Vision, Mission and PEOs of B. Tech. Mechanical Engineering

Vision of the Department
To be recognized as one of the preeminent Mechanical Engineering Programs

Mission of the Department
• To prepare students competent to make their careers in Mechanical Engineering
• To provide value education to students to make them responsible citizen
• To strengthen collaborations with Industries, Academia and Research Organizations to enrich learning environment and to enhance Research Culture
• To be recognized as a leading Mechanical Engineering Department in the field of Knowledge, Skill and Research

Program Educational Objectives
• To achieve the mission of the program, Mechanical Engineering graduates will be able:
  • To work independently as well as in team to formulate, design, execute solutions for engineering problems and also analyze, synthesize technical data for application to product, process, system design & development
  • To understand & contribute towards social, environmental issues, following professional ethics and codes of conduct and embrace lifelong learning for continuous improvement
  • To develop expertise towards use of modern engineering tools, instruments, programming languages and software’s
  • To acquire and develop careers in industries, Research organizations, academia and demonstrate entrepreneurial skill
Program Outcomes

Mechanical Engineering

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

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

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

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

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

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

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

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

**Program Specific Outcomes (PSO)**

**Mechanical Engineering**

**Mechanical Engineering Graduates will be able to:**

1. Read & generate 2D & 3D computer based drawings of Mechanical Engineering components & systems and select appropriate materials and manufacturing processes for their production.
2. Conceptually understand Mechanical Engineering components & systems and thereby design & analyze them for enhancement of thermal & mechanical performance.
3. Conduct experiments on mechanical systems to measure different parameters required to evaluate the performance of materials, components & systems and deduce relevant conclusions
### Structure for B.TECH. Mechanical Engineering (Pattern A-14 Revised)

**Academic Year – 2017-18**

**Module – VII**

<table>
<thead>
<tr>
<th>Course</th>
<th>Course Code</th>
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<th>Contact Hours / Week</th>
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| S_1    | ME401THP    | CAD/CAM/CAE                          | THP         | 3                    | 2   | 30  | 20  | 50  | 30  | 35  | 35  | 100 | 4    |
| S_2    | ME402THP    | Design of Mechanical Systems         | THP         | 3                    | 2   | 30  | 20  | 50  | 30  | 35  | 35  | 100 | 4    |
| S_3    | ME403THL    | Vibration Analysis                   | THL         | 3                    | 2   | 30  | 20  | 50  | 30  | 35  | 35  | 100 | 4    |
| S_4    | ME404THL    | Refrigeration and Air Conditioning    | THL         | 3                    | 2   | 30  | 20  | 50  | 30  | 35  | 35  | 100 | 4    |
| S_5    | ME405PRJ    | Project work                         | PRJ         | 10                   |     | 30  | 20  | 50  | 100 | -   | -   | 100 | 5    |

| TOTAL  |             |                                      |             | 12                   | 14  | 4   |     |     |     |     |     | 21  |

Structure and syllabus Final year B. Tech Mechanical Engineering, Pattern A-14 revised, A.Y. 2017-18
**Structure for B.TECH. Mechanical Engineering (Pattern A-14 Revised)**

**Academic Year – 2017-18**

**Module-VIII**

**Option-A (4 Elective & Project based)**

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<th>Course</th>
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* Course type of electives may be **THP** or **THL** or **TPL**
## Electives (2017-18)

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<td>Dynamic -Kinematics</td>
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<td>ME418THP</td>
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<td>Hybrid Electric Vehicles- Performance &amp; Environment Impact</td>
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### Structure for B.TECH. Mechanical Engineering (Pattern A-14 Revised)

**Academic Year – 2017-18**

**Module-VIII**

**Option-B (six months internship based)**

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**S₁** - Open elective selected as per recommendation of company

**S₄** - CVV based on S₁, S₂ & S₃ (Report, presentation and Viva)
Structure for B.TECH. Mechanical Engineering (Pattern A-14 Revised)  
Academic Year – 2017-18

Module –VII
ME 401THP: CAD/CAM/CAE

Credits: 04  
Teaching Scheme: 3 Hours / Week

Unit 1: Computer Graphics  
(6 Hours)

Introduction to Basic Transformations - Translation, Rotation, Scaling, Reflection, Homogenous Coordinate system, Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations. Projections - Orthographic, Isometric.

Unit 2: Geometric Modeling  
(12 Hours)

Curves


Surfaces

Introduction to Parametric representation of Surfaces. Analytic Surfaces: Plane, Ruled, Tabulated, Revolved surfaces. Synthetic Surfaces: Bezier Surface, B-Spline Surface

Solids

Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry, Boolean operation for CSG, Hybrid Modelling, Feature Based Modelling, Parametric Modelling, Constraint Based Modelling, Mass, area, volume calculation

Unit 3: Finite Element Analysis  
(6 Hours)

Types of 1D element. Displacement function, Global and local coordinate systems, Order of element, primary and secondary variables, shape functions and its properties. Formulation of elemental stiffness matrix and load vector for spring, bar, beam, truss and Plane frame. Transformation matrix for truss and plane frame, Assembly of global stiffness matrix and load vector, Properties of stiffness matrix, half bandwidth, Boundary conditions elimination method and penalty approach, Symmetric boundary conditions, Stress calculations.

Unit 4: Two Dimensional Finite Element Analysis  
(8 Hours)

Types of 2D elements, Formulation of elemental stiffness matrix and load vector for Plane stress/strain such as Linear Strain Rectangle (LSR), Constant Strain Triangles (CST), Pascal’s
triangle, primary and secondary variables, properties of shape functions. Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), Overview of axi-symmetric elements

Unit 5: Computer Aided Manufacturing (8 Hours)


Unit 6: Rapid Prototyping

Introduction to Rapid Prototyping, classification of RP Processes, Working principle, models & specification process, application, advantages & disadvantages & case study of

- Stereo Lithography Apparatus (SLA)
- Laminated Object Manufacturing (LOM)
- Selective Laser Sintering (SLS)
- 3D Printing.
- Fused Deposition Modelling [FDM]
- Rapid Towing and STL format.

CAD/CAM/CAE - PROJECT BASED LABORATORY

Teaching Scheme: 02 Hours / Week

Project based lab includes (not limited to) of the following projects:

Students are required to study the obtained results and Make proper engineering judgments and interpretations

1) Develop a mathematical model of Mechanical system perform by using FEA technique in commercial software .Plot and discuss whether the mathematical model you chose gives you physically meaningful results. Compare with analytical results

2) Motion analysis of mechanism (Practical application) in commercial software compare with Analytical results

3) Manufacturing mechanical component on Rapid prototyping Machine

4) Fatigue analysis of mechanical component (practical application) in commercial software compare with analytical results

Text Books: (As per IEEE format)

2. Groover M. P., “Automation, production systems and computer integrated manufacturing” Prentice Hall of India

Reference Books: (As per IEEE format)


Course Outcomes:

The student will be able to –

1. Able to use the underlying algorithms, mathematical concepts, supporting computer graphics. These include but are not limited to: Composite2D & 3D homogeneous matrices for translation, rotation, and scaling transformations.
2. Able to use and demonstrate fundamental knowledge of CAD/CAM.
3. Able to:— Understand the basic theory behind the finite element method
4. Able to:— Use the finite element method for the solution of practical engineering problems
5. Able to Create the G-code program (with a standard computer post processor) of a work-piece on a standard numerically controlled machine tool with CNC controls.
6. Able to:— Understand Rapid prototyping Technique
ME402THP: DESIGN OF MECHANICAL SYSTEMS

Credits: 03                             Teaching Scheme: 3 Hours / Week

Unit 1: Design of Worm Gear & Machine Tool Gearbox (8 Hours)

Worm Gears: Worm and worm gear terminology and geometrical relationship, Types of worm and worm gears, Standard dimensions, Force analysis of worm gear drives, Friction in Worm gears and its efficiency, Worm and worm-wheel material, Strength and wear ratings of worm gears as per IS-7443-1974. Thermal consideration in worm gear drive. Introduction to machine tool gearboxes, design and its applications, basic considerations in design of drives, determination of variable speed range, graphical representation of speed and structure diagram, ray diagram, selection of optimum ray diagram, deviation diagram, difference between numbers of teeth of successive gears in a change gear box.

