F Y M Tech Mech Engg (MED) Semester - II										
Course Code	**Course Title**	**Teaching Scheme Hours /Week**			**Examination Scheme**				**Marks**	**Credit**
		Lecture	**Tutorial**	**Practical**	**In Semester**	**End Semester**	**Oral**	**Practical**		
MED1201	Automation and Control Technology	3	0	0	50	50	0	0	100	3
MED1202	Vibration and Acoustic	3	0	0	50	50	0	0	100	3
MED1203	Finite Element Analysis	3	0	0	50	50	0	0	100	3
MED1204	Design & Optimization	3	0	0	50	50	0	0	100	3
PEMED1201	Elective II	3	0	0	50	50	0	0	100	3
MED1205	Automation and Control Technology Lab	0	0	2	0	0	25	0	25	1
MED1206	Vibration and Acoustic Lab	0	0	2	0	0	25	0	25	1
MED1207	Finite Element Analysis Lab	0	0	2	0	0	0	25	25	1
MED1208	Seminar	0	2	0	0	0	50	0	50	2
AC 1201	Audit Course*	0	0	2	0	0	0	0	0	0
Total		**15**	**2**	**8**	**250**	**250**	**100**	**25**	**625**	**20**
Grand Total		**25**			**625**				**625**	**20**

Elective II: (Programme)

1. Computational Fluid Dynamics
2. Design for Manufacture and Assembly
3. Heat Exchanger Design

Audit Course

1. Soft Skills and Business Communication
2. Entrepreneurship Development

DEAN ACADEMICS
MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

Principal
MKBSS's Cummins College of Engg. For Women, Karvenagar, Pune-52

APPROVED BY
Governing Body Members
MKSSS's Cummins College of Engineering for Women Karvenagar, Pune-411052

MED 1201 Automation and Control Technology

Teaching Scheme: **Examination Scheme:**

Lectures: 3 Hrs/week In Sem = 50 Marks

End Sem= 50 Marks

Credit: 3

Course Objective:

1) Study of an Automation System elements and types of Automation systems.
2) Understanding the Principles of Operations of Sensors, Transducers and Actuators.
3) Study of a Complete Mechatronics System design through various case studies.
4) Implementation of an Automatic Control technology through PLC, SCADA & HMI
5) Study of System Modelling, Stability concept and various modes of Controllers.

Course Outcomes:

At the end of the course

1) student will be able to correlate manufacturing and Electronics interfaces for automation of the systems.
2) Student will understand the working principle and apply the knowledge of sensors and Actuators through measurement, Signal conditioning for Automatic control systems.
3) Students will be able to identify the elements of Mechatronics and Automation Systems.
4) Students can apply the knowledge of Mechatronics System Design for automation of any Production line.
5) Students can remember and analyze the Mathematical Model for any Mechanical system.

Unit I: Introduction to Automation technology (7)

Automation & Its Importance, Mechanization Vs Automation, Automation Applications, Social Issues of automation, Elements of automated systems, advanced automation functions, levels of automation, types of automation, Fixed, programmable, flexible, Hard & soft automation, Fundamentals of automated production lines, material handling in automated systems, Group technology.

Automated guided vehicle (AGV) systems: types, guiding techniques, AGV system design, Inspection techniques in automation.

Unit II: Automatic Control System (5)

Control System Definition, Open loop and closed loop Control system, Examples, Feedback and Feed Forward Control System, Transfer Function. Block diagram reduction techniques, Signal flow Graphs-Mason's Gain Formula

Unit III: Transducers and Actuators (7)

Introduction and Elements of Mechatronics system, Measurement system,

Sensors and Transducers: Potentiometers, LVDT, Position Sensors, Optical Encoders, Proximity Sensor, Temperature Sensor, Strain Guage, Flow Sensors, Level and Pressure switch.

Actuators: Piezo and Shape Memory Alloy actuators, Stepper Motor, Servomotor, Solenoid Valve
Interfacing of various sensors and transducers using suitable kit.

Unit IV: Mechatronics System Design (7)
Traditional and Mechatronics design concepts. Mechatronics design process. Mechatronics Control in Automated Manufacturing, Signal Conditioning, D/A & A/D Conversion
Case Studies of Mechatronics system design- Car Engine Management System, Washing Machine, Pick and Place Robot, Conveyor based Material Handling System, PC based CNC Drilling Machine.

Unit V: Programmable Logic Controllers (PLC's) (7)
Introduction-Basic Structure, PLC operating Cycle, Specifications, Advantage of PLC over Relay system, Input and Output devices, Selection of PLC, Ladder Programming-Mnemonics-Timers, Counters, SCADA, MTU and RTU Functions, HMI.

Unit VI: System Modelling &Controller Modes (6)
System Models, Mathematical Model. Modelling of physical system-Mechanical, Thermal, Hydraulic system and Electrical Analogy.
Stability, Relative Stability, Poles and Zeros of System, Time domain Response.
Controller Modes: On-Off Modes, Proportional Control Mode, Integral Control Mode, Derivative Control Mode, Composite Control Mode: PI, PD and PID Controller.

