Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow charts, starting condition, run size, experimental design consideration, output analysis, verification and validation of simulation models.

UNIT 4: Simulation Languages

Comparison and selection of simulation languages, study of any one simulation language

.

UNIT 5: Discrete Event Simulation

Concepts in discrete -event simulation, development of simulation models for queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network. Programming for discrete event simulation in GPSS, case studies.

Text Book(s)

1. Jerry Banks and John S Carson, Barry L Nelson, David M Nicol, 'Discrete event system simulation', Prentice Hall, India, 2000
2. Gordon G, 'System Simulation', Prentice Hall, India, 1991

Reference Books

1. Khoshnevi. B., 'Discrete system simulation', McGraw Hill International edition, 1994
2. Ronald G Askin and Charles R Standridge, 'Modeling and analysis of manufacturing systems', John Wiley & Sons, 1993
3. Thomas J Schriber., 'Simulation using GPSS', John Wiley & Sons, 1991
4. Shannon, R.E., 'System Simulation - The art and science', Prentice Hall, India, 1975

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF353**
Course Title	**Computational methods in thermal and fluid engineering**
Credits (L:T:P:C)	**2:0:2:3**
Contact Hours (L:T:P)	**2:0:2**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

The course gives an introduction to numerical simulation of heat transfer and fluid flow problems in industrial and natural processes. Emphasis is put on learning the practical use of numerical methods. The students will learn to assess the accuracy and to interpret the meaning of the numerical results in heat transfer and fluid flow.

Course Objectives

- Introduce the students about the numerical techniques for solving heat transfer and fluid flow problems
- Classification of the basic equations for fluid dynamics and heat transfer.
- Discretization of transport equations for compressible and incompressible flow.
- Describe the finite difference, finite volume and finite element methods.
- Introduction to a computational solution tool and application to heat and fluid flow.

Course Outcomes

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

CO1: Understand the theories and approaches used in numerical solution of heat transfer and fluid dynamics problems.

CO2: Apply the finite volume, finite difference and finite element methods.

CO3: Analyze different approaches in modeling and prediction of flow and temperature fields in engineering problems.

Curriculum Content

UNIT 1: Mathematical description of fluid flow and heat transfer:

Basics of heat transfer, fluid flow. Mathematical description of fluid flow and heat transfer: conservation equations for mass, momentum, energy. Classification of partial differential equations, coordinate systems.

UNIT 2: Finite Difference Technique:

Finite difference methods; different means for formulating finite difference equation; Taylor series expansion, integration over element, local function method; treatment of boundary conditions; boundary layer treatment; variable property; interface and free surface treatment; accuracy of finite difference method.

UNIT 3: Finite Volume Technique:

Finite volume methods; different types of finite volume grids; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and

comparison for convection-diffusion problem.

UNIT 4: Finite Element Methods:

Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications.

UNIT 5: Methods of Solution:

Solution of finite difference equations; iterative methods; matrix inversion methods; ADI method; operator splitting; fast Fourier transform. Time integration Methods: Single and multilevel methods; predictor corrector methods; stability analysis: Applications to transient conduction and advection diffusion problems. Numerical Grid Generation: Numerical grid generation; basic ideas; transformation and mapping.

Text Book(s)

1. Anderson, D.A., Tannehill, J.C. and Pletcher, R. H. (1997). Computational Fluid Mechanics and Heat Transfer. Taylor & Francis.

Reference Books

1. Ferziger, J. H. and Peric, M. (2003). Computational Methods for Fluid Dynamics. Third Edition,SpringerVerlag,Berlin.
2. Versteeg, H.K. and Malalasekara, W. (2008). Introduction to Computational Fluid Dynamics: The Finite Volume Method. Second Edition (Indian Reprint) Pearson Education.
3. Anderson, D.A., Tannehill, J.C. and Pletcher, R. H. (1997). Computational Fluid Mechanics and Heat Transfer. Taylor & Francis.
4. Reddy, J.N. and Gartling, D.K., 2010. The finite element method in heat transfer and fluid dynamics. CRC press.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

List of Experiments

1. Analysis of heat conduction in a solid object.
2. Calculation of Reynolds's number and Nusselt Number in a tube under laminar flow condition.
3. Analysis of turbulent flow in a pipe.
4. Localized Heating Analysis in a pipe flow condition.
5. The grid independence test using the parametric analysis method

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF354**
Course Title	**Power Plant Engineering**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

This course is intended to expose the students to the applications of thermodynamics cycle and principles of turbo machine in energy generation system.

