Nirma University
Institute of Technology
School of Engineering

Mechanical Engineering Department

M.Tech CAD/CAM

3ME1107 Advanced Kinematics and Dynamics of Machines [3 0 2 5]

Course Learning Outcome:

After successful completion of the course, student will be able to

- principles of kinematic synthesis, analysis and dynamics to planer mechanisms.
- learn field balancing and dynamics of flexible rotors.
- Formulate the mathematical models of real life engineering systems for vibration study.
- Interpret the vibratory responses of multi degree of freedom systems and continuous system through experiments.

Syllabus:

Review of Kinematic Analysis:
Mobility, displacement, velocity and acceleration analysis of mechanisms.
Kinematic Synthesis:
Function generation, path generation and rigid body guidance. Graphical and analytical techniques of synthesis.
Dynamic Analysis of Mechanisms:
Equations of motion, forward and inverse dynamic analysis, simulation of systems of interconnected rigid bodies.
Vibration:
Review of single and two DOF systems. Multi DOF systems of vibration, Transfer Matrix, Holzer and vector iteration techniques. Lagrange's equations of motion. Vibrations of continuous systems-axial, torsional and lateral vibrations of bars. Introduction to nonlinear and random vibrations.
Balancing:
Balancing of flexible rotors, field balancing.
Laboratory Work will be based on topics covered under the above syllabus.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory Work will be based on topics covered under the above syllabus.

References:

1. Joseph E Shigley, Theory of Machines & Mechanics, McGraw Hill.
2. G. Sandor and A.G. Erdman, Advanced Mechanism Design Vol.1 and 2, Prentice Hall of India.
3. A. Ghosh and A.K. Mallik, Theory of Mechanisms and Machines, Affiliated East-West Press.
4. A.S. Hall, Prentice Hall and L. Meirovitch, Kinematics and Linkage Design, Elements of Vibration Analysis, McGraw Hill.
5. S.S.Rao, Mechanical Vibration, Pearson Publication.

3ME1108 Advanced Machine Design I [3 1 0 4]

Course Learning Outcome:

After successful completion of the course, student will be able to

- apply design philosophies and knowledge of design.
- design various mechanical systems incorporating the effect of fatigue, creep and fracture mechanics.
- incorporate friction, wear and lubrication consideration in the design.
- design of tank and pressure vessel as per ASME and BIS standards.

Syllabus:

1.General Design Procedure. Design Philosophies, Design for X, Reliability, Concurrent Engineering, Aesthetics and Ergonomics, Brief review of principal stresses, Theories of Failure.

2. Advanced Materials and Material selection.

3. Design based on Fatigue.

Design against fatigue, factors affecting fatigue behavior, Theoretical stress concentration factor and notch sensitivity factor. Fatigue under complex stresses, cumulative fatigue design. Linear damage (Miner's Rule), Manson's method.

4. Creep

True stress and true strain, creep phenomenon, creep parameters, stress relaxation. Designing components subjected to creep.

5. Fracture Mechanics

Griffith theory, Concept of SIF and KIC Crack Tip Plasticity. Determination of plastic zone. size and shape. Fatigue crack propagation and life estimation.

6. Design for Rigidity:

Design of shafts and spindles, Design of slideways and guideways Selection of ball screws for M/c. tool applications.

7. Tribology

Wear and its types. Hydrodynamic, hydrostatic and elsatorydrodynamic lubrication. Porous bearings, stresses in bearing. Determination of static and dynamic load capacity of bearings. Arrangement of bearings for different load conditions.

8. Tanks and pressure vessels subjected to external pressure and internal pressure. Testing of tanks and pressure vessels as per ASME and BIS.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Tutorial Work:

Tutorial work will be based on above syllabus with minimum 10 tutorials to be incorporated.

References:

1. Prashant Kumar, Engg. Fracture Mechanics, Wheeler publication.
2. Ali Fatemi and Ralph stephens, Metal fatigue in Engg., John-wiley and sons publication.
3. Brownell and Young, Process Equipment Design, Wiley India Pvt Ltd
4. CMTI Handbook, TMH publication.
5. Joshi, Process Equipment Design, Mcmillan India Pvt Ltd.
6. Ashok Saxena, The Science and Design of Engg. Materials, Irwin publication.