Text Books:
1) M.P.Groover, Automation, Production systems and Computer Integrated Manufacturing, PHI learning Pvt. Ltd.
2) Industrial Automation: W.P. David, John Wiley and Sons.
3) Ogata K., "Modern Control Engineering" Prentice Hall of India
4) Nagrath I.J., & Gopal M, "Control system Engineering." Wiley Eastern Reprint
5) Michael B. Histand and David G. Alciatore : Introduction to Mechatronics and Measurement Systems, McGraw-Hill International Edition.
6) W. Bolton: Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Third Edition, Pearson Education (Low Price Edition).

Reference Books:
1) Devdas Shetty and Richard A. Kolk: Mechatronics System Design, PWS Publishing Company (An International Thomson Publishing Company).
2) C D Johnson, "Process Control Instrumentation Technology", Prentice Hall of India, New Delhi. ISBN: 8120309871
3) Nagrath and Gopal "Mathematical Modelling, Simulation and Analysis", MGH Pub.
4) Gary Dunning, "Introduction to Programmable Logic controller", Thomas Learning, edition, 2001.
5) Handbook of design, manufacturing and Automation: R.C. Dorf, John Wiley and Sons

MED 1202 VIBRATION AND ACOUSTICS

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 50 Marks
End semester: 50 Marks
Credit: 3

Prerequisite: Higher Engineering Mathematics, Applied Physics, Mechanical Vibrations

Course Objectives: Students should be able to,

1. To know the fundamentals of vibration through the complex problems with mathematical approach.
2. To know and able to determine the natural frequency of the multi degree freedom system.
3. To know the fundamentals of continuous and random vibrations.
4. To know the fundamentals of acoustics and India standards of Noise.
5. To know the sound absorbing materials and its practical application.
6. To know the measurement and control techniques of vibration and noise.

Course Outcome: Students will be able to,

1. An ability to solve the complex problems in vibration
2. An ability to measure the vibration and noise of machines/engines
3. An ability to do the modal analysis of beams
4. An ability to understand the lifelong learning through industry visit

Unit 1: Fundamentals of Vibration: 6

Introduction, Definition, Types of vibration, Phenomenon of beats, Harmonic motion representation by vector method, complex number method, complex algebra method, Harmonic analysis by Fourier Series Expansion, Complex Fourier Series, Time and Frequency domain, Even and Odd function, Half-Range function.

Unit 2: Two Degree of Freedom System 6

Introduction, Free and Forced- undamped and damped vibrations- equation of motion, generalized coordinates and coordinate coupling, Natural Frequencies and Mode shapes (Eigenvalues and Eigenvectors) Modal Analysis of free and forced undamped and damped vibrations, Matrix iteration method.

Unit 3: Multi Degree of Freedom Systems 6

Introduction, Free and Forced- undamped and damped vibrations- equation of motion, Influence coefficients, generalized coordinates and coordinate coupling, Natural Frequencies and Mode shapes (Eigenvalues and Eigenvectors) Orthogonal properties of normal modes, Modal analysis of free and forced undamped and damped vibrations, Matrix iteration method.

Unit 3: Introduction to Random Vibration 4

Introduction, Functions of Random variables, Random processes in time domain and frequency domain, Correlation Function of a Random Process, Power Spectral Density, Wide band and Narrow band processes.

Unit 4: Fundamentals of Acoustic **6**

Basic physics of sound, decibels, sound pressure level, sound intensity, sound fields, sound reflection, Logarithmic addition, subtraction and averaging, sound absorption and transmission, concept and governing equation with co-relation of each other, Noise Limits in India, Resonators and Filters.

Unit 5: **Acoustic of Rooms, Partitions, Enclosures and Barriers** 7

Sound absorbing materials, Sound insulation, Sound in rooms, Reverberation room, Sound proof room, Partition, Enclosures and Barriers, Mufflers and Silencers, Transmission and insertion loss in silencers and mufflers.

Unit 6: Measurement and Control Vibration and Noise- **6**

Vibration Noun graph and Acceptable vibration levels, Transducers and pickups for measurement of vibration and noise, FFT Analyzer, Impact Hammer, Vibration Exciter, Sound level meter, Vibration isolation, Isolator design for fixed base systems, Dynamic Vibrations Absorber, Active Vibration Control, Nosie source control, path control, noise control at the receiver, Impact noise control.

References:

1. Mechanical Vibrations, S S Rao, Pearson Education.
2. Mechanical Vibrations, Rao V Dukkipati, Narosa Publisher, New Delhi.
3. Random Vibration, Zach Liang and George C Lee, CRC Press Taylor & Francis Group
4. Random Vibrations, Loren D Lutes and Shahram Sarkani, Elsevier B-H UK
5. Noise and Vibration Control, M L Munjal IISc Press, World Scientific
6. Acoustics of Ducts and Mufflers. M L Munjal John Wiley and sons, New York
7. Mechanical Vibrations and Industrial Noise Control. Lasithan L G PHI Learning P Ltd. New Delhi.

MED1203 Finite Element Analysis

Teaching Scheme
Lecture: 3 Hrs/week
Tutorials: Nil

Examination Scheme
In semester: 25 marks
End semester: 50 marks
Credits: 3

Pre-Requisites:
Advanced Mathematics and Numerical Techniques

Course Objectives:
1. To understand the philosophy and general procedure of Finite Element Method as applied to solid mechanics and thermal analysis problems.
2. To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
3. To provide a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
4. To study approximate nature of the finite element method and convergence of results are examined.
5. To provide some experience with a commercial FEM code and some practical modeling exercises

Course Outcome:

On completion of the course, students will be able to -
1. understand the different techniques used to solve mechanical engineering problems.
2. derive and use 1-D and 2-D element stiffness matrices and load vectors from various methods to solve for displacements and stresses.
3. apply mechanics of materials and machine design topics to provide preliminary results used for testing the reasonableness of finite element results.
4. explain the inner workings of a finite element code for linear stress, displacement, temperature and modal analysis.
5. use commercial finite element analysis software to solve complex problems in solid mechanics and heat transfer.
6. interpret the results of finite element analyses and make an assessment of the results in terms of modeling (physics assumptions) errors, discretization (mesh density and refinement toward convergence) errors, and numerical (round-off) errors.