Course Objectives

- To analyze the economics analysis of energy generation.
- To learn about different form of energy generation and vapor cycles and their layout as per power plant
- To learn about gas cycles and their layout as per power plant.
- To learn about nuclear power plant terminology.
- To learn about hydroelectric power plant constructional details and hydrology.

Course Outcomes

Upon completion of the course, the students can

CO1: Relate the basic principles of operation of power plants components.

CO2: Explain the working of plant accessories and mountings.

CO3: Solve the energy demand and its economics.

CO4: Compare the type of power plants requirements according to energy demands.

Curriculum Content

UNIT 1: Introduction: Economics of Power Generation.

Global trend for per capita consumption of energy, Demand of energy and future availability in usable form. Load duration curve, tariff methods for electrical energy, advantage of combined working, load division between power stations.

UNIT 2: Steam Power Plant:

Analysis of steam cycles, effect of steam condition on thermal efficiency, Layout of modern coal power plant, Steam Generator, FBC boilers, Circulation-natural and Forced, circulation ratio, pulverizer and coal burners, subsystems of thermal power plants, ash handling system, Dust collection system, Feed water treatment, deaerator, condenser and cooling towers, Turbine lubrication and supervisory system, Operation and maintenance of steam power plant.

UNIT 3: Gas Turbine Power Plant:

Brayton cycle analysis and optimization, combined cycle, Gas turbine fuels, cogeneration, Gas turbine power plants components, selection and governing system, comparative study with other energy generation system, Layout of gas turbine power plant, operation and maintenance.

UNIT 4: Nuclear Energy:

Principles of release of nuclear Energy-Fusion and fission reactions, Nuclear fuels used in the reactors, Layout and subsystems of nuclear power plants, General components of a nuclear reactor Brief description- Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, Safety measures for nuclear power plants.

UNIT 5: Hydroelectric Power Plants:

Classification, typical layout and components, Hydrology, Site selection for hydroelectric power plants, Design construction and operation of different components of hydroelectric power stations.

Text Book(s)

1. S. Domkundwar, S.C. Arora., A Course in Power Plant Engineering, 6th edition.2011.
2. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 5th edition.2005.
3. El Wakil M.M., Power Plant Technology, Tata McGraw Hill.
4. Yadav, R. Steam & Gas Turbines & Power Plant Engineering, Central Pub. House.

Reference Books

1. Power Plant Engineering- F.T. Morse
2. Steam Turbine Design and Practice- Kareton
3. Power Plant Engineering- Black and Veatch
4. Boiler Operation Engineering: Questions and Answers Hardcover – P. Chattopadhyay

Teaching and Learning Strategy

1. Class room delivery.
2. Power point presentation.
3. Nearby plant visit.
4. Simulation training.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF441**
Course Title	**Advanced Automobile Engineering**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

The course helps student to understand the all subsystems of vehicle technologies in modern development.

Course Objectives

- To learn about vehicle homologation & safety design aspects
- To learn about constructional design basics, operating control characteristics of vehicle
- To learn about the critical subsystems of vehicle chassis.

Course Outcomes

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

CO1: Acquire vehicle sub systems design and control basics with current vehicles technology scenario.

CO2: Students will learn about homologation and vehicle safety aspects.

Curriculum Content

UNIT 1:

Categorization and Homologation of vehicles. Classification & Constructional details of various vehicles. Introduction to wheel loaders, ATV, sports vehicles their nomenclature

UNIT 2:

Passenger car Regulations. Basic ergonomics, driver's visibility and safety measures in vehicle design. Car body construction; design criteria. AIS testing standards, Crash tests and crumple zones.