3ME1110 Computer Aided Production Management [3 0 0 3]

Course Learning Outcome:

After successful completion of the course, student will be able to

- understand principles of production and quality management
- analyze and interpret the quality issues and provide optimum solution to the problem
- solve production and quality management problems using software
- formulate and solve management and quality problems through group task

Syllabus:

Introduction to Computer Aided Production Management

Forecasting Techniques: Quantitative and Qualitative forecasting, Forecasting error measures, Selection of forecasting techniques

Scheduling: Scheduling classes, Deterministic scheduling for single machine, parallel machine, flow shop, open shop and job shop

Facility location and layout: Mathematical approaches for facility location, Computerized relative allocation of facility technique, automated layout design program and computerized relationship layout planning for facility location and layout

Group Technology: Introduction, objectives, part families, algorithms and models for G.T. - rank order clustering, bond energy, mathematical model for machine – component cell formation. Design and manufacturing attributes. Parts classification and coding, concept of composite job, machine group, cell group tooling, design rationalization, CAD/CAM and GT benefits

Quality Engineering: Quality Control, Quality Assurance, Quality Improvement, Total Quality Concept, Statistical Process Control. Taguchi method, Robust design. Causes of defects and failures, Failure modes, Techniques of failure analysis, Product liability

Computer Aided Process Planning: Its application in the sheet metal, 3-D solid model and assembly of mechanical components etc.

MRP : Introduction, objectives, inputs, computational procedure, information provided by the system detailed capacity planning, manufacturing resources planning, MRP-II

ERP: Introduction, main feature, Generic model of ERP system, selection of ERP, proof of concept approach, analytic hierarchy approach, ERP implementation. MRP vs ERP.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. Tien-Chien Chang, Richard A. Wysk, An introduction to automated process planning systems, Prentice Hall

2. Mikell P. Groover, Automation, production systems, and computer integrated manufacturing, Prentice-Hall
3. Elwood S. Buffa and Rakesh K. Sarin, Modern Production /Operations Management, John Wiley & Sons, Inc.
4. P. B. Mahapatra, Computer-Aided Production Management, Prentice-Hall of India Pvt. Ltd.
5. Everett E. Adam and Ronald J. Ebert, Production and Operations Management: Concepts, Models and Behavior, Prentice-Hall, Inc.
6. R. Paneerselvam, Production and Operations Management, Prentice-Hall of India Pvt. Ltd.
7. Michael L Pinedo, Scheduling: Theory, Algorithms, and Systems, Springer.
8. R. Francis, L. McGinnis and J. White, Facility Layout and Location: An Analytical Approach, Prentice Hall

3ME1111 Computer Aided Design [3 0 2 5]

Course Learning Outcome:

After successful completion of the course, student will be able to:

- select input and output devices for computer systems for mechanical engineering requirements.
- apply knowledge of mathematical concept for geometry manipulation and modeling of curves, surface and solids.
- operate CAD packages to prepare solid model of components, assemble them to represent complex mechanical systems.
- develop computer algorithm for design and analysis of mechanical systems.

Syllabus:

Introduction

Application of computers to design, benefits of CAD, conventional design vs CAD.
Software configuration of a Graphic system, Functions of a Graphics package, Constructing the Geometry, Transformations, Data Base Structure and Content,

CAD hardware and software

Types of systems, systems, systems evaluation criteria, input devices, output devices, display devices, technical specification of CAD workstation, computer software-operating system, files creation, data file processing, application software in CAD.