Unit 1: Introduction to Finite Element Method

Finite element method, brief history, basic steps, advantages and disadvantages, weak formulation, variational methods of approximation – Rayleigh-Ritz methods, Methods of Weighted Residuals (Galerkin, Least-squares & Collocation methods), Variational formulation of 1D bar and beam elements (Euler Bernoulli and Timoshenko beam) – governing equation, domain discretization, elemental equations, assembly and element connectivity, application of boundary condition, solution of equations, post processing of the results.

Unit 2: Iso-parametric Elements and Formulation of Plane Elasticity Problems
Introduction, shape functions – linear & quadratic, displacement function – criteria for the choice of the displacement function, polynomial displacement functions, displacement function in terms of nodal parameters, strain-nodal parameter relationship, stress-strain relationship, element stiffness matrix, convergence of iso-parametric elements, numerical integration – Trapezoidal rule, Simpson's 1/3 rule, Newton-Cotes Formula, Gauss Quadrature formula, Gauss Quadrature in two and three dimensions

Unit 3: Nonlinear Problems – Geometric, Material and Contact Problems
Introduction to non-linear analysis, formulation for geometrical, material and contact nonlinear problems, Nonlinear equation solving procedure - direct iteration, Newton-Raphson method, modified Newton-Raphson method, incremental techniques

Unit 4: Dynamic Problems – Eigen value and Time Dependent Problems
Formulation of dynamic problems, consistent and lumped mass matrices
Solution of eigenvalue problems – transformation methods, Jacobi method, Vector Iteration methods, subspace iteration method
Forced vibration – steady state and transient vibration analysis, modelling of damping, the mode superposition scheme, direct integration methods – implicit and explicit numerical integration

Unit 5: Special Topics
Linear buckling analysis, Three-Dimensional Stress Analysis, Thermal Stress Analysis, adaptive finite element technique, error estimation, h & p refinements, symmetry – mirror/plane, axial, cyclic & repetitive, submodelling and substructuing,

Unit 6: Practical Considerations in Modelling
Preprocessing: model definition – nodal coordinates, element connectivity, material and element type and property definitions, type of analysis (static/modal), loading and boundary conditions.
Meshing techniques: free and mapped meshing, Quality checks – aspect ratio, warp angle, skew, Jacobian, distortion, stretch, included angle, taper
Processing: Element level calculations, Equation assembly, Equation solver (sparse solvers, factorization, numerical/computational issues)
Post Processing: strain and stress recovery (integration and nodal points), interpretation of results (results validation and data interpretation) and design modification

Books:

1. Daryl Logan, First Course in the Finite Element Method, Cengage Learning India Pvt. Ltd.
2. Gokhale N. S., Deshpande S. S., Bedekar S. V. and Thite A. N., Practical Finite Element Analysis, Finite to Infinite, Pune
3. Seshu P., "Text book of Finite Element Analysis", PHI Learning Private Ltd., New Delhi, 2010.
4. Reddy, J. N., "An Introduction to The Finite Element Method", Tata McGraw Hill, 2003.
5. Cook R. D., "Finite Element Modeling for Stress Analysis", John Wiley and Sons Inc, 1995
6. Mukhopadhyay M and Sheikh A. H., "Matrix and Finite Element Analyses of Structures", Anne Books Pvt. Ltd., 2009.
7. Bathe K. J., "Finite Element Procedures", Prentice-Hall of India (P) Ltd., New Delhi.

8. Chandrupatla T. R. and Belegunda A. D., “Introduction to Finite Elements in Engineering”, Prentice Hall India.
9. Liu G. R. and Quek S. S. “The Finite Element Method – A Practical Course”, Butterworth-Heinemann, 2003.

MED1204 – Design & Optimization

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits: 3

Course Objectives:

1. To introduce to the student optimization problems and various solution techniques,
2. To impart knowledge of various classical and modern optimization techniques
3. To make students aware about industrial optimization problems
4. To expose students to numerical techniques to solve optimization problems

Course Outcomes:

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

1. formulate objective functions and constraint equations for a given classical problem,
2. apply classical and modern method of optimization to standard problems
3. solve realistic and industrial design problems
4. use computational tools such as MATLAB/OCTAVE to get solutions

Unit 1: Introduction to Optimization **5 Hrs.**

Engineering Applications of Optimization, Statement of an Optimization Problem, Classification of Optimization Problems, Graphical Optimization Techniques

Unit 2: Classical Optimization Techniques **9 Hrs.**

Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints: Solution by Direct Substitution, Solution by the Method of Constrained Variation, Solution by the Method of Lagrange Multipliers, Multivariable Optimization with Inequality Constraints: Kuhn–Tucker Conditions, Constraint Qualification, Convex Programming Problem