UNIT 3:

Chassis & Controls

Vehicle frame design and its types. Vehicle Transmission Systems: Basic design principles and operational control, Antilock brake system and throttle controls, Controls on dashboard meters Suspension system: Types of suspensions, introduction to basics of suspension analysis, types of dampers.

UNIT 4:

Vehicle pollution controls and vehicle emission norms.

Electric vehicles: Introduction, types of batteries, types of electric vehicles drives. Hybrid vehicles.

UNIT 5:

Case study on features of Indian models of PC, LCV and two wheelers and comparative analysis.

Text Book(s)

1. Automobile Engineering - Kripal Singh.
2. Automotive mechanics by Srinivasan, TMH, New Delhi
3. Automotive Technology by Sethi, TMH, New Delhi

Reference Books

1. Motor Vehicles by Newton Steeds and Garrot, Butterworths, London – 2000.
2. Mechanism of the Car by Judge A.W, Chapman and Halls Ltd., London –1986
3. Automotive Chassis and Body by Crouse W.H, McGraw –Hill, New York –1971.
4. Automobile Engg. by K.K. Jain, R.B. Asthana, TMH –2002.
5. Automotive Engineering- Hietner.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF442**
Course Title	**Turbomachines**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

To enable the students to know the design principle, construction and working operation of turbo machines for compressible and incompressible flow.

Course Objectives

- To learn about basic concept of turbo machines.
- To learn about principle of energy exchange in turbo machines.
- To learn about general analysis of turbo machines.
- To learn about blade theory.
- To analyze the performance by dimensional and model analysis.

Course Outcomes

At the end of the course the student can:

CO1: To describe the basic governing equation of turbo machine.

CO2: Explain the characteristic curves of turbomachine.

CO3: Solve the compression process in terms of performance parameters.

CO4: Compare the effect of blade geometry over the turbomachine.

CO5: Design of turbomachine according to specific requirements.

Curriculum Content

UNIT 1: Basic Concept of Turbomachines:

Definition, Classification of Turbo machines, Basic laws and governing equations, Efficiencies of turbine and compressor with reference of stagnation properties, preheat factor in compressor and reheat factor in turbine.

Energy exchange in Turbo Machines:

Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor.

UNIT 2: General Analysis of Turbo Machines:

Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, General analysis of axial flow pumps and compressors.

UNIT 3: Blade Theory and Steam Turbines

Aero foil section, Energy transfer in terms of lift and drag coefficient, blade terminology, Velocity triangle-impulse and reaction turbine, compounding in steam turbine, Degree of reaction, Steam turbine governing, characteristic curves. – Features of Steam turbine and Gas turbine.

UNIT 4: Fans, Blowers and Compressors

Centrifugal Compressors – component and description, velocity diagram, Stage pressure rise - Stage pressure co-efficient, slip factors, effect of impeller shape on performance, Stalling and Surging, centrifugal and axial compressor characteristic curves.

UNIT 5: Dimensional and Model analysis:

Introduction: fundamental and derived dimension, dimensional homogeneity, Dimensional analysis method, similitude, classification of hydraulic models, specific speed of pump and turbine, Model testing of hydraulic turbo machine, unit quantities.

Text Book(S)

1. Valan Arasu, A," Turbomachine",2nd edition, vikash publishers.
2. Pai, B.U.," Turbomachine",1st edition-2013, Wiley.
3. S.M. Yahya," Turbine, Fans and Compressors, TMH, 2002.

Reference Books

1. Douglas J.F., Gasiorek, J.M and Swaffield J.A., Fluid Mechanics, Addison – Weisly.1999
2. Dixon, S.L, 'Fluid Mechanics and Thermodynamics of Turbomachinery', Pergamon Publishers 1999
3. Kadambi and Prasad, (1997), Energy conversion Vol. III – Turbomachines, Wiley Eastern.
4. A.H. Church and Jagadish Lal, (2000), Centrifugal Pumps and Blowers; Metropolitan Book Co, Pvt. Ltd.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF443**
Course Title	**Machine Tool Design**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

This course aims at imparting the students the knowledge of the working mechanism, parametric analysis, design and dynamics involved in different machine tools and their components.