Unit 2: Design of Cylinders and Pressure vessels: (7 Hours)

Thick and thin cylinders – Thin cylindrical and spherical vessels – Lame’s equation, Clavarino’s and Birnie’s equation, Design of hydraulic and pneumatic cylinders, Auto frettage and compound cylinders – Gasketed joints in cylindrical vessels. Modes of failures in pressure vessels. Unfired pressure vessels – Classification of pressure vessels as per I. S. 2825 –1965-categories and types of welded joints – Weld joint efficiency – Corrosion, erosion and protection vessels, stresses induced in pressure vessels, materials of construction. Thickness of cylindrical and spherical shells and design of end closures as per code – Nozzles and Openings in pressure vessels – Reinforcement of openings in shell and end closures. Area compensation method.

Unit 3: Design of Material Handling System (7 Hours)

Material handling system concept, basic principles, objectives of material handling system, unit load and containerization. Flat belt and troughed belt conveyors, capacity of conveyor, rubber covered and fabric ply belts, belt tensions, types of conveyor pulleys, types of belt idlers, types of tension take-up systems, power requirement of horizontal and inclined belt conveyors.

Unit 4: Optimum Design and Statistical consideration in design (6 Hours)


Statistical consideration in design: Frequency distribution – Histogram and frequency polygon – Normal distribution – Units of measurement of central tendency and dispersion – Standard
Vishwakarma Institute of Technology  Issue 01 : Rev No.1 : Dt. 24/03/17

variable – population combinations – Design and natural tolerances –Design for assembly-
Statistical analysis of tolerances – Mechanical reliability and factor of safety.

Unit 5: Design of I.C. Engine components  
(6 Hours)

Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, construction of cylinder liners, design of piston and piston-pins, piston rings, design of connecting rod, design of crank-shaft and crank-pin.

Unit 6: Product Design and Guidelines  
(6 Hours)

Engineering Product Design and Development
Introduction: Classification & Specifications of Products, Product life cycle, Product mix,
Introduction to product design, Modern product development process, Innovative thinking,
Morphology of design, Conceptual Design: Generation, selection & embodiment of concept,
Product architecture, Industrial design: process, need, Design Optimization.
Design for Manufacturing and Assembly: Methods of designing for Manufacturing and Assembly, Designs for Maintainability, Designs for Environment, Product costing, Legal factors
and social issues, Engineering ethics and issues of society related to design of products.
Ergonomics and Aesthetics considerations in design: Man-Machine interaction. Concepts of size and texture,colour. Comfort criteria, Psychological and Physiological considerations,
Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design,
drawing, simulation, detail design.

List of Project areas: (For THP, TLP courses)
Teaching Scheme: 02 Hours / Week
1. Design of Worm gear box,
2. Design of Pressure vessel,
3. Design of I. C. Engine
4. Design of Material Handling System,
5. Design of Reciprocating Compressor Design,
6. Design of Machine Tool Gear Box

The design project shall consist of assembly drawing with bill of materials, overall dimensions
and working drawings for individual components complete with manufacturing tolerances,
surface finish symbols, geometric tolerances etc. A design report duly supplemented with
necessary calculations, process sheets, cost estimation, operating instructions and trouble
shooting for the system should be submitted along with drawings.

Text Books: (As per IEEE format)

   (India) Pvt. Ltd., New Delhi
Reference Books: (*As per IEEE format*)

1. IS-2825-1969 Code for unfired pressure vessels
5. Joshi M. V., Mahajani V. V., “Process Equipment Design”, MacMillan India, Ltd., Delhi

Course Outcomes:

The student will be able to –

1. Design as per IS code the Mechanical components like worm gears, Unfired Pressure vessels, Machine Tool Gearboxes.
2. Design Mechanical systems like Pressure vessels.
3. Design material handling system like belt conveyor
4. Use Statistical considerations and optimize the Design for Mechanical Elements like Shaft, Gear, and Spring.
5. Design Mechanical systems like IC Engine and its components.
6. Apply DFMA, Aesthetics and Ergonomics principles in designing engineering component or product.
ME 403THL: VIBRATION ANALYSIS

Credits: 04

Teaching Scheme: 3 Hours / Week

Unit 1: Gyroscope

(6 Hours)

GYROSCOPE: Principles of gyroscopic action, precession, gyroscopic couple, effect of gyroscopic couple on ships, aero plane and vehicles etc.

Unit 2: Balancing

(8 Hours)

Balancing: Balancing of rotating masses in one and several planes, balancing of reciprocating masses in single and multi cylinder engines—inclined, radial and Vee type. Primary and secondary balancing analysis. Concept of direct and reverse cranks. Static and dynamic balancing machines.

Unit 3: Free Vibration

(8 Hours)

Introduction to vibration:
Elements of a vibratory system, S.H.M., degrees of freedom and modeling of a system, Concept of linear and non-linear systems, equivalent spring, damper and inertia for linear and torsional systems.

Single degree of freedom system:
Undamped free vibration, natural frequency, initial conditions, damped free vibrations, over damped, critically damped and under damped vibrations, logarithmic decrement, viscous damping and dry friction / Coulombs damping.

Unit 4: Forced Damped Vibration

(6 Hours)

Forced Damped Vibration:
Single degree of freedom system, rectilinear and torsional forced vibrations --- harmonic excitation, excitation due to reciprocating and rotating unbalance, magnification factor, resonance, phase angle, base excitation, force and motion transmissibility, vibration isolation.

Unit 5: Two Degrees of Freedom System

(6 Hours)

Free Vibrations:
Introduction, Formulation of equations, elastic and inertial couplings, stiffness and mass matrix, characteristics matrix and determinant, natural frequencies and mode shapes, orthogonality of mode shapes, principal coordinates, two and three rotor system.
Unit 6: Vibration Measurements and Whirling of Shafts  
(6 Hours)

Measurement of displacement, velocity, acceleration, frequency and damping.
Different types of pick-ups, exciters, vibration meter, periodic motion and Fourier analysis, FFT Spectrum Analyzer, Introduction to vibration analysis of machine tools, centrifugal pumps and turbines.

Text Books:

2. Grover G. K., Mechanical Vibrations, Nem Chand and Bros

Reference Books:

2. Hannah and Stephans, Mechanics of Machines, Edward Aronold Publication
3. Meirovitch, Elements of Mechanical Vibrations, Tata McGraw Hill
5. Thomas Bevan, Theory of Machines, CBS Publications.
6. Ghosh and Malik, Theory of Mechanism and Machines, East West Pvt. Ltd
VISHWAKARMA INSTITUTE OF TECHNOLOGY

FF No. : 654

VIBRATION ANALYSIS Laboratory

Teaching Scheme: 2 Hours / Week

List of Practicals (any ten):

1. Verification of principle of gyroscope and gyroscopic couple, magnitude.
2. Study of any two gyro controlled instruments.
3. To study the dynamic balancing machine and to balance a rotor. (e. g. rotor of electric motor, flywheel, fan etc.)
4. To determine the natural frequency of damped vibration of single degree freedom system and to find its damping coefficient.
5. To verify natural frequency of torsional vibration of two rotor system and position of node.
6. To determine critical speed of single rotor system.
7. To determine resonance frequency of transverse vibration of beam.
8. To determine the frequency response curve under different damping conditions for single degree freedom system of vibration.
9. To determine shock absorber transmissibility curve.
10. Determination of natural frequencies and damping in a mechanical component/assembly with vibration shaker.
11. Determination of natural frequencies and damping in a mechanical component/assembly with impact hammer
12. Determination of vibration transmissibility under random vibrations.