Unit 3: Linear Programming: Simplex Method **6 Hrs.**

Applications of Linear Programming, Standard Form of a Linear Programming Problem, Simplex Algorithm, Two Phases of the Simplex Method

Unit 4: Nonlinear Programming **8 Hrs.**

Introduction, Unrestricted Search, Interval Halving Method, Golden Section Method, Quadratic Interpolation Method, Newton Method, Practical Considerations,

Unit 5: Special Optimization Methods **8 Hrs.**

Geometric Programming, Dynamic Programming, Integer Programming, Optimal Control

Unit 6: Modern Methods of Optimization **8 Hrs.**

Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, Neural-Network-Based optimization, Practical Aspects of Optimization

Suggested Texts and Reference Materials:

1. Engineering Optimization -Theory and Practice/ Singerusu S. Rao/ New Age.

2. Optimum Design of Mechanical elements/ Johnson Ray C/ Wiley, John & Sons

3. Genetic Algorithms in search, Optimization and Machine/ Goldberg D. E. Addison/Wesley / New York

4. Optimization for Engineering Design Algorithms and Examples/ Kalyanamoy Deb/Prentice Hall of India

PEMED1202A Computational Fluid Dynamics

Teaching Scheme:
Theory: 3 Hrs/week

Examination Scheme:
In Sem: 50 Marks
End Sem: 50 Marks
Credit: 3

Prerequisites
Fluid dynamics, Heat transfer, Numerical methods

Course Objectives
To introduce students to,

1. Finite volume method (FVM) of discretization for differential equations
2. Development of solution of discretized equations using various methods
3. Development of numerical codes for diffusion and convection problems
4. CFD techniques to fluid dynamics and heat transfer problem

Course Outcomes
Students will be able to

1. Discretize a given differential equation with FVM
2. Write a numerical code for diffusion and convection problems
3. Develop a Navier-Stokes equation solver
4. Apply CFD techniques to real life industrial problems

Unit 1 Introduction to CFD:
Governing equations: the continuity equation, momentum equation and energy equations, convective forms of the equations and general description, Reynolds transport theorem. Classification of partial differential equations; physical examples of elliptic, parabolic and hyperbolic equations. Mathematical nature of the flow equations& their boundary conditions.

Unit 2 Discretization Methods:
Discretization Methods: The discretization concept, the structure of discretization equations, methods of deriving the discretization equations. Finite volume methods; approximation of surface and volume Integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem. Concept of consistency, accuracy, stability and Convergence.

Unit 3 Solution of Discretization Equations
Tri-Diagonal Matrix Algorithm (TDMA), Application of TDMA Method to Two-dimensional Problem, Application of TDMA Method to Three-Dimensional Problem

Unit 4 Finite Volume Method for Diffusion Problems:
Finite Volume Method for Diffusion Problems:
Finite Volume Method for one dimensional steady state Diffusion, Worked Example – One dimensional steady state Diffusion, Finite Volume Method for Two-Dimensional Diffusion Problem, Finite Volume Method for Three-Dimensional Diffusion Problem

Unit 5 Finite Volume Method for Convection-Diffusion Problem:
Finite Volume Method for Convection-Diffusion Problem: Steady one-dimensional convection and Diffusion, Central Differencing Scheme, Properties of Discretization Schemes, Assessment of Central Differencing Schemes for Convection Diffusion Problem, Upwind Differencing Scheme Hybrid Differencing Scheme

Unit 6 Solution Algorithms:
Solution Algorithms for Pressure-Velocity Coupling Steady Flow, Staggered Grid, Momentum Equations, Simple Algorithm, Assembly of Complete Method.

Programming Assignments:
1. Development of FVM code for conduction problem
2. Development of FVM code for convection problem
3. Development of FVM code for Convection-Diffusion Problem
4. Lid Driven Cavity using SIMPLE algorithm

Visiting Lectures: Visiting lectures will conducted by the professionals from Industries/Research labs etc.

References

1. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.
2. John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor &Francis
3. Versteeg, H. K. and Malalasekara, W. (2008). Introduction to Computational Fluid Dynamics: The Finite Volume Method. Second Edition (Indian Reprint) Pearson Education.
4. Anderson, J.D. Computational Fluid Dynamics, McGraw Hill, 1995.

PEMED 1201B Design for Manufacturing and Assembly

Teaching Scheme
Lecture: 3 Hrs/week

Examination Scheme
In semester: 50 marks
End semester: 50 marks
Credits : 3

Prerequisite: Manufacturing process, Machine shop, Machine Design I & II, CAMD, Mini / Final year B.E./B.Tech. Projects

Course Objectives:

1. To introduce the DFMA concepts general guidelines for selection of material and manufacturing processes.
2. To acquaint students with various design rules and recommendations for optimum design based on different manufacturing process and material used to manufacture the parts.
3. To make students understand the design factors and processes along customer desires for manufacturing.
4. To develop thinking in the mind of students about the process of cost saving by knowing method to use DFMA concepts for avoid scrap and minimize reworks, design iterations between design and manufacturing / vendors.

Course Outcome:

After learning the course, the students should be able to –

1. Identify the design factors and processes along customer needs for manufacturing.
2. Apply various techniques of DFMA for product design and assembly.
3. Apply GD&T guidelines for DFMA processes.
4. Identify the design factors for design for additive manufacture and for environment.