Course Objectives

- Understanding the construction and operations of various machine tools.
- Understanding of various machine tool drive mechanism.
- Study of the different speed and feed parameters involved in the machining process.
- Study of the design of different machine tools and their components.
- Study the dynamics and basics of numerical control and machine tool testing.

Course Outcomes

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

CO1: Understand the construction and working mechanisms of machine tools along with importance of various parameters involved in the machining process.

CO2: Implement the knowledge gained in solving the problems based on machining parameters.

CO3: Design the machine tool and their components.

CO4: Explain the basic of dynamics, numerical control and machine tool testing

Curriculum Content

UNIT 1: Introduction and General Principles of Machine Tool Design

Developments in machine tools, Types of machine tools, Constructional and Operational Features of basic machine tools e.g. Lathe, Drill, Milling, Shapers and Planers, Grinding machine etc., General requirement of machine tool design, Machine tool design process, Tool wear, Force Analysis.

UNIT 2: Machine Tools Drives

Classification of machine tool drives, Group vs Individual drives, Selection of electric motor, A brief review of the elements of mechanical transmission e.g. gear, belt and chain drives, slider-crank mechanism, cam mechanism, nut & screw transmission, Devices for intermittent motion, Reversing & Differential mechanisms, Couplings and clutches, Elements of hydraulic transmission system. e.g. pumps, cylinder, directional control valves, pressure valves etc., Fundamentals of kinematic structure of machine tools.

UNIT 3: Regulation of Speed and Feed rates

Laws of stepped regulation, Selection of range ratio, Standard progression ratio, Selection of best possible structural diagram, Speed chart, Design of feed box, Developing gearing diagrams, Step-less regulation of speed and feed in machine tool, Speed and feed control.

UNIT 4: Design of Machine Tool Structure

Function of machine tool structures and their requirements, Design criteria for machine tool structures, Selection of material, Basic design procedure for machine tool structures, Design of bed, column and housing, Model technique in design, Design of guide ways and power screws: basic guide way profiles, Designing guide way for stiffness and wear resistance, Hydrostatic and antifriction grand ways, Design of sliding friction power screws, Design of spindle & spindle supports, Layout of bearings, selection of bearings for machine tools.

UNIT 5: Dynamics of machine tools

General procedure for assessing the dynamic stability of cutting process, closed loop system, Chatter in machine tools. Control Systems: Functions, requirements & types of machine tool controls, Controls for speed & feed change, Automatic and manual Controls, Basics of numerical controls, Machine tool testing: Geometrical tests on Lathe, Milling and Drilling machines, their performance & significance

Text Book(s)

1. N.K. Mehta, “Machine Tool Design and Numerical Control” 3rd Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2012.

Reference Books

1. S.K. Basu and D.K. Pal, “Design of Machine Tools”, 5th Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2009
2. G.C. Sen and A. Bhattacharya, “Principles of Machine Tools”, Second Edition, New Central Book Agency (P) Ltd., Kolkata, 2009

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF444**
Course Title	**Operation Research**
Credits (L:T:P:C)	**2:1:0:3**
Contact Hours (L:T:P)	**2:2:0**
Prerequisites (if any)	**NA**
Course Basket	**DE & FE**

Course Summary

Operations research helps in solving problems in different environments that needs decisions. The module covers the topics that include: linear programming, Transportation, Assignment, and CPM/PERT/SPT techniques. Analytic techniques will be used to solve problems facing business managers in decision environments.

Course Objectives

This course aims to make the student capable of formulating the various real life decision making problem as mathematical programming problems. Students to learn the fundamental techniques of operation research and to choose a suitable OR technique to solve problems on hand.

Course Outcomes

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

CO1: Formulate the linear and nonlinear programming problems.