Text Books:

2. Grover G. K., Mechanical Vibrations, Nem Chand and Bros

Reference Books:

2. Hannah and Stephans, Mechanics of Machines, Edward Aronold Publication
3. Meirovitch, Elements of Mechanical Vibrations, Tata McGraw Hill
5. Thomas Bevan, Theory of Machines, CBS Publications.
6. Ghosh and Malik, Theory of Mechanism and Machines, East West Pvt. Ltd

Course Outcomes:

The student will be able to –
1. Students will be able to demonstrate the problem solving ability related to balancing of rotor system, multi-cylinder in-line engine and radial engine.
2. Students will be able to demonstrate the gyroscopic couple and predict its effect related to planes, ships and automobiles.
3. Students will be able to develop and solve the mathematical model of one degree of freedom system to calculate natural frequency.
4. Students will be able to perform the analysis of vibratory system under free and forced vibration conditions.
5. Students will be able to develop the mathematical model of two degrees of freedom system to get natural frequencies and mode shapes.
6. Students will be able to select the instruments for a vibration measurement and analyze the measured data.
ME 404THL: REFRIGERATION AND AIR-CONDITIONING

Credits: 04                Teaching Scheme: 03 Hours / Week

Unit 1: Vapour Compression Refrigeration System (CO 1)  (8 Hours)

Introduction of Refrigeration – Second Law Interpretation, Reverse Carnot Cycle (RCC), Limitations of RCC with vapour as refrigerant, Modifications in RCC with vapour as refrigerant, Ideal vapour compression cycle (VCC), effect of operating parameters on VCC, use of p-h charts, actual vapour compression cycle, method to improve COP of Vapour Compression Cycle, Introduction to multistage systems. Single stage compression with two evaporators, two stage compression with liquid intercooler.

Unit 2: Refrigerants and Components of VCR System (CO 2)  (8 Hours)

Refrigerants
Classification of refrigerants, Desirable properties of refrigerants, Designation of refrigerants, primary and secondary refrigerants, Ozone depletion potential (ODP) Global warming potential (GWP), Montreal protocol, Kyoto protocol, Alternative Refrigerants, Azeotropes, Total equivalent warming impact (TEWI).

Components of VCC
Compressor - Hermetic, scroll, screw, rotary and centrifugal; Condenser - air cooled, water cooled, Evaporator – flooded, direct expansion; Expansion Device - capillary tube, automatic expansion valve, thermostatic expansion valve, Refrigeration system controls

Unit 3: Vapour Absorption Refrigeration System (CO 3)  (6 Hours)

Introduction to vapour absorption, Simple vapour absorption system, COP of simple vapour absorption system, Desirable properties of refrigerant and absorbent, Requirements of ideal refrigerant-absorbent mixture, Mixtures for Vapour absorption systems, Actual vapour absorption system, water ammonia system and lithium bromide system, Electrolux Refrigerator, Comparison between Vapour Compression and Vapour Absorption systems, Single effect and double effect VAR systems, Absorption Chiller.

Unit 4: Air Refrigeration Systems (CO 4)  (6 Hours)

Limitations of RCC with gas/air as refrigerant, Modifications in RCC with gas/air as refrigerant, Bell Coleman cycle – ideal and actual, Aircraft refrigeration systems- Simple, boot strap, reduced ambient, regenerative, Dry Air Rated Temperature, Vortex tube refrigeration system.

Unit 5: Psychrometry (CO 5)  (6 Hours)
Introduction, Psychrometric properties, Use of Psychrometric chart, Psychrometric processes, Application of first law to psychrometric process, Adiabatic saturation, Sensible heat Factor (SHF), Application of psychrometric processes in Air-conditioning equipment - Apparatus Dew Point (ADP), Bypass factor of coil, Air Washer, Evaporative cooling.

**Unit 6: Air-Conditioning (CO 6)** (6 Hours)

Thermodynamics of human body, Metabolism of human body, Human Comfort, Factors influencing comfort, Concept of effective temperature
Air conditioning Systems - Unitary, Zoned and Central; Summer, Winter and Year-round; Applications of Air conditioning in Industry and Transport; Introduction to duct system

**Text Books:**

**Reference Books:**

**Course Outcomes: (Theory + Lab)**
The student will be able to –
1. analysevapour compression refrigeration system and conduct its experimental analysis
2. select suitable components for vapour compression refrigeration system application and compatible eco-friendly refrigerant based on international protocols and execute experimental analysis of an application
3. evaluate performance of vapour absorption system and demonstrate its hands-on knowledge
4. compute performance of air refrigeration systems and demonstrate hands-on knowledge of one system
5. analysepsychrometric processes and apply for air conditioning and perform their experimental analysis
6. describe different Air conditioning systems applied for human comfort and industry and correlate the concepts with industrial applications

**REFRIGERATION AND AIR-CONDITIONING (Lab)**

**Teaching Scheme: 02 Hours / Week**

**List of Practicals:**
1. Trial on vapour compression system of ice plant. (CO 1)
2. Trial on vapour compression system of heat pump. (CO 1)
3. Trial on vapour compression cycle of air conditioning test rig. (CO 1)
4. Trial on ice plant. (CO 2)
5. Determination of COP of vapour absorption system. (CO 3)
6. Trial on vortex tube refrigeration system. (CO 4)
7. Trial on air conditioning test rig for psychrometric process: cooling and dehumidification. (CO 5)
8. Trial on air conditioning test rig for psychrometric process: heating and humidification. (CO 5)
9. Visit to cold storage plant. (CO 6)
10. Visit to central air conditioning plant. (CO 6)

Text Books:
1. Khurmi R. S., Gupta J. K —Refrigeration and Air conditioning, S. Chand Publication (Fifth edition)
3. Dossat Ray J, —Refrigeration and Air conditioning, Wiley Eastern Limited

Reference Books:
ME405PRJ: MAJOR PROJECT
(Duration: - One Semester)

Credits: 05
Contact Hours/Week: 10, Project based Lab

Prerequisite: Basic knowledge of Science and Engineering

Objectives:

• To make them aware in the selection of domain, area and topic of their interest
• To orient the students to identify the problem precisely, analyze the same and subsequently do the synthesis.
• To orient the students to apply their knowledge preferably to real life engineering problem solving
• To evolve students in conceptual, lateral, and out of box thinking
• To provide an opportunity to them to acquire hands on experience of manufacturing processes
• To provide platform to learn how to work in a group and gain basic management skills
• To expose them to the process of selection of manufacturing methods, materials, fits and tolerances, assembling and disassembling of system, equations or correlations, boundary conditions, input parameters, dependent and independent variables, technical data, analysis techniques, data generation techniques etc.
• To give an exposure to selection of Standards, Standard processes, Standard Techniques, Standard components, Standard Mechanisms, Standard measuring and regulating instruments etc.

The project work shall contain:
Design/Development/Retrofitting/Fabrication/Atomization/Optimization/Modeling/Coding/Simulations/Experimental-analysis/Computational-analysis/Mathematical-analysis/Use of analogies/Use of commercially available software/Use of available codes/Use of open source codes and software’s/Performance improvements of Mechanism/Machine/Model/Prototype/System based on existing/new ideas/principle etc.

Energy audit/conservation/management, Use of renewable energy sources etc.
Validation or Bench marking of the outcome/ results

A report containing maximum 30 pages (printed on both sides excluding certificate, permission letter, and title pages) shall be submitted based on the background, motivation and scope of the project, project specifications, activities involved in the project and activity plan, literature review made, basic theory, details of methodology adopted and data reduction, results and discussions, conclusions extracted and proposed future work (if any) followed by referencing and appendices (if any).

