MED 1201 Automation and Control Technology

Teaching Scheme:
Lectures: 3 Hrs/week
Credit: 3

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

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.

Outcomes:

1) At the end of the course the 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 analyse the Mathematical Model for any Mechanical system.

Unit I: Introduction to Automation technology (7)

Automation & Its Importance, Mechanisation 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 sytem, 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

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

Assignments: Minimum 2 Assignments

1) Report based on Industrial visit where students can find the applications of PLC,SCADA & HMI.
2) Mechatronics system desing of any system.

MED 1202 Vibration and Acoustics

Teaching Scheme
Lecture : 3 Hrs/week

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

Prerequisite: Higher Engineering Mathematics, Applied Physics, Mechanical Vibrations

Course Objectives:

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 Indian standards of Noise
5. To know the sound absorbing materials and its practical applications.
6. To know the measurement and control techniques of vibration and noise.

Course Outcome:

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to do the harmonic analysis of complex problem
3. An ability to solve the multi-degree freedom system problems
4. An ability to apply the knowledge of Continuous and Random vibrations
5. An ability to apply the knowledge of acoustics in practice
6. An ability to implement the measurement and control techniques of Vibration and Noise.

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 functions, Half-Range function.

Unit 2: Multi-Degree of Freedom Systems (8)
Introduction, Free and Forced – undamped and damped vibrations- equation of motion, Influence coefficients, Generalised 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 of Vibration of Continuous system (Transverse Vibration of Beams) and Random Vibration (8)
Introduction, Equation of motion, Initial conditions**,** Free and Forced of vibration of simply supported Beam.
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: Acoustics of Rooms, Partitions, Enclosures and Barriers (7)

Sound absorbing materials, Sound insulation, Sound in rooms, Reverberation room, Sound proof room, Partitions, Enclosures and Barriers, Diesel engine noise, Gas turbine noise, Mufflers and Silencers, Transmission and insertion loss in silencers and mufflers.

Unit 6: Measurement and Control of Vibration and Noise (6)

Vibration Nomograph 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 Vibration Absorber, Active Vibration Control, Noise 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	**Examination Scheme**
Lecture: 3 Hrs/week	**In semester: 25 marks**
Credits: 3	**End semester: 50 marks**

Pre-Requisites:

Advanced Mathematics and Numerical Techniques

Course Objectives:

Course Outcome:

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

Pre processing: 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 Analy sis, 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 and Optimization

Teaching Scheme:
Theory: 3 Hrs/week
Credit: 3

Examination Scheme:
In Sem: 25+25 Marks
End Sem: 50 Marks

Prerequisites

Strength of materials, Basic principles of machine design

Course Objectives

To introduce students to,

1. Various modes of failures and corresponding design criteria,
2. Theories of failures and their applications,
3. Formulation and classification of optimization problems,
4. Various optimization methods and their features.

Course Outcomes

Students will be able to

1. Apply the relevant theory of failure,
2. Design the given element based on fatigue life,
3. Formulate the optimization problems and classify them,
4. Understand various optimization techniques.

Unit 1 Design Process and theories of failures (06)

Design considerations, design procedure, use of standards, engineering materials, stresses and their combination, modes of failures, theories of failures and their applications.

Unit 2 Design approach for various criteria (08)

Fatigue failure, design against fluctuating load, design for combined fatigue loads, design for life, rigidity, impact, creep.

Unit 3 Introduction to engineering optimization (06)

- Introduction to mathematical modeling: Problem formulation, objective function, design variables, constraints, classification of optimization problems.
- Classical optimization techniques: Single variable and multi variable optimization with and without constraints.

Unit 4 Linear and non-linear programming (08)

- Linear programming: applications, standard form, geometry of linear programming problems, theorems, simplex algorithm.
- Non linear programming: One dimensional minimization methods, elimination and interpolation methods.

Unit 5 Introduction to modern methods of optimization (06)

Generic algorithms simulated annealing, particle swan optimization.

References

1 Mechanical Engineering Design, Shigley, Mischke, Budynas, Nisbett, McGraw Hill.

2 Design of Machine Elements, M.F.Spotts, Pearson Publication

3 Engineering Optimization, S.S.Rao, New Age International publishers.

4 Optimization for Engineering Design, K. Deb, PHI.

5 Optimization concepts and applications in engineering, Belegundu, Chandrupatla, Pearson Education.

PEMED 1202 Computational Fluid Dynamics

Teaching Scheme:
Theory: 3 Hrs/week
Credit: 3

Examination Scheme:
In Sem: 25+25 Marks
End Sem: 50 Marks

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 4. Anderson, J.D. Computational Fluid Dynamics, McGraw Hill, 1995.

PEMED 1202 Design for Manufacturing and Assembly

Teaching Scheme	**Examination Scheme**
Lecture: 3 Hrs/week	**In semester: 50 marks**
Credits: 3	**End semester: 50 marks**

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 desires for manufacturing.
2. Apply various techniques of DFMA for product design and assembly.
3. Apply the concept of designs for different manufacturing and assembly processes.
4. Understand the quality aspects of design for manufacture and assembly.