Course Description:

- To introduce the basic concepts and design guidelines of different manufacturing processes.
- It is also equally important that students should understand the concepts of design for assembly to reduce number of parts and to optimize design without compromising function.
- Also, to introduce current global trends, requirements of environmental design and DFMA tools.

Unit 1: Introduction to DFMA and general requirements (4 Hrs.)

Introduction: Design for Manufacture and Assembly, History of DFMA, DFMA during product design, advantages, DFMA case studies,

Classification and Selection: Introduction to Manufacturing processes, Introduction to Materials, Selection of Manufacturing processes and materials for product design.

Unit 2: Design for Assembly (6 Hrs.)

Design for Assembly: The assembly process, Characteristics and applications, General taxonomies of assembly operation and systems, Examples of common assemblies;

DFA for design consideration and design recommendation for Part Handling- Insertion, Fasteners [e.g. for manual assembly, high-speed automatic assembly and robot assembly],

DFA analysis (evaluating assembly): Assembly Metrics, Example of worksheet;

Unit 3: Design for Machining (7 Hrs.)

Introduction: Material removing/machining processes; recommended materials for machinability;

Design for **Turning, Milling, Round-Holes Machining, Planning, Shaping and Slotting, Broaching, Grinding** [Process description; Typical characteristics and applications; Suitable materials; Dimensional factors and tolerances];

Design recommendations for Jigs & Fixtures for manufacturing and measurement parts.

Unit 4: Design for Forming and Joining Processes (7 hrs.)

Design for **Castings, Injection Molding, Forging, Sheet-metal stamping Welding Extrusion and Powder Metal Processing** [Process steps, Typical characteristics and applications; Defects; Suitable materials; Design consideration and recommendations for selected process].

Unit 5: Design for Additive Manufacturing and Environment (5 Hrs.)

Additive Manufacturing: Brief introduction, comparison between Additive Manufacturing (AM) and traditional manufacturing methods; Typical characteristics (w.r.to supports, overhangs, rounds etc.) and application; Rapid Prototyping.

Design for the Environment: Introduction, objectives, Design guidelines, Techniques to reduce environmental impact, Design for: Recyclability/remanufacture, energy efficiency, sustainability, Design to regulations and standards.

Unit 6: G D & T for DFMA and DFMA Tools (7 Hrs.)

G D & T Considerations for DFMA: Tolerances, Limits and Fits (IS and ASME Y 14.5 standard), tolerance Chains and identification of functionally important dimensions. Geometric tolerancing for manufacture: Tolerance stack up calculations; Review of relationship between attainable tolerance grades and different machining.

DFMA Tools: DFA index, Introduction to DFX Software, DFMA case studies.

Assessment Methods:

1. Assignment Based evaluation: T1- 25 Marks (5 Marks per assignment)

- ❖ Four assignments of case studies, based on visiting any manufacturing and assembly industry related to units no. 2, 3, 4 and 5.
- ❖ Case study base assignment using software (to understand automated DFM process).

2. Paper Pen Tests: T2 - 25 Marks and ESE – 50 Marks.

Text Books:

1. G. Boothroyd, P. Dewhurst, W. A. Knight, Product Design for Manufacture and Assembly, CRC Press.
2. K. T. Ulrich and S. D. Eppinger, Product Design and Development, McGraw-Hill Higher Education.
3. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill.
4. G E Dieter, Engineering Design - A Material Processing Approach, McGraw Hill.
5. B. R. Fischer, Mechanical Tolerance stackup and analysis, CRC Press.
6. D E Whitney, Mechanical assemblies: their design, manufacture, and role in product development, Oxford Press.

References:

1. J. Lesko, (1999) Industrial Design, Materials and Manufacture Guide, John Willy and Sons, Inc.
2. George E. Dieter and Linda C. Schmidt (2009), Engineering Design, Fourth edition, McGraw-Hill companies, New York, USA
3. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight (2002) Product Design for Manufacture and Assembly, Third Edition, CRC press, Taylor & Francis, Florida, USA
4. O. Molloy, S. Tilley and E.A. Warman (1998) Design for Manufacturing and assembly, First Edition, Chapman &Hall, London, UK.
5. D. E. Whitney, (2004) Mechanical Assemblies: Their Design, Manufacture, and Role inProduct Development, Oxford University Press, New York
6. A.K. Chitale and R.C. Gupta, (1999) Product design and Manufacturing, Prentice Hall of India, New Delhi.
7. James G. Bralla (1998) Design for Manufacturability Handbook, Second Edition,McGraw-Hill companies, New York, USA
8. Geoffrey Boothroyd (2005) Assembly Automation and Product Design, SecondEdition, CRC press, Taylor & Francis, Florida, USA
9. G. Q. Huang (1996) Design for X, Concurrent Engineering Imperatives, First Edition, Chapman &Hall, London, UK.

PEMED1201C Heat Exchanger Design

Teaching Scheme
3 Lectures / week

Examination Scheme
In Sem: - 50 Marks
End Sem: - 50 Marks
Credit: - 3

Course Objectives: -

1. To study the fundamentals concepts in designing heat exchangers.
2. To study design aspects in simulation of heat exchangers.
3. To calculate efficiency of heat exchanger
4. To study different types of heat exchangers on different conditions.

Course Outcome: -

1. Determine the fundamentals concepts in designing heat exchangers.
2. Evaluate the design aspects in simulation of heat exchangers.
3. Analyze heat transfer in compact heat exchangers.
4. Analyze and calculate operating conditions of condensers.
5. Analyze different types of heat exchangers on different conditions.