Outcomes:
The student shall be able to;
- Define/Develop/Select methodology for executing the project work
- Apply theoretical concepts for solving the project problem, decide and apply the manufacturing techniques and instrumentation
- To develop the procurement skills
- To assemble and demonstrate the working model
- To develop skills of technical report writing and presentation

**Guidelines:**
- Report shall be typed and printed in standard format.
- Figures and tables shall be at appropriate positions, with numbers and captions.
- Project title and approval sheets shall be attached at the beginning of the report followed by Index and Abstract of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students with GR No and Roll No shall be included on every certified project report copy.
- Each group of students shall submit to the concerned the required number of copies of project reports as decided by the department and one copy shall be prepared for each individual student.
- The project work shall be taken up individually or in a group consisting of not more than 4 students.

**References:**
2. Cited Papers from Journals and Conferences
3. Already available literature from open source
Structure for B.TECH. Mechanical Engineering
(Pattern A-14 Revised)
Academic Year – 2017-18
Option-A (4 Elective & Project based)

Module-VIII
ME410TLP: TRIBOLOGY

Credits: 04                Teaching Scheme: 3 Hours / Week

Unit I: Basic equations for fluid film lubrication and Hydrodynamic thrust bearings

(8 Hrs)

Modes of lubrication, Types of lubricants, properties of lubricants, Mechanics of fluid flow, Reynold's equation. Hydrodynamic thrust bearings: Pressure development mechanism. Plane slider bearing with fixed inclination, Tilting pad slider bearings, parallel step slider bearing, Finite width thrust bearings

Unit II: Hydrodynamic Journal Bearings

(8 Hrs)

Mechanism of pressure development in journal bearing, Infinitely long bearing analysis, Infinitely short bearing analysis, Petroff’s equation, theoretical and practical considerations in bearing design, Oil supply grooves in journal bearing, Bearing materials, Finite length journal bearing, Design procedure, Hydrodynamic instability.

Unit III: Squeeze film bearings

(5 Hrs)

Squeeze film bearings: Introduction, infinitely long parallel rectangular plates, lubrication between parallel circular plates, lubrication between cylinder and a flat plane.

Unit IV: Hydrostatic bearings

(6 Hrs)

Hydrostatic bearings: Introduction, classification, hydrostatic circular step bearings, friction and pumping losses, stiffness calculation of hydrostatic circular step bearing

Unit V: Gas Lubricated bearings and Elastohydrodynamic lubrication

(5 Hrs)


Elastohydrodynamic lubrication: Introduction, Hetrz contact stress theory, lubricant rheology, different regimes in EHL, Grubin theory, Pressure and film thickness distribution in EHL contacts.

Unit VI: Friction and Wear

(8 Hrs)

Friction: Laws of Friction, Types of Friction, Theories of friction, friction measurement.
**Vishwakarma Institute of Technology**  Issue 01 : Rev No.1 : Dt. 24/03/17

**Wear:** Classification of Wear, Wear Mechanisms, Quantitative Laws of Wear, Wear measurement.

**Total Contact Hours:** 40 hours

**Text Books**

1. Introduction to Tribology of bearings: B.C Majumdar, S. Chand and company ltd. New Delhi (2008)

**Reference Books**


**TRIBOLOGY: Project and lab**

**Teaching Scheme: 02 Hours / Week**

**List of labs:**

1. Journal Bearing Test: Experimental measurement of the pressure distribution and frictional torque in the journal bearing. (co 2)
2. Four-Ball Test: To investigate the Wear preventive ability (WP) and Friction behaviour of lubricants operating under non-conformal (point contact) contact condition. (co 4))
3. Four-Ball Test: To investigate the Extreme pressure capacity (EP) of lubricants operating under non-conformal (point contact) contact condition. (co 4)
4. Pin-on-Disc Test: To investigate the behaviour of interacting surfaces in terms of Friction and Wear measurement under dry condition (co6)
5. Pin-on-Disc Test: To investigate the behaviour of interacting surfaces in terms of Friction and Wear measurement under lubricated condition (co6)

**List of project:**

**Project 1: Analysis of slider bearing (CO 1)**

**Project 2: Analysis of journal bearing (CO 2)**
Project 3: Design of hydrodynamic journal bearing based on theoretical and practical considerations (CO 2)

Course Outcomes:

The student will be able to –

1. Perform analysis of hydrodynamic thrust bearing.
2. Design the hydrodynamic journal bearing based on theoretical and practical considerations.
3. Perform analysis of components subjected to squeeze film lubrication.
4. Perform analysis of hydrostatic thrust bearing
5. Demonstrate knowledge about mechanism of Gas lubricated bearings and lubrication of non-conformal contacts.
6. Demonstrate knowledge about laws / theories of friction and wear.
ME411THP: Dynamic –Kinematics

Credits: 04

Teaching Scheme: 3 Hours / Week

Unit I: Fundamentals and review of basics concepts (8 Hours)
Vector representation, Free body diagrams, rectilinear motion: position, velocity, acceleration, translation frame of reference.
Newton laws, conservation of momentum, work-energy principle, Impact, determination of radius of gyration, instantaneous center of rotation of a simple mechanisms.

Unit II: Kinematics of particles - 2D (8 Hours)
Curvilinear motion of a particle: position, velocity and acceleration, rectangular components, tangential and normal components, radial and transverse components, motion of a particle relative to 2D moving reference frame (translation).
Relative and constrained motion of connected particles.

Unit III: Kinematics of particles - 3D (8 Hours)
Space curvilinear motion: rectangular coordinates, cylindrical coordinates, spherical coordinates.
Motion of a particle relative to 3D moving reference frame (translation).

Unit IV: 2D (Plane) Rigid body Kinematics (8 Hours)
Introduction, Translation, rotation about a fixed axis, general plane motion, absolute and relative velocity in plane motion, absolute and relative acceleration in plane motion, plane motion of a particle relative to rotating frame of reference.
Instantaneous center of rotation in plane motion.

Unit V: 3D Rigid body Kinematics (8 Hours)
Translation, fixed-axis rotation, parallel-pane motion, rotation about a fixed point, 3D motion of a particle relative to a rotating frame of reference.
Body and space cone, angular momentum: moments and products of inertia.

Text Books:

Reference Books:


Course Outcomes:

The student will be able to –

1. Perform the kinematic analysis using vector approach.
2. Develop and use the relative motion equations that relate the velocity and acceleration of two points.
3. Analyse the relative kinematics of two points whose motion are constrained by taut inextensible cables.
4. Develop and use the velocity and acceleration equations for the analysis of planar motion of rigid bodies.
5. Solve kinematics problem involving 2-D and 3-D moving reference frame.
ME412THP: HEAT EXCHANGE DEVICES

Credits: 04
Teaching Scheme: 03 Hours / Week

Unit 1: Introduction to Heat Exchange Devices (6 Hrs)
Engineering significance, Classification, Selection and Applications, LMTD, e - NTU methods. Introduction to fouling, Introduction to TEMA standards, Constructional details of different Heat Exchangers

Unit 2: Basic Thermal Design Theory-The LMTD approach (8 Hrs)
Heat transfer and pressure loss, Flow configuration, Exchanger Analysis: Logarithmic mean temperature difference for parallel and counter flow heat exchangers, LMTD correction factor. Consideration of fouling factor in the analysis, Selection of appropriate correlations for heat transfer and pressure loss. LMTD correction factors charts for various Heat Exchangers

Unit 3: Basic Thermal Design Theory-The e - NTU approach (6 Hrs)
The e - NTU method for parallel and counter flow heat exchangers. Design considerations for heat exchangers. Introduction to compact heat exchanger, Introduction to heat pipes

Unit 4: Additional Considerations in Thermal Design of Heat Exchangers (8 Hrs)
Design standards and codes, key terms in heat exchanger design, material selection, and thickness calculation for major components such as tube sheet, shell, tubes, flanges and nozzles, Introduction to Helical baffle heat exchangers and their design considerations

Unit 5: Cooling Towers, Condensing System (6 Hrs)
Design of surface and evaporative condensers, Introduction to Cooling towers and their design and selection aspects.