Computer graphics

Scan conversions, DDA and Bresenhan's algorithm for generation of various figure, 2D and 3D transformations, mathematical representation of plane curves, space curves such as cubic splines, Bezier curves, Bspline and NURBS, Surface Generation and description, analytic surfaces, parametric surfaces, Bezier and B – spline surfaces, mathematical representation of solids- B-rep, CSG etc., analytical solid modeling, solid manipulation, visual realism.
Standards in CAD, graphics and computing standards, data exchange standards, design database, interfacing design and drafting, mechanical assembly.
Computer aided design of mechanical elements with animation.
Capabilities of various commercially available software in the area of CAD such as Pro E, I-DEAS, CATIA etc.
Mechanical Assembly: Introduction, Assembly Modeling – Parts, Modeling & Representation, Hierarchical Relationships, Mating Conditions. Inference of position from mating conditions.
Representation schemes - Graph structure, Location graph, Virtual Link.
Generation of Assembling Sequences-Precedence Diagram, Liaison-Sequence analysis, Precedence Graph. Assembly Analysis.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory Work will be based on topics covered under the above syllabus.

References:

1. Hearn & Baker, Computer Graphics, PHI Publisher.
2. David F. Rogers & J. Alan Adams, Mathematical Elements for Computer Graphics, McGraw Hill.
3. Ibrahim Zeid, CAD / CAM Theory and Practice, McGraw Hill.
4. Chris McMohan & Jimmie Brown Addison, CAD / CAM, Wesley Publication

L	T	P	C
2	1	0	3

Course Code	**3ME1112**
Course Title	**Advanced Machine Design**

Course Outcomes (COs):

After successful completion of the course, student will be able to-

1. design various mechanical systems incorporating the effect of fatigue, creep and fracture mechanics,
2. incorporate friction, wear and lubrication consideration in the design,
3. design the components of overhead crane.

Syllabus **Teaching hours: 30**

UNIT-I **02 hours**

Engineering Materials and Material Selection.

UNIT-II **04 hours**

Design based on Fatigue, Design against fatigue, factors affecting fatigue behaviour, Theoretical stress concentration factor and notch sensitivity factor. Fatigue under complex stresses, cumulative fatigue design. Linear damage (Miner's Rule), Manson's method.

UNIT-III **04 hours**

Creep, True stress and true strain, creep phenomenon, creep parameters, stress relaxation. Designing components subjected to creep.

UNIT-IV **04 hours**

Fracture Mechanics, Griffith theory, Concept of SIF and KIC Crack Tip Plasticity. Determination of plastic zone. size and shape. Fatigue crack propagation and life estimation.

UNIT-V **05 hours**

Tribology, gear and its types. Hydrodynamic, hydrostatic and elasto-hydrodynamic lubrication. Porous bearings, stresses in bearing. Determination of static and dynamic load capacity of bearings. Arrangement of bearings for different load conditions. Gear Materials, corrected gear tooth design, power rating of gears as per BIS.

UNIT-VI **04 hours**

Design and analysis of crane structure. Design of main girder of overhead traveling crane. Testing of crane structure as per BIS.

UNIT-VII **03 hours**

Rotating Discs and rotating cylinder Discs with uniform thickness. Discs with uniform strength. Stresses in rotating cylinder with and without internal pressures.

UNIT-VIII **04 hours**

Theory of Shells Design of thick cylinders. Autofrettage. Wire wound cylinders, thick spherical shells. Design of circular and non-circular plates with different loading conditions and supports.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Suggested Readings:

1. Prashant Kumar, Engg. Fracture Mechanics, Wheeler publication.
2. G.M.Maitra, Hand book of Gear Design, McGraw hill Education.
3. P. Rudenko, Material Handling Equipment, Mir Publication.
4. Burr and Cheathaam, Mechanical Analysis & Design , PHI.
5. Shigley"s Mechanical Engineering Design, McGraw hill Education.
6. Autar Kaw, Composite Materials, CRC Publications.

L=Lecture, T= Tutorial, P=Practical, C=Credit

w.e.f. academic year 2019-20 and onwards

L	T	P	C
2	1	0	3

Course Code	**3ME1113**
Course Title	**Advanced Theory of Machines**

Course Outcomes (COs):

After successful completion of the course, student will be able to-

1. Apply principles of kinematic analysis and dynamics to planer mechanisms.
2. Understand fundamentals of mechanisms syntheses for specific applications.
3. Formulate the mathematical models of real life engineering systems for vibration study.
4. Interpret the vibratory responses of multi degree of freedom systems and continuous system through experiments.