CO2: Solve linear programming problems using L.P.P., Simplex method and its variants

CO3: Construct, analyse and optimize various Inventory, Queuing and Network models.

Curriculum Content

UNIT 1: Linear Models

Introduction to Operations Research – Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Duality – Two – Phase Simplex method –Transportation problems – Northwest Corner method– Vogel's Approximation method –MODI method – Assignment problems Applications.

UNIT 2: Sequencing and Networks

Sequencing- Problem with N jobs on 2 and 3 machines. Network models – Basic Concepts – Construction of Networks – Project Network – CPM and PERT - Critical Path Scheduling – Crashing of Network.

UNIT 3: Inventory Models

Inventory Control: Concept, Various costs and types, Inventory Models- Deterministic Inventory models: EOQ, EPQ and Probabilistic Inventory models: Demand profit model, service level model.

UNIT 4: Queuing Models

Queuing models – Poisson arrivals and Exponential service times – Single channel models and Multi-channel models.

UNIT 5: Decision Models

Decision models – Game theory – Two-person zero sum game – Graphic solution - Property of dominance – Algebraic solution.

Text Book(s)

1. Hira D S and Gupta P K, (2007), Operations Research, S. Chand & Sons.
2. Hamdy Taha, (2009), Operations Research: An Introduction, Pearson Education Inc.

Reference Books

1. Panneerselvan. R. (2006), Operation Research, Prentice Hall of India Pvt Ltd
2. Kanti Swarup, Gupta P.K., and Manmohan, (2004), Operations Research, S.Chand & sons.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF 445**
Course Title	**Tribology**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

This course is intended to expose the students to the fundamental knowledge of tribology. Students will also be able to understand about various aspects of friction, wear, hydrodynamic and hydrostatic lubrication etc.

Course Objectives

-To know about properties of lubricants, modes of lubrication, additives etc.
- To select suitable/proper grade lubricant for specific application.
- To select suitable material combination for tribological contact.
- To apply the basic theories of friction, wear and lubrications about frictional behaviour commonly encountered in sliding surfaces.

Course Outcomes

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

CO1: Understand of basic concepts of tribology.
CO2: Understand the fundamentals of friction and wear.
CO3: Analyze various dimensions of hydrodynamic lubrication.
CO4: Apply the concepts of hydrostatic and gas lubrication.

Curriculum Content

UNIT 1: Introduction

Tribology definition. Tribology in design- bearing material its properties and construction Tribological characteristics of oil seals and gasket. Tribology in industry (Maintenance).
Lubrication-Definition, basic modes of lubrication, properties of lubricants, additives, EP lubricants, Recycling of used oil, oil conservation. Bearing Terminology-Types of Sliding contact, rolling contact bearings. Comparison between sliding and rolling contact bearing. (Theoretical treatment only).

UNIT 2: Friction and Wear

Introduction, laws of friction, Friction classification, causes of friction. Theories of dry friction. Friction measurement. Stick-slip motion and friction instabilities.
Wear-classification, wear between solids, wear between solid and liquids, factors affecting wear. Theories of wear. Wear measurement. Controlling friction.

UNIT 3: Hydrodynamic lubrication

Theory of hydrodynamic lubrication, mechanism of pressure development in oil film. Two dimensional Reynold‘s equation and its limitations, Petroff`s equation. Designing journal

Bearing. Hydrodynamic thrust Bearing-Introduction, types. Flat plate thrust Bearing-Pressure equation, load, and centre of pressure.

UNIT 4: Hydrostatic lubrication and Gas (Air) lubrication

Hydrostatic Lubrication-Basic concept, advantages, limitations, viscous flow, load carrying capacity, flow requirement of hydrostatic step bearing, energy losses, design concepts of stepped bearing. Squeeze film lubrication- Basic concept, circular and rectangular plate approaching a plane.

Gas(air) lubricated Bearings-Introduction, advantages, disadvantages, applications of tilting pad bearing, hydrostatic and hydrodynamic bearing with air lubrication.