Unit 6: Introduction to Simulation and Optimization (6 Hrs)
Modeling and commercial codes. Introduction to simulation and optimization of heat exchangers.

Text Books:

Reference Books:

Course Outcomes:
The student will be able to –
1. Know common heat exchanger types, their advantages, limitations and applications
2. Understand use and significance of heat transfer and pressure loss for flow configurations
3. Apply thermal design of heat exchanger and fouling considerations
4. Know how to incorporate Mechanical design and awareness of TEMA standards in designing heat exchanger
5. Understand design and selection aspect of Condensers and cooling towers
6. Understand the concepts of modeling and simulation used for optimization of heat exchangers

Project Based lab

Teaching Scheme: 02 Hours / Week

List of Projects:
Project 1: Design of Heat Exchanger for sizing-C02 (Unit No II)
Project 2: Design of Heat Exchanger for rating-C03 (Unit No III)
Project 3: Design of Multi pass/Cross flow Heat Exchanger-C04 (Unit No IV)

* For above projects, any one methodology (Analytical/Numerical/Experimental) can be incorporated in the project work.
ME413TLP: POWER PLANT ENGINEERING

**Credits:** 04  
**Teaching Scheme:** 3 Hours / Week

**Unit I: Introduction to Power Plants (8 Hrs)**
Schematic Diagrams and relative merits of Steam, Gas, Diesel and Hydro Power Plants, Factors affecting Selection of site, Nuclear Power Plants Classification, Types of Various Reactors with working of various Components.

Present status of Power generation in India. Nuclear Power plants In India, Waste Disposal of nuclear power plants, VVER power plants.

**Unit II: Improved Rankine Cycle (08 Hrs)**
Improved Rankine Cycle, Rankine Cycle with Reheating and Regeneration, Steam Power Plants with process heating (reheating, regeneration and combined reheat regeneration).

**Unit III: High pressure and steam Nozzles (06 Hrs)**
High Pressure Boilers, High pressure boilers types, construction and working, Principle of Fluidized bed combustion, Types of fluidized bed combustion boilers (CFBCB, PFBCB), Introduction to steam nozzles and Nozzle theory

**Unit IV: Essential Components of the power plants (05 Hrs)**
DM Plant and water treatments, Ash handling & dust collection, Introduction to steam turbines, Equipments used for handling, storage, preparation, feeding, burning of coal fired boilers, Air Preheater, superheater, fuel treatment unit

**Unit V: Steam Condensers (07 Hrs)**
Necessity of condensers, types of condensers, Dalton’s law of partial pressures, condenser vacuum and vacuum efficiency, condenser efficiency, air pumps, capacity of air extraction pumps, cooling water requirements.

Cooling towers and cooling ponds

**Unit VI: Economics of Power Generation (06 Hrs)**
Load duration, load curves, demand factor, average factor, capacity factor, reserve factor, diversity factor, plant use factor, construction of load duration curves, effect of variable load on power plant design and operation. Selection of power plant from site to waste disposal, life cycle costing, Fuel costs, Present worth concept.

**Text Books**
3. Yadav R “Steam and gas turbines and Power Plant Engineering”,, Central publishing house

**Reference Books**
2. Sharma P. C., “Power Plant Engineering”, S. Kataria and sons, New Delhi
3. Wesisman and Eckart “Modern Power Plant Engineering”, Prentice Hall of India
Course Outcomes:
The student will be able to –
6. Compare different power plants, their present status and recent trends.
7. Do Mathematical analysis of Improved Rankine cycle and condenser
8. Compare different high pressure boilers and do the analysis of nozzle
9. Demonstrate essential and supplementary Power plant components
10. Perform Testing of thermal power plant and data analysis to draw conclusions
11. Perform analysis for power plant economics.

Project and lab Based lab

Teaching Scheme: 2 Hours / Week

List of Projects:

List of labs: Any 5 of the following

6. Trial on Diesel power plant to determine the optimum load (CO 5)
7. Trial on steam power plant to determine the optimum load (CO 5)
8. Industrial visit to power plant and a detailed visit report (CO1 & CO5)
9. Trial and demonstration of a boiler feed water treatment. (CO4)
10. Study and demonstration of power plant instrumentation (CO4)
11. Study and demonstration of High pressure boiler (CO 4)
12. Study and demonstration of FBCB pressure boiler (CO4)

List of project:

Project 1: A survey type Project based on conventional power plants (CO 1)

Project 2: A survey type Project based on nuclear power plant (CO 1)

Project 3: A report based on Power plant auxiliaries specifications of any power plant (including turbine, condenser, feed pumps, boilers, coal handling systems, ash handling, water treatments, cooling towers, boiler mountings and auxiliaries, control strategy, waste management etc.) (CO1 & CO5)
ME 414THP: TURBOMACHINES

Credits: 4
Teaching Scheme: 3 Hours / Week

Unit 1: Introduction (8 Hours)
Basic definitions, Velocity Triangles, Euler Blade eqn, Vane congruent flow, effect of vane thickness, slip

Unit 2: Dimensional Analysis (4 Hours)
Non-dimensional parameters, scaling laws, Prototype prediction using model tests

Unit 3: Centrifugal machines (8 Hours)
Design and analysis of Centrifugal Blowers, Compressors and Pumps, cavitation, operating point

Unit 4: Axial Compressors (8 Hours)
Design Point and Off-design point analysis, loss estimation, efficiency determination

Unit 5: Gas and Steam Turbines (8 Hours)
Gas, Steam and wind Turbines: analysis

Unit 6: Hydraulic Turbines (6 Hours)
Design Procedure, cavitation analysis

List of Project areas: (For THP, TLP courses)
1. Design of a Centrifugal Fan/ Pump
2. Design Point and Off-design point analysis of an axial compressor stage
3. Design of a hydraulic turbine

Text Books:

Reference Books:


Course Outcomes:

The student will be able to –

Understand the basic principles of turbomachines
Understand the scaling laws and be able to predict prototype performance
Analyse and design centrifugal machines, operating point analysis, cavitation
Analysis of axial compressors and estimation of performance at design and off-design points
Analysis of gas, steam and wind turbines
Design and analysis of hydraulic turbines and cavitation check
**ME 415THP : Industrial Fluid power**

Credits: 04        Teaching Scheme: 3 Hours / Week

Unit 1: Introduction to Fluid Power
Fluid power systems: Components, advantages, applications. Hydraulic fluids, Properties of fluids, selection of fluids, sources of contamination and contamination control. Pipes, hoses, connectors, seal. Accumulators: Types, selection/design procedure, applications of accumulators.

Unit 2: Hydraulic Pumps
Pumps: Types, classification, working and constructional details, characteristics. Power units and accessories, Types of power units, reservoir assembly.

Unit 3: Fluid Power Control
Control of fluid power, pressure control, directional control, flow control valves. Direct operated and pilot operated relief valves, pressure reducing valve, Principle of flow control valves, pressure compensated, temperature compensated flow control valves, directional control valves: types, constructional details, characteristics, centre positions. Cartridge valves.

Unit 4: Actuators and Hydraulic circuits
Linear and Rotary actuators, types, constructional details, characteristics. Hydraulic circuits for different applications. symbols of fluid power components, trouble shooting.

Unit 5: Pneumatics
Conditioning of compressed air, compressed air distribution system, filters, regulators, lubricators, mufflers, dryers. Direction control valves, rotary and reciprocating actuators, logic elements, pneumatic and electro pneumatic circuits for different applications.