Unit 1. Classification of Heat Exchangers:

Introduction, Classification, Overview of Heat Exchanger Design Methodology, Process and Design Specifications, Thermal and Hydraulic Design, Mechanical Design, Optimum Design, Heat Exchanger Variables and Thermal Circuit, Assumptions, Basic Definitions, ε - NTU Method, The P-NTU Method, TEMA, Multi-pass Exchangers, LMTD, Heat Exchanger Arrays and Multi-passing, Sizing and Rating Problems, Kern Method, Bell Delaware Method, Numerical on Shell and tube HEX.

Unit 2. Solution Methods for Determining Exchanger Effectiveness:

Exact Analytical Methods, Approximate Methods, Numerical Methods, Matrix Formalism, Chain Rule Methodology, Flow-Reversal Symmetry, Design Problems, Longitudinal Wall Heat Conduction Effects, Multipass Exchangers, Non-uniform Overall Heat Transfer Coefficients, Temperature - Length - Combined Effect

Unit 3. Heat Exchanger Pressure Drop Analysis:

Importance of Pressure Drop, Devices, Extended Surface Heat Exchanger Pressure Drop, Tubular Heat Exchanger Pressure Drop, Tube Banks, Shell-and-Tube Exchangers, Plate Heat Exchanger Pressure Drop, Pipe Losses, Non-dimensional Presentation of Pressure Drop Data

Unit 4. Heat Transfer Characteristics:

Dimensionless Surface Characteristics, Experimental Techniques for Determining Surface Characteristics, Steady-State Kays and London Technique, Wilson Plot Technique, Transient Test Techniques, Friction Factor Determination, Hydrodynamic ally Developing Flows, Thermally Developing Flows, Extended Reynolds Analogy, Heat Exchanger Surface Geometrical Characteristics, Selection of Heat Exchangers and Their Components, Temperature Difference Distributions

Unit 5. Cooling tower fundamentals:

Types, Nomenclature, material for construction, Structural components in details, Mechanical components (Fan, Speed reducer, Valves, Safety), Electrical components, Thermal performance testing – conduction and evaluation.

Unit 6. Thermal Devices:

Heat pipe, Thermal interface material, use of nano particle in heat transfer equipments, Steam Trap, Electronics cooling systems, Thermal interface materials, Heat transfer augmentation techniques.

Reference Books:

1. Cooling Tower, Fundamentals- John C. Hensley, SPX Cooling Technologies
2. Heat exchangers Selection, Rating and Thermal Design – Sadik Kakac,Hongtan Liu,Anchasa Pramunjanaroenkij, CRC Press
3. Process Heat Transfer – Donald Q. Kern, Tata McGraw-Hill
4. Process Heat Transfer – Hewitt, Shires & Bott, CRC Press
5. Heat Pipes Theory, Design & Applications – D.A. Reay, P.D.Dunn, Pergamon
6. Cooling Techniques for Electronic Equipment– Dave S. Steinberg, Wiley-InterScience Publication
7. Fundamentals of Heat Exchanger Design -Ramesh K. Shah, Dusan P. Sekulic,WileyIndia

MED 1205 Automation and Control Technology Laboratory

Teaching Scheme:

Practical: 02 Hrs / week

Examination Scheme:

Oral = 25 Marks

Total Credit =01

Course Objective:

1. Hands-on Automation system components and types of Automation system
2. Understanding the Principles of Operations of Sensors, Transducers and Actuators.
3. Design of a typical Mechatronics System through various case studies.
4. Practical Implementation of an Automatic Control technology through PLC using Automation Studio software

Course Outcomes:

1. At the end of the course the student will be able to identify and differentiate between the various components of Automation system.
2. Student will understand the working principle and apply the knowledge of sensors and Actuators through measurement, Signal conditioning for Automatic control systems.
3. Students will be able to design a simple Mechatronics system and Automation Systems.
4. Students can apply the knowledge of Automation in Design of Automated Production line.

List of the Experiments (Expt. No.6 is Compulsory & Any 3 from remaining):

1) Demonstration of Bottle Filling plant using an Automation Studio simulation software

2) Design of Automatic Traffic Control System

3) Study of Automatic control in Car Engine Management System.

4) Industrial Visit to study the different types of Automation on Production line.

5) Demonstration on Pick and Place Robot for implementation of Automation on production line.

6) Design of Real time system by interfacing various sensors and actuators using **NI my Rio**.

Assignments: (Any 2)

1) Report based on Industrial visit where students can find the applications of PLC, SCADA & HMI.
2) Case Study: Mechatronics system design of any system.
3) Study of Modeling and Analysis of typical Mechanical System.

MED 1206: VIBARTION AND ACOUSTICS LABORATORY

Teaching Scheme
Lecture: 2 Hrs/week

Examination Scheme
Oral: 25 Marks
Credit: 1

Prerequisite: Higher Engineering Mathematics, Applied Physics, Mechanical Vibrations

Course Objectives: Students should be able to,
1. To know the fundamentals of vibration through the complex problems with mathematical approach.
2. To know and able to determine the natural frequency of the multi degree freedom system.
3. To know the fundamentals of continuous and random vibrations.
4. To know the fundamentals of acoustics and India standards of Noise.
5. To know the sound absorbing materials and its practical application.
6. To know the measurement and control techniques of vibration and noise.