UNIT 5: Tribological Aspects

Lubrication in rolling, forging, drawing and extrusion. Theory of tyre road interaction, road grip. Surface engineering for wear and corrosion resistance-diffusion, plating and coating methods.

Textbook(s)

1. Bharat Bhushan, — Principles and Applications of Tribology, 2nd Edition, Wiley India.

Reference Books

1. Cameron A., —Basic Lubrication Theory‖, Wiley Eastern Ltd.
2. Mujumdar B. C., —Introduction to Tribology and Bearings‖, S. Chand and Company Ltd. New Delhi.
3. Fuller D. D., —Theory and Practice of Lubrication for Engineers‖, John Wiley and Sons.
4. Halling J., —Principles of Tribology‖, McMillan Press Ltd.
5. Bhushan B. and Gupta B. K., — Handbook of Tribology: Material, Coatings and SurfaceTreatments‖, McGraw Hill Ltd.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Summary: The focus of Product Design and Development is integration of the marketing, design, and manufacturing functions of the firm in creating a new product. At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF446**
Course Title	**Product Design & Development**
Credits (L:T:P:C)	**3:0:0:3**
Contact Hours (L:T:P)	**3:0:0**
Prerequisites (if any)	**NA**
Course Basket	**DE & FE**

Course Objectives:

- Competence with a set of tools and methods for product design and development.
- Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
- Confidence in your own abilities to create a new product.

Course Outcomes

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

CO1: To understand the innovation, product design process, user study, need/problem identification, development of design brief.

CO2: To understand competitive benchmarking, aspects of human factors in product design, tools for creative concept generation, and prototyping/model making and evaluation techniques for user-product interaction.

CO3: This course will be explained with lectures including case studies and hands-on exercises. This will help students to generate creative ideas in to product design, considering human factors aspects.

Curriculum Content

UNIT 1:

Significance of product design, need for developing products, product design and development process, the importance of engineering design, sequential engineering design method, relevance of product lifecycle issues in design, the challenges of product development.

Product Planning and Project Selection: generic product development process, identifying opportunities, evaluate and prioritize projects, allocation of resources, various phases of product development-planning for products.

UNIT 2:

Identifying Customer Needs voice of customer, customer populations, Interpret raw data in terms of customers need, hierarchy of human needs, need gathering methods, establish the relative importance of needs.

Product Specifications: Establish target specifications, setting final specifications

Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output

UNIT 3:

Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design, human factors design, user friendly design

Concept Selection: Overview, concept screening and concept scoring, methods of selection, case studies.

UNIT 4:

Theory of inventive problem solving (TRIZ): Fundamentals, methods and techniques, General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model based technology for generating innovative ideas measurement of customer's response.

Concept Testing: Elements of testing: qualitative and quantitative methods including survey.

UNIT 5:

Intellectual Property: Elements and outline, patenting procedures, claim procedure.

Design for Environment: Impact, regulations from government, ISO system, case studies.

Text Book [TB]:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", Tata McGraw-Hill Education, 4th Edition, 2009.
2. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, Indian Reprint 2004.

Reference Books [RB]:

1. Yousef Haik, T. M. M. Shahin, "Engineering Design Process Cengage Learning, 2010", 2nd Edition Reprint.
2. Kevin Otto, Kristin Wood, "Product Design", Pearson Education Indian Reprint 2004.
3. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", John Wiley & Sons, 3rd Edition 2009.

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF447**
Course Title	**Design of Hydraulics & Pneumatics systems**
Credits (L:T:P:C)	**2:0:2:3**
Contact Hours (L:T:P)	**2:0:2**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary:

This subject imparts the students an understanding of standard terminologies, conventions, processes, design, operational characteristics, applications and interfacing of key components of contemporary automation technologies used in hydraulic, pneumatic, electro-pneumatic and PLC based automation systems. Also this course introduces the students to various automation system devices and control elements used in modern automatic manufacturing environments

Course Objectives:

- To learn and analyse operation of industrial fluid power and pneumatics systems.
- To provide student with the knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

Course Outcomes:

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

CO1: Identify different symbols of components used in hydraulic and pneumatic system.