Unit 6: System Design
Design of hydraulic/pneumatic circuits for practical applications, Selection of different components

**Text Books:**
1 A. Esposito - ‘Fluid Power with application’, Pearson Education, New Delhi
2 Peter Croser, Frank Ebel; ‘Pneumatics’; Festo Didactic GmbH & Co
Reference Books:
1 D.A.Pease – ‘Basic Fluid Power’, Prentice hall
3 Yeaple F; ‘Fluid Power Design Handbook’;MarcelDekker,Newyork
4 Vickers ; Industrial Hydraulics Manual
5 D.Merkle, B.Schrader,M.Thomes;’Hydraulics’; Festo Didactic GmbH & Co
6 ISO 1219;Fluid Systems and components, Graphic Symbols
7 Sullivan James A;’Fluid Power Theory &Applications’; Prentice Hall, New Jercy

Course Outcomes:
The student will be able to –
1. Illustrate the selection of components hydraulic systems.
2. Evaluate the performance of hydraulic pumps..
3. Analyze the performance of hydraulic control valves and develop simple hydraulic circuits.
4. Evaluate the performance and applications of hydraulic actuators.
5. Understand the components of pneumatic systems and develop simple pneumatic circuits.
6. Design simple hydraulic and pneumatic systems based on applications.

Project based Lab

Teaching Scheme: 02 Hours / Week

List of Projects:
1. Performance evaluation of gear pump in hydraulic system.
2. Speed control of hydraulic actuators (meter in and meter out circuit).
3. Design the hydraulic actuator for application.
ME416THP: ROBOTICS

Credits: 04
Teaching Scheme: 03 Hours / Week

Unit 1: Introduction to Robotics (7 Hours)


Unit 2: Robot Direct and Inverse Kinematics (7 Hours)

Description of links and joints, Kinematic modeling of manipulator, Denavit - Hartenberg Notation, Kinematic relationship between adjacent links, Manipulator transformation matrix Inverse kinematics – Meaning, Manipulator workspace, Solution Techniques, Guidelines for closed form solutions, Geometric approaches for inverse kinematics.

Unit 3: Trajectory Planning and Manipulator Control (7 Hours)

Terminology, Steps in trajectory planning, Joint space techniques, path description, Use of polynomials as interpolating function, various trajectories, Introduction to Cartesian space techniques.
Manipulator Control – Manipulator control problem, Linear control of manipulators, 2nd order control systems, Modeling and control of a single joint, Control law partitioning, introduction to force control.

Unit 4: Manipulator differential motion and Dynamic Modeling (7 Hours)

Relationship between transformation matrix and angular velocity, Manipulator Jacobian, Jacobian inverse, Jacobian singularities.
Dynamic modeling – Lagrange Euler approach, Lagrangian mechanics, Manipulator dynamic model, LE formulation, equations of motion, Use of dynamic model for study of torque variations, Inverse dynamics.

Unit 5: End effectors, sensors and vision system (6 Hours)

Tools as end effectors, Robot Grippers - Types of Grippers, Design aspect for gripper, Force analysis for various basic gripper system.
Sensors for Robots - Characteristics of sensing devices, Classification, applications and selection of sensors.
Robotic vision system, image acquisition, spatial and amplitude digitization, image processing and analysis.

**Unit 6: Robotic System design and applications (6 Hours)**

Correlation between robot design and task to be performed, Manipulator Mechanism design, kinematic configuration, redundant and closed chain structures, Actuation schemes, position and force sensing.

Robot Programming – Methods, Leadthrough methods, A robot program as a Path in Space, Motion interpolation, capabilities and limitations of Leadthrough methods, robot languages, commands, program control and subroutines.

Robot applications in material handling, machine loading / unloading, assembly, inspection and processing. Robot Operation: Hydraulic, pneumatic and electrical actuators, characteristics and comparison.

**ROBOTICS - PROJECT BASED LABORATORY**

**Teaching Scheme: 02 Hours / Week**

Robotics Project based lab includes (not limited to) any one of the following projects:
1. Validation of End effector transformation matrix of an industrial robot using suitable software and Matlab.
2. Generalized Matlab code for determination of end effector transformation matrix of an industrial robot.
3. Motion study and simulation of a robotic manipulator using Adams.
4. Motion study and simulation of a robotic manipulator using suitable software.
5. Trajectory planner for a robotic manipulator using Matlab.
6. Stress distribution analysis of a robotic manipulator throughout the work cycle for SCARA Industrial Robot and subsequent design of various links.
7. Vigilance / patrolling system using image processing and micro-controller (use of gripper recommended).
8. Robot programming using Robotic lego-kit or FIREBIRD V (use of sensors, gripper recommended).

**Text Books: (As per IEEE format)**

Reference Books: (As per IEEE format)


Course Outcomes:

The student will be able to -
1. solve the manipulator transformations with knowledge of robotic system components and matrix algebra.
2. solve robot forward and inverse kinematic problems.
3. carry out trajectory planning and joint modeling for the simple robotic system.
4. carry out velocity analysis and dynamic modeling for a manipulator.
5. identify appropriate end effectors and sensors for particular application.
6. execute various steps in robot design and robot programming.
ME417THP: FINITE ELEMENT METHODS

Credits: 04  
Teaching Scheme: 3 Hours / Week

Unit 1: Fundamental Concepts  
(7 Hours)
Stresses and equilibrium, boundary conditions, strain displacement relation, temperature effect, potential energy and equilibrium, Galerkin’s method, Integral formulation for Numerical Solution-Variational method, Collocation method, Galerkin’s method. Von Mises stress theory, minimum potential energy method

Unit 2: One Dimensional Problems  
(6 Hours)
Linear element, Solution by Galerkin’s method, solution for nodal residual equation, Obtaining elemental stiffness and load matrices form the above equation. Application of the above equation for Problems like, axially loaded bar (Self weight consideration), temperature distribution analysis.

Unit 3: Two Dimensional Finite Elements  
(6 Hours)
Bilinear Rectangular elements, Shape function for the same. Local co-ordinate system, significance of natural co-ordinate system, Natural co-ordinate systems for linear element and for linear triangular element, Local co-ordinate system for Bilinear Rectangular elements.Isoparametric representation for triangular element

Unit 4: Two Dimensional FEA Modeling  
(7 Hours)
Formulation of 2D elemental stiffness matrix and global stiffness matrix, formulation of global load vector, stress calculation, temperature effect, problems based on plane trusses, problems by using triangular elements.

Unit 5: Two Dimensional FEA Applications  
(9 Hours)

Unit 6: Introduction to Dynamic Analysis using Finite Element  
(5 Hours)
Introduction to types of dynamic problem, Equations of motion based on weak form, Axial vibration of a rod, Transverse vibration of a beam.
Project based lab

Project based lab includes (not limited to) any one of the following projects:
1. Validation of any mechanical design problem through ANSYS or MATLAB etc
2. Design a MATLAB code for solving 1D problems
3. Design a MATLAB code for solving 2D problems
4. Perform thermal analysis of an IC engine cylinder.
5. Perform analysis of turbine blade.

Text Books:

Reference Books:

Course Outcomes:

1. use different weighted residual methods and variational method to obtain preliminary approximate solution to a governing differential equation of a system.
2. formulate and solve mechanical system involving 1D elements.
3. transform systems in different coordinate systems and use Isoparametric property to solve different problems involving triangular elements.
4. formulate and solve mechanical system involving two degrees of freedom.
5. explain background working of and solve engineering problems using commercial FEA code like ANSYS, NASTRAN,MATLAB etc.
6. able to find response of the system as a function of time given the external disturbances using finite element method
ME418THP: OPTIMIZATION TECHNIQUES AND OPERATIONS RESEARCH

Credits: 04
Teaching Scheme: 03 Hours / Week

Unit 1: Single Variable optimization Algorithms
(8 Hours)

Unit 2: Multivariable and Constrained optimization Algorithms
(8 Hours)

Unit 3: Linear Programming
(8 Hours)
Linear Programming, Formulation of LP Problem, Standard Form, Solution using Simplex Method, Duality, Special Conditions in LPP, Economic Interpretation of Dual, Solution of LPP using Duality concept, Dual Simplex Method, Sensitivity Analysis, Big M method, two phase method. Solution of LPP using TORA & Solver in Excel

Unit 4: Important Topics in Operations Research - I
(6 Hours)
Transportation problem modeling, Assignment and Sequencing model, Dynamic Programming, Decision / Game theory, Forecasting.