Course Outcome: Students will be able to,
1. An ability to solve the complex problems in vibration
2. An ability to measure the vibration and noise of machines/engines
3. An ability to do the modal analysis of beams
4. An ability to understand the lifelong learning through industry visit

A] Assignments:
The following SIX assignments are mandatory to the students
1. Unit 1 (2 nos)
2. Unit 2 and Unit 3 (Each one)
3. Unit 5 on Environmental Impact Assessment (1 No)
4. Unit 6 (1 No)

B] Experiments: (Any Three)
1. Experiment on forced damped vibratory system
2. Experimental measurement and analysis of Vibration and Noise spectrum of Machine or Engine
3. Experiment on Shock Absorber Test Rig
4. Experimental Modal Analysis of metal beam and composite beam
5. Experiment Modal Analysis by sine sweep on Vibration Shaker.
6. Experiment on Vibration Absorber
7. Experimental measurement of Transmission Loss of reactive muffler

C] Industrial Visits: (Minimum One)
1. Engine Manufacturer
2. Engine Testing and NVH Laboratory

The industry visit report should be enclosed in the lab journal.

References:

1. Mechanical Vibrations, S S Rao, Pearson Education
2. Mechanical Vibrations, Rao V Dukkipati, Narosa Publisher, New Delhi
3. Random Vibration, Zach Liang and George C. Lee, CRC Press Taylor & Francis Group
4. Random Vibrations, Loren D Lutes and Shahram sarkari, Elsevier B-H, UK
5. Noise and Vibration Control, M L Munjal, IISc Press, World Scientific
6. Mechanical Vibrations and Industrial Noise Control, Lasithan L.G. PHI Learning P Ltd, New Delhi.

MED1207 Finite Element Analysis Lab

Teaching Scheme **Examination Scheme**
Practical: 2 Hrs/week Oral: 25 Marks
Credits: 1

Pre-Requisites:
Advanced Mathematics and Numerical Techniques

Course Objectives:
1. To understand the philosophy and general procedure of Finite Element Method as applied to solid mechanics and thermal analysis problems.
2. To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
3. To provide a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
4. To study approximate nature of the finite element method and convergence of results are examined.
5. To provide some experience with a commercial FEM code and some practical modeling exercises

Course Outcome:
On completion of the course, students will be able to -
1. understand the different techniques used to solve mechanical engineering problems.
2. derive and use 1-D and 2-D element stiffness matrices and load vectors from various methods to solve for displacements and stresses.
3. apply mechanics of materials and machine design topics to provide preliminary results used for testing the reasonableness of finite element results.
4. explain the inner workings of a finite element code for linear stress, displacement, temperature and modal analysis.
5. use commercial finite element analysis software to solve complex problems in solid mechanics and heat transfer.
6. interpret the results of finite element analyses and make an assessment of the results in terms of modeling (physics assumptions) errors, discretization (mesh density and refinement toward convergence) errors, and numerical (round-off) errors.

List of experiments:

1. Introduction to Software Tools used for Finite Element Analysis -- MATLAB and ANSYS
2. Write 4 computer programs using Finite Element Analysis in MATLAB
3. Analyze 4 real life problems using ANSYS modeling and write a short report

List of Assignments:

Two assignments based on the theory topics will be given during the semester.

Books:

1. Daryl Logan, First Course in the Finite Element Method, Cengage Learning India Pvt. Ltd.
2. Gokhale N. S., Deshpande S. S., Bedekar S. V. and Thite A. N., Practical Finite Element Analysis, Finite to Infinite, Pune
3. Seshu P., "Text book of Finite Element Analysis", PHI Learning Private Ltd., New Delhi, 2010.
4. Reddy, J. N., "An Introduction to The Finite Element Method", Tata McGraw Hill, 2003.
5. Cook R. D., "Finite Element Modeling for Stress Analysis", John Wiley and Sons Inc, 1995
6. Mukhopadhyay M and Sheikh A. H., "Matrix and Finite Element Analyses of Structures", Anne Books Pvt. Ltd., 2009.
7. Bathe K. J., "Finite Element Procedures", Prentice-Hall of India (P) Ltd., New Delhi.
8. Chandrupatla T. R. and Belegunda A. D., "Introduction to Finite Elements in Engineering", Prentice Hall India.
9. Liu G. R. and Quek S. S. "The Finite Element Method – A Practical Course", Butterworth-Heinemann, 2003.

MED1208 Seminar

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Oral: 50 Marks
Credits: 2

Course Objectives:

1. Identify and compare technical and practical issues related to the area of course specialization.
2. Outline annotated bibliography of research demonstrating scholarly skills.
3. Prepare a well-organized report employing elements of technical writing and critical thinking.
4. Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presentation.

Course Outcome: With this seminar report and presentation, the student will be able to

1. Identify and compare technical and practical issues related to the area of course specialization.
2. Outline annotated bibliography of research demonstrating scholarly skills.
3. Prepare a well-organized report employing elements of technical writing and critical thinking.
4. Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presentation.

Course Contents:

The evaluation of the seminar report is proposed with the two stages.

- **In Sem Review** In this stage the student is expected to deliver the Topic selection, Literature review, State of the art related to the topic of interest, Problem statement, Methodology, Scope and objectives.
- **Final review:** In this stage the student is expected to deliver the Quantification of results, concluding remarks or summary, Seminar report, final presentation/viva.