CO2: Selection and sizing of components of the circuit.

CO3: Develop a circuit diagram for Pneumatics and hydraulic systems.

Curriculum Content:

UNIT 1: Introduction

Mechanization vs. Automation, low cost automation with hydraulics and pneumatics. Requirement of industrial automation with hydraulics and pneumatics.

Basic pneumatics and hydraulics system: Fundamentals and basic principal of Hydraulics, advantages and disadvantages, pneumatics power vs. hydraulics power, overview of basic pneumatics and basic hydraulic systems.

UNIT 2: Hydraulic and Pneumatic Actuators

Pumps and compressors: Pumps vs. compressor, classification of pumps, positive displacement pumps, rotary pumps, and reciprocating pumps, centrifugal pumps. Pump selection parameters. Types of air compressors, positive displacement compressor, rotary compressor, reciprocating compressor.

Cylinders and motors: Symbolic representation of motors and cylinders, cylinder classification on the basic of construction, single acting cylinder, double acting cylinder, other types of

cylinders. Hydraulic and pneumatics cylinders, cylinder sizing, types of motors, motor rating, gear motors and vane motors

UNIT 3: Fluid Accessories and Control Valves

Fluid Accessories: Air receiver, air dryer, air filter, Pressure regulator, Air service unit (FRL), Seals, hydraulic filters, accumulator, intensifier, Hoses, pressure gauge.

Control Valves: Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Sequence valve, pneumatic logic valve, shuttle and servo valves, Selection of valves for circuits,

Symbolic representation of control valves and fluid accessories.

UNIT 4: Design of Pneumatic Circuits

Pneumatics circuits for control of single acting cylinder and double acting cylinder. Circuit with mechanical feedback, speed control circuit, use of flow control valve, quick exhaust valve in pneumatics circuits. Application with twin pressure and shuttle valves. Sequencing and cascading method for two and three-cylinder application.

UNIT 5: Design of Hydraulic Circuits

Hydraulic circuits for control of single acting cylinder and double acting cylinder. Circuit with mechanical feedback, speed control circuit, use of flow control valve, quick exhaust valve in hydraulic circuits. Application with twin pressure and shuttle valves. Designing of Sequencing and cascading circuit for two and three-cylinder application.

List of Practicals:

A. Experiments on Hydraulics Circuits: 1. Extend-Retract and Stop system of a linear actuator. 2. Regenerative circuit. 3. Speed Control circuits: meter-in, meter-out and bleed off. 4. Sequencing circuit 5. Use of solenoid operated DCV. 6. Rapid Traverse and Feed circuit.

B. Experiments on Pneumatic Circuits: 1. Study of Compressor, FRL unit and 5/3 DCV. 2. Reciprocating motion of a single and a double-acting actuator using 5/3 DCV. 3. Speed control circuits. 4. Automatic to & fro motion of a pneumatic linear actuator. 5. Sequencing circuit. 6. Logical circuits using shuttle valve. 7. Cascading Circuit

Text Book [TB]:

1. Industrial Hydraulics by John Pippenger and Tyler Hicks, McGraw Hill. 2010
2. Oil Hydraulic Systems, Principle and Maintenance by S R Majumdar, McGraw-Hill.2006
3. Fluid Power with Applications by Anthony Esposito, Pearson. 2010
4. Industrial automation and robotics by A. K. Gupta, University science press.1012

Reference Books [RB]:

1. Fluid Power: Generation, Transmission and Control, Jagadeesha T., Thammaiah Gowda, Wiley.2010
2. The Analysis & Design of Pneumatic Systems by B. W. Anderson, John Wiley.2009
3. Control of Fluid Power Analysis and Design by Mc Clay Donaldson, Ellis Horwood Ltd.2006

COURSE STRUCTURE & SYLLABUS OF B.TECH.– MECHANICAL ENGINEERING APPLICABLE FOR BATCH: 2022-26

Department offering the course	**Mechanical Engineering**
Course Code	**MEF448**
Course Title	**Computer Integrated Manufacturing**
Credits (L:T:P:C)	**2:0:2:3**
Contact Hours (L:T:P)	**2:0:4**
Prerequisites (if any)	**NA**
Course Basket	**DE**

Course Summary

This course is intended to expose the students to the applications of computer in the manufacturing field and to give the overall idea of the various techniques in the manufacturing to make it easier and computer based.