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 andgeneral requirements (4 Hrs.)

- **Introduction:** Design for Manufacture and Assembly, History of DFMA, DFMA during productdesign,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 Manual Assembly, High-Speed Automatic Assembly and Robot Assembly**
  The assembly process, Characteristics and applications, General taxonomies of assembly operation and systems, Example of common assembly, Economic significance of assembly, Assembling a product;
  Design for Assembly: Introduction, Design consideration, Design recommendation for fasteners, Design for Poka-Yoke, Design for disassembly,
- **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.

Unit 3: Design for Machining (7 Hrs.)

- **Introduction:**Material removing/machining processes;recommended materials formachinability;Design recommendations;Jigs & Fixtures for manufacturing and measurementparts.
- **Design for Turning,Milling, Round-HolesMachining, Planning, Shaping and Slotting, Broaching,Grinding:** Process description;Typical characteristics and applications; Suitable materials;Dimensional factors and tolerances; Design recommendations.

Unit 4: Design forCastings, Injection Molding,Forging, Sheet-metal stamping and Welding (7 hrs.)

- **Design for Castings, Injection Molding, Forging, Sheet-metal stamping WeldingExtrusionandPowder 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.)

- **Brief introduction to Additive Manufacturing**
  Additive Manufacturing (AM)and traditional manufacturing methods;Typical characteristics (w.r.to supports, overhangs, rounds etc.)and applicationRapid Prototyping; Use ofDFM for AMto combine the functions of multiple parts into one.
- **Design for the Environment:** Introduction, Environmental objectives, Design guide lines, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for Recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards, Design for sustainability and the environment.

Unit 6: Design for Environment and DFMA Tools (7 Hrs.)

- **DFMA Tools:** Traditional design and manufacture Vs concurrent engineering, DFA index, lean principles, six sigma concepts, DFMA as the tool for concurrent engineering, three DFMA criteria for retaining components for redesign of a product.
- **Introduction to CAD and Topology Optimization:** Introduction tovarious analysis led manufacturing software Organic type part designs generates, manufacturing limitations for producing these optimized parts,DFMA case studies.

- **Term-Work**
  The Term-Work shall consist of
  - ❖ Four assignments of case studies, based on visiting any manufacturing and assembly industry related to units no. 2, 3, 4 & 5.
  - ❖ Case studies using software to understand automated DFM process.

- **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 andSons, 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 forManufacture 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 Hallof India, New Delhi.
7. James G. Bralla (1998) Design for Manufacturability Handbook, Second Edition,McGraw-Hill companies, New York, USA
8. Geoffrey Boothroyd (2005) AssemblyAutomation 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.

MED 1205 Automation and Control Technology Lab

Teaching Scheme:
Practical: 02 Hrs / week
Credit: 01

Examination Scheme:
Oral: 25 Marks

Objective:

1) Handson 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

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 a 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 myRio**.

Assignments: (Any 2)

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

MED 1206 Vibration and Acoustics Laboratory

Teaching Scheme
Practical : 2 Hrs / week

Examination Scheme
Oral : 25 marks
Credit : 1

Prerequisite: Higher Engineering Mathematics, Applied Physics, Mechanical Vibrations

Course Objectives:

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 sound absorbing materials and its practical applications.
4. To know the measurement and control techniques of vibration and noise.

Course Outcome:

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 have the life long learning of vibration and noise through industrial applications

A] Assignments :

The following **SIX** assignments are **mandatory** to the students.
1. Unit 1 (2 Nos)
2. Unit 2 (2 Nos)
3. Dynamic Vibration Absorber (1 No)
4. Active Vibration Control (1 No)

B] Experiments: (Any Three)

1. Experimental measurement and analysis of Vibration and Noise spectrum of Machine or Engine.
2. Experiment on Shock Absorber Test Rig
3. Experimental Modal Analysis of metal beam and composite beam
4. Modal Analysis by Sine sweep on Vibration Shaker
5. Experiment on Vibration Absorber

C] Industrial Visits:

1. Engine Manufacturer
2. Engine Testing and NVH Laboratory

The Industry visit report should be enclosed in the laboratory journal.

References:

8. Mechanical Vibrations, S S Rao, Pearson Education
9. Mechanical Vibrations, Rao V Dukkipati, Narosa Publisher, New Delhi

10. Random Vibration, Zach Liang and George C. Lee, CRC Press Taylor & Francis Group
11. Random Vibrations, Loren D Lutes and Shahram Sarkani, Elsevier B-H, UK
12. Noise and Vibration Control, M L Munjal, IISc Press, World Scientific
13. Acoustics of Ducts and Mufflers , M L Munjal, John Wiley and Sons, New York
14. 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:

Course Outcome:

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.