Unit 5: Important Topics in Operations Research - II
(6 Hours)
Inventory models, Queueing Theory and Models, Network Analysis,

Unit 6: Modern / Evolutionary Optimization Methods
(6 Hours)
Introduction to Evolutionary Algorithms, Genetic Algorithm, Fuzzy Logic, Artificial Neural Network based optimization methods. Shape and Topology Optimization, Parametric Optimum design using FEA solvers
**Text Books: (As per IEEE format)**

4. Paneerselvam,“Operations Research”, Prentice Hall of India

**Reference Books: (As per IEEE format)**


**Course Outcomes:**

1. The student will be able to understand and use the single variable optimization algorithm to solve different problems
2. The student will be able to select appropriate algorithm and implement it for multi-variable and constrained optimization problems.
3. The student will be able to formulate linear programming problem and apply different linear programming methods to solve it.
4. The student will be able to formulate managerial decision problems into inventory model, game theory problem and queueing theory problem.

5. The student will be able to use mathematical software for the solution of engineering problems with conventional and evolutionary algorithms.
ME 419THP : NON-CONVENTIONAL ENERGY SOURCES

Credits: 4  
Teaching Scheme: 3 Hours / Week

Unit 1: Introduction to Energy Sources  
(6 Hours)

Energy scenario, energy and development, energy consumption, energy demand and availability, energy crisis, energy and environment, sources of energy – conventional and non-conventional, non-renewable and renewable, Need for alternative energy sources, Prospects and potential of non-conventional energy sources

Unit 2: Solar Thermal Energy  
(7 Hours)

Solar radiation, solar thermal energy conversion, solar energy collectors, solar energy storage, solar energy applications, solar thermal power plant, Passive building

Unit 3: Ocean Energy  
(7 Hours)

Ocean thermal energy conversion, open, closed and hybrid cycles, Tidal energy conversion principle, single and double basin arrangements, Wave energy conversion devices, Tidal power plant

Unit 4: Wind Energy  
(7 Hours)

Wind energy conversion principle, wind energy conversion systems, wind energy collectors, applications of wind energy, Site selection considerations for wind energy applications, Material selection for geothermal power plants

Unit 5: Biomass and other alternate sources  
(7 Hours)

Biomass conversion, biogas generation, biogas plants, biomass gasification, Hydrogen as an alternative fuel, Fuel cell

Unit 6: Geothermal energy and other sources  
(6 Hours)

Geothermal energy conversion cycles, Hydrothermal and petrothermal resources, Magneto-hydro-dynamic (MHD) power generation principle and systems

Text Books: (As per IEEE format)
1. G. D. Rai, Non-conventional Energy Sources, Khanna Publishers
2. S. Rao and Dr. B. B. Parulekar, Energy Technology – Nonconventional, Renewable and Conventional, Khanna Publishers

**Reference Books: (As per IEEE format)**

1. G. S. Sawhney, Non-conventional Energy Resources, PHI
2. Chetan Singh Solanki, Renewable Energy Technologies – A practical guide for beginners, PHI

**Course Outcomes: (Theory + Projects)**

The student will be able to –

1. Compare different non-conventional sources of energy
2. Compute efficiency of solar energy collectors
3. Explain different ocean energy conversion systems
4. Evaluate performance of wind energy conversion system
5. Illustrate applications of biomass energy and fuel cell technology
6. Describe Geothermal and Magneto-hydrodynamic (MHD) power generation systems

Projects may be based on the following points

P1: Design a solar water heating system
P2: Analyse an ocean energy conversion system
P3: Design of wind turbine power plant
ME 420THP : AUTOMOBILE ENGINEERING

Credits: 4                          Teaching Scheme: 3 Hours / Week

Unit 1: Basic Concepts, Engines and Clutches (6 Hours)

Vehicle specifications, classification, layout, applications. Engine components, basic engine nomenclature, engine classification, working of four stroke & two stroke engines, valve timing diagrams, port timing diagrams, engine selection criteria for different automotive applications, Clutches: purpose of clutch, classification, single plate clutch, multiple plate clutches, centrifugal clutch, cone clutch, diaphragm spring clutch, vacuum operated clutch, clutch plate, lining material.

Unit 2: Gearbox (7 Hours)

Function, various resistances, tractive effort, performance curves, power required for acceleration and gradability, selection of gear ratio, sliding mesh gearbox, constant mesh gearbox and synchromesh gearbox, epicyclic gearbox, torque converter, automatic transmission, overdrive.

Unit 3: Steering System, Wheels and Tyres (7 Hours)

Purpose, requirement, steering mechanisms, wheel alignment and wheel balancing, centre point steering, cornering force, slip angle, scrub radius, steering characteristics, steering gearboxes, power steering, Wheels and Tyres.

Unit 4: Propeller Shaft, Universal joints, Differential and Rear Axle (7 Hours)

Propeller shaft, universal joints, final drive, differential and their types, rear axle arrangements, two speed rear axle, single, double and triple reduction rear axles, driving thrust, torque reaction, Hotchkiss drive, Torque tube drive.

Unit 5: Suspension System (7 Hours)

Suspension System
Object, various types of springs, shock absorbers, sprung weight and unsprung weight, basic suspension movements, conventional suspension system, independent suspension systems, air suspension, hydroelastic suspension, hydra-gas suspension, interconnected suspension, self leveling suspension.

Unit 6: Braking System & Automotive Electricals (6Hours)

Braking System
Purpose, stopping distance and time, braking force, brake efficiency, classification, Mechanical, hydraulic, air brakes, servo-braking systems, antiskid braking system.

Automotive Electricals
Battery, Ignition system. Starting system, Charging system, Dashboard instruments

List of Projects

1: Preventive maintenance, trouble shooting and diagnosis of gearbox
2: Preventive maintenance, trouble shooting and diagnosis of steering system
3: Preventive maintenance, trouble shooting and diagnosis of differential and rear axle
4: Preventive maintenance, trouble shooting and diagnosis of suspension system

Text Books:


Reference Books


Course Outcomes:

Structure and syllabus Final year B. Tech Mechanical Engineering, Pattern A-14 revised, A.Y. 2017-18
The student will be able to-
1. Describe construction, working and other details of Internal Combustion Engines and Clutches
2. Demonstrate knowledge about construction, working and other details of different Gearboxes
3. Understand and explain about construction, working and other details of Steering system, Wheels and Tyres
4. Demonstrate knowledge about construction, working, and other details of Propeller Shaft, Universal joints, Differential and Rear Axle
5. Describe construction, working and other details of Suspension System
6. Describe construction, working and other details of Braking System and Automotive electrical components
ME 421THP: HYBRID-ELECTRIC VEHICLES – PERFORMANCE AND ENVIRONMENT IMPACT
(Online course as per PurdueNext)

Credits: 04  Teaching Scheme: 3 Hours / Week

Unit 1: GLOBAL GROUND TRANSPORTATION SECTOR  (6 Hours)
Motivation for Hybrids, Increase in Transportation Demand, Motivation and Plant to Well Analysis, Well to Plant Analysis and Well To Wheel analysis, Comparison of Conventional Vs. Hybrid Vehicles, Factors Affecting Vehicle Fuel Economy

Unit 2: DEFINITION OF HYBRIDIZATION AND HYBRID VEHICLES  (8 Hours)
What is a Hybrid Electric Vehicle, Hybridization Basics, Hybrid Vehicle Classification