Course Objectives

a) To impart knowledge of CIM and Automation and different concepts of automation by developing mathematical models.
b) To make students to understand the Computer Applications in Design and Manufacturing [CAD /CAM) leading to Computer integrated systems. Enable them to perform various transformations of entities on display devices.
c) To expose students to automated flow lines, assembly lines, Line Balancing Techniques, and Flexible Manufacturing Systems.

Course Outcomes

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

CO1: Define Automation, CIM, CAD, CAM and explain the differences between these concepts. Solve simple problems of transformations of entities on computer screen

CO2: Explain the basics of automated manufacturing industries through mathematical models and analyze different types of automated flow lines.

CO3: Analyze the automated flow lines to reduce time and enhance productivity.

CO4: Explain the use of different computer applications in manufacturing, and able to prepare part programs for simple jobs on CNC machine tools and robot programming.

CO5: Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing.

UNIT – I

Introduction- Concepts of CIM, Manufacturing system, components of CIM, CASA/SME model of CIM, CIM II, Benefits of CIM, Communication matrix in CIM, Fundamentals of computer communication in CIM, computer networking in CIM- seven layers of OSI model.

UNIT – II

NC & CNC part programming: Fundamental of NC technology, computer numerical control, distributed numerical control, coding systems and formats, Manual NC part programming, Examples drilling and milling, turning, CNC machines and turning centers, CNC part programming.

UNIT – III

Material Handling System & Industrial robotics -introduction to material handling, material transport equipment like industrial trucks, automated guided vehicles, monorail and other rail guided vehicles, conveyors, cranes and hoists.AS/RS design process Identification technologies- introduction, bar code technology, radio frequency identification.

UNIT – IV

Flexible manufacturing systems: introduction, FMS components, equipment's, FMS tool management systems, system layout, FMS control, case study. FMS applications and benefits. Group technology and cellular Manufacturing: part families, part classification and coding Production flow analysis, application of Group technology.

UNIT – V

Process planning and Concurrent Engineering- process planning, computer aided process planning, concurrent engineering and design for manufacturing, advance manufacturing planning, Production Planning and Control systems- Aggregate production planning and the Master Production schedule, Material Requirement planning, Shop floor control, Inventory control, JUST IN TIME, Lean and Agile manufacturing.

Text Books:

1. Rao P N, "CAD/CAM Principles and Applications "third edition, McGraw Hill Education Pvt.Ltd.

Reference Books:

1. Groover. Mikell P, "Automation, Production systems and computer integrated manufacturing", Third edition, PHI learning private limited, ISBN-978-81-203-3418-2.
2. Groover .Mikell P and Zimmers jr. Emory, "CAD/CAM", Prentice hall of India Pvt Ltd., 1998.
3. James A, Regh and Henry W. Kreabber "Computer integrated manufacturing" Pearson Education 2 nded, 2005.
4. Paul G. Ranky., "Computer Integrated Manufacturing", Prentice hall of India Pvt Ltd., 2005.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

List of Experiments:

1. Study of Flexible manufacturing system
2. Writing a part-programming (in word address forma tor in APT) for a job for turning operation and running on NC machine.
3. Writing a part-programming (in word address format or in APT) for a job for drilling operation (point-to point) and running on NC machine.
4. Writing a part programming (in word address format or in APT) for a job for milling operation (contouring) and running on NC machine
5. Experiment on Robots and it programs
6. Experiment on Transfer line/Material handling (AS/RS).
7. Experiment on difference between ordinary machine and NC machine.