The contents of the seminar report and presentation are expected to include the following: Abstract/Summary, Introduction: Scope and Methodology, Literature review (The review should be conducted from recent research papers), Case study and References.

The final presentation/viva will be assessed by an internal panel. The internal panel will consist of the seminar guide and a subject expert, approved by the HOD.

References:

1. Technical Communication, Mike Markel, Bedford/St. Martin's; Ninth edition, 2009
2. Technical Writing, Basu, Prentice Hall India Learning Private Limited, 1st Edition, 2007
3. Technical Writing, O.N. Pandey, S.K. Kataria & Sons; 2014th edition
4. The Insider's Guide to Technical Writing, Kristaa Vaan Lann, XML Press, 2012
5. LaTeX Beginner's Guide, Stefan Kottwitz, Packt Publishing; 2nd edition

AC1201 Soft Skills and Business Communication

Teaching Scheme: **Examination Scheme:**

Practical: 2 Hrs/Week In-Semester: --

End-Semester: --

Credits: NIL

Course Objectives:

1. To help the students to develop as team member, leader and all-round professional in the long run.
2. This course would focus on over all personality development.
3. Have right attitudinal and behavioural aspects, and build the same through activities.
4. Possess right professional and social ethical values.
5. To make student confident in communicating in Business environment.
6. Improve their fluency in English language.

Course Outcomes:

1. To communicate, interact and present his ideas to the other professionals.
2. Understand and aware of importance, role and contents of soft skills through instructions, knowledge acquisition, demonstration and practice.
3. Have right attitudinal and behavioural aspects, and build the same through activities.
4. Possess right professional and social ethical values.
5. The student will overcome apprehension of communicating in professional environment.
6. Language proficiency will enable student present ideas, applications and reports effectively in oral and written communication.

Unit – I: Self-Awareness & self-Development (03)

a) Self-Assessment, Self-Appraisal, SWOT, Goal setting -Personal &career-Self-Assessment, Self-Awareness, Perceptions and Attitudes, Positive Attitude, Values and Belief Systems, Self-Esteem, Self-appraisal, Personal Goal setting.

b) Career Planning, Personal success factors, Handling failure, Depression and Habit, relating SWOT analysis & goal setting, prioritization.

Unit – II: Communication Skill (06)

a) Importance of communication, types, barriers of communication, effective communication.

b) Speaking Skills– Public Speaking, Presentation skills, Group discussion- Importance of speaking effectively, speech process, message, audience, speech style, feedback, conversation and oral skills, fluency and self-expression, body language phonetics and spoken English, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques.

c) Listening Skills: Law of nature- you have 2 ears and 1 tongue so listen twice and speak once is the best policy, Empathic listening, Avoid selective listening.

d) Group Discussion- characteristics, subject knowledge, oral and leadership skills, team management, strategies and individual contribution and consistency.

e) Presentation skills- planning, preparation, organization, delivery.

f) Written Skills– Formal & Informal letter writing, Report writing, Resume writing- Sentence structure, sentence coherence, emphasis. Paragraph writing, Letter writing skills-form and structure, style and tone. Inquiry letters, Instruction letters, complaint letters, Routine business letters, Sales Letters etc.

Unit – III: Corporate/ Business Etiquettes. (02)

Corporate grooming & dressing, Email & telephone etiquettes, etiquettes in social & office setting- Understand the importance of professional behavior at the workplace, Understand and Implement etiquettes in workplace, presenting oneself with finesse and making others comfortable in a business setting. Importance of first impression, Grooming, Wardrobe, Body language, Meeting etiquettes (targeted at young professionals who are just entering business environment), Introduction to Ethics in engineering and ethical reasoning, rights and responsibilities.

Unit – IV: Interpersonal relationship (03)

Team work, Team effectiveness, Group discussion, Decision making - Team Communication Team, Conflict Resolution, Team Goal Setting, Team Motivation Understanding Team Development, Team Problem Solving, Building the team dynamics. Multicultural team activity

Unit – V: Leadership skills (01)

Leaders' role, responsibilities and skill required- Understanding good Leadership behaviours, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules, Defining Qualities and Strengths of leadership, Determining how well you perceive what's going on around you, interpersonal Skills and Communication Skills, Learning about Commitment and How to Move Things Forward, Making Key Decisions, Handling Your and Other People's Stress, Empowering, Motivating and Inspiring Others, Leading by example, effective feedback

Unit – VI: Other skill (03)

a) Time management-The Time management matrix, apply the Pareto Principle (80/20Rule) to time management issues, to prioritise using decision matrices, to beat the most common time wasters, how to plan ahead, how to handle interruptions, to maximize your personal effectiveness, how to say "no" to time wasters, develop your own individual plan of action.

b) Stress management- understanding the stress & its impact, techniques of handling stress

c) Problem solving skill, Confidence building Problem solving skill, Confidence building.

Reference Books:

1. S. Kumar, S. Pushpalata, 'Communication Skills', Oxford University Press. (2011)
2. K. Mohan, M. Banerji , 'Developing Communication Skill' , McMillan India Ltd. (2011)
3. S. Sweeney, 'English for Business Communication' Cambridge UniversityPress. (2013)
4. B. K. Mitra, 'Personality Development and Group Discussions', Oxford University Press
5. S. Napoleon Hill 'Think and Grow Rich', Ebury Publishing, (1937)