Unit 3: VEHICLE DYNAMICS AND ENERGY FLOW (6 Hours)
Vehicle Requirements, Introduction to Autonomie, Introduction to Autonomie

Unit 4: HYBRID DRIVETRAIN CHARACTERIZATION (6 Hours)
System Components, Typical ICE Engine Efficiency Maps

Unit 5: HYBRID DRIVETRAIN SYSTEM COMPONENTS (6 Hours)
Electric Motors, System Components: Energy Storage, System Components for Different HEV Architectures

Unit 6: HYBRID ARCHITECTURES
A Vehicle Powertrain Architecture, HEV Base Operational Definitions, Hybrid Architecture Selection, Architecture and Component Selection

List of Project areas:
1. Drive cycle study and analysis
2. Energy and Power calculations based on drive cycle
   3. Hybrid Electric vehicle component sizing
   4. Environmental impact analysis of a Hybrid Electric Vehicle

Text Books:
Transcripts, slides and demonstration of Purdue Next online course
Reference Books:
Transcripts, slides and demonstration of Purdue Next online course

Course Outcomes:
The student will be able to –
1. Appreciate and demonstrate general overview of the need for hybrid-electric vehicles (HEVs) for transportation and environmental improvement possible using HEVs.
2. Study and understand the emission norms and its impact on automobile sector
3. Demonstrate and evaluate various architectures of HEVs.
4. Analyze various architectures of HEVs.
5. Demonstrate and evaluate various components of HEVs
6. Design the HEV with energy balance, sizing and well to wheel analysis
ME409PRJ: MAJOR PROJECT
(Duration: - One Semester)

Credits: 05 Contact Hours/Week: 10, Project based Lab

Prerequisite: Basic knowledge of Science and Engineering

Objectives:
• To make them aware in the selection of domain, area and topic of their interest
• To orient the students to identify the problem precisely, analyze the same and subsequently do the synthesis.
• To orient the students to apply their knowledge preferably to real life engineering problem solving
• To evolve students in conceptual, lateral, and out of box thinking
• To provide an opportunity to them to acquire hands on experience of manufacturing processes
• To provide platform to learn how to work in a group and gain basic management skills
• To expose them to the process of selection of manufacturing methods, materials, fits and tolerances, assembling and disassembling of system, equations or correlations, boundary conditions, input parameters, dependent and independent variables, technical data, analysis techniques, data generation techniques etc.
• To give an exposure to selection of Standards, Standard processes, Standard Techniques, Standard components, Standard Mechanisms, Standard measuring and regulating instruments etc

The project work shall contain:
Design/Development/Retrofitting/Fabrication/Atomization/Optimization/Modeling/Coding/Simulations/Experimental-analysis/Computational-analysis/Mathematical-analysis/Use of analogies/Use of commercially available software/Use of available codes/Use of open source codes and software’s/Performance improvements of Mechanism/Machine/Model/Prototype/System based on existing/new ideas/principle etc.

Energy audit/conservation/management, Use of renewable energy sources etc.
Validation or Bench marking of the outcome/ results

A report containing maximum 30 pages (printed on both sides excluding certificate, permission letter, and title pages) shall be submitted based on the background, motivation and scope of the project, project specifications, activities involved in the project and activity plan, literature review made, basic theory, details of methodology adopted and data reduction, results and discussions, conclusions extracted and proposed future work (if any) followed by referencing and appendices (if any).

Outcomes:
The student shall be able to:

- Define/Develop/Select methodology for executing the project work
- Apply theoretical concepts for solving the project problem, decide and apply the manufacturing techniques and instrumentation
- To develop the procurement skills
- To assemble and demonstrate the working model
- To develop skills of technical report writing and presentation

**Guidelines:**

- Report shall be typed and printed in standard format.
- Figures and tables shall be at appropriate positions, with numbers and captions.
- Project title and approval sheets shall be attached at the beginning of the report followed by Index and Abstract of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students with GR No and Roll No shall be included on every certified project report copy.
- Each group of students shall submit to the concerned the required number of copies of project reports as decided by the department and one copy shall be prepared for each individual student.
- The project work shall be taken up individually or in a group consisting of not more than 4 students.

**References:**

2. Cited Papers from Journals and Conferences
3. Already available literature from open source
Structure for B.TECH. Mechanical Engineering
(Pattern A-14 Revised)
Academic Year – 2017-18
Option-B (six months internship based)

Module-VIII
ME406NT: Industrial In-Plant Training

Semester long (minimum 14 weeks) industrial training in Mechanical Industries

Course Outcomes:
1. Students will be able to correlate the theoretical and practical concepts
2. Students will be able to understand various processes of product developments and services
3. Students will be able to understand industrial works and management
4. Students will be able to demonstrate verbal, written and graphical communication skills.
5. Students will be able to undertake technical discussions.
ME409PRJ: MAJOR PROJECT
(Duration: - One Semester)

Credits: 05 Contact Hours/Week: 10, Project based Lab

Prerequisite: Basic knowledge of Science and Engineering

Objectives:
- To make them aware in the selection of domain, area and topic of their interest
- To orient the students to identify the problem precisely, analyze the same and subsequently do the synthesis.
- To orient the students to apply their knowledge preferably to real life engineering problem solving
- To evolve students in conceptual, lateral, and out of box thinking
- To provide an opportunity to them to acquire hands on experience of manufacturing processes
- To provide platform to learn how to work in a group and gain basic management skills
- To expose them to the process of selection of manufacturing methods, materials, fits and tolerances, assembling and disassembling of system, equations or correlations, boundary conditions, input parameters, dependent and independent variables, technical data, analysis techniques, data generation techniques etc.
- To give an exposure to selection of Standards, Standard processes, Standard Techniques, Standard components, Standard Mechanisms, Standard measuring and regulating instruments etc

The project work shall contain:
Design/Development/Retrofitting/Fabrication/Atomization/Optimization/Modeling/Coding/Simulations/Experimental-analysis/Computational-analysis/Mathematical-analysis/Use of analogies/Use of commercially available software/Use of available codes/Use of open source codes and software’s/Performance improvements of Mechanism/Machine/Model/Prototype/System based on existing/new ideas/principle etc.

Energy audit/conservation/management, Use of renewable energy sources etc.
Validation or Bench marking of the outcome/ results

A report containing maximum 30 pages (printed on both sides excluding certificate, permission letter, and title pages) shall be submitted based on the background, motivation and scope of the project, project specifications, activities involved in the project and activity plan, literature review made, basic theory, details of methodology adopted and data reduction, results and discussions, conclusions extracted and proposed future work (if any) followed by referencing and appendices (if any).
Outcomes:
The student shall be able to;

- Define/Develop/Select methodology for executing the project work
- Apply theoretical concepts for solving the project problem, decide and apply the manufacturing techniques and instrumentation
- To develop the procurement skills
- To assemble and demonstrate the working model
- To develop skills of technical report writing and presentation

Guidelines:

- Report shall be typed and printed in standard format.
- Figures and tables shall be at appropriate positions, with numbers and captions.
- Project title and approval sheets shall be attached at the beginning of the report followed by Index and Abstract of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students with GR No and Roll No shall be included on every certified project report copy.
- Each group of students shall submit to the concerned the required number of copies of project reports as decided by the department and one copy shall be prepared for each individual student.
- The project work shall be taken up individually or in a group consisting of not more than 4 students.

References:
2. Cited Papers from Journals and Conferences
3. Already available literature from open source
ME408CVV: Comprehensive Viva Voce (CVV)

The CVV will be conducted on the basis of following

ME406NT: Industrial In-Plant Training

ME409PRJ: Major Project

Course Outcomes:
1. Students will be able to exhibit the theoretical concept.
2. Students will be able to demonstrate verbal, written and graphical communication skills.
3. Students will be able to undertake technical discussions.