Syllabus: **Teaching Hours: 30**

UNIT-I **07 hours**

Kinematic Analysis: Mobility, displacement, velocity and acceleration and static force analysis of mechanisms.

UNIT-II **07 hours**

Kinematic Synthesis: Function generation, path generation and rigid body guidance. Coupler curve synthesis, Chebychev theorem, Freudesten's Equation, Graphical and analytical techniques of synthesis.

UNIT-III **07 hours**

Dynamic Analysis of Mechanisms: Equations of motion, forward and inverse dynamic analysis, simulation of systems of interconnected rigid bodies.

UNIT-IV **09 hours**

Vibration: Review of single and two DOF systems. Multi DOF systems of vibration, Transfer Matrix, Holzer and vector iteration techniques. Lagrange's equations of motion. Vibrations of continuous systems-axial, torsional and lateral vibrations of bars. Introduction to nonlinear and random vibrations.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Suggested Readings:

1. Joseph E Shigley, Theory of Machines & Mechanics, McGraw hill Education.
2. G. Sandor and A.G. Erdman, Advanced Mechanism Design Vol.1 and 2, Prentice Hall of India.
3. A.Ghosh and A.K. Mallik, Theory of Mechanisms and Machines, Affiliated East-West Press.
4. A.S. Hall, Prentice Hall and L. Meirovitch, Kinematics and Linkage Design, Elements of Vibration Analysis, McGraw hill Education.
5. S. S. Rao, Mechanical Vibration, Pearson Publication.

L=Lecture, T= Tutorial, P=Practical, C=Credit

w.e.f. academic year 2019-20 and onwards

L	T	P	C
3	0	0	3

Course Code	**3ME1114**
Course Title	**Industrial Automation**

Course Outcomes (COs):

After successful completion of the course, student will be able to-

1. demonstrate use of hard automation for industrial application,
2. interpret the hydraulic and pneumatic systems,
3. evaluate and select an appropriate automation system for industrial automation,
4. design an automatic system for a manufacturing system.

Syllabus **Teaching Hours: 45**

UNIT-I **15 hours**

Automation in Assembly and Production systems

Introduction to automation, Historical development of assembly processes, Basics of automated work piece handling, Preparation for automated handling, Transfer mechanisms, Construction elements for automation, concepts of transfer lines, unit built machines, Analysis of vibratory and non-vibratory feeders and part orienting devices.

Low cost automation- Concept, Technologies used for LCA, Applications and Case studies, Factory automation.

UNIT-II **16 hours**

Automation using Hydraulic and Pneumatic systems

Hydraulic and Pneumatic Principles- Elements of hydraulic and pneumatic systems, study of their functional and design characteristics, Analysis and study of typical Hydraulic and Pneumatic circuits in automation systems, Maintenance of hydraulic and pneumatic systems

UNIT-III **10 hours**

Control systems for Automation

Introduction to servo system, Components of electrical controls- Push button switches, Pressure switches, Limit switches, Temperature switches, Solenoids, Relays, Timers, Electro - hydraulic / pneumatic circuits.

Microelectronics Controls- Uses of PLCs and Microprocessors in automation construction, Difference between PLCs and Microprocessors.

Hybrid automatic circuits in automation systems, Design of automation systems for specific requirements,

UNIT-IV **04 hours**
Advance Automation

Use of robotics in automation, Internet of Things (IoT) in Industry 4.0.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings:

1. Boothroyd G., Automatic Assembly and Product Design.
2. Khaimoswitch E. M., Hydraulic Control of Machine Tools, Pergamon Press.
3. Antony E., Fluid Power with Applications, Pearsorn India..
4. Srinivasan R., Hydraulic and Pneumatic Controls, VNIPL.
5. Industrial hydraulics by Vickers.
6. Webb J. W., Reis R. A., Programmable Logic controller: Principle & Applications,
7. Groover M.P., Mitchell W., Roger N. N., and Godfrey N., Industrial Robotics, McGraw hill Education.

L=Lecture, T= Tutorial, P=Practical, C=Credit

w.e.f. academic year 2019-20 and onwards

L	T	P	C
0	0	4	2

Course Code	3ME1115
Course Title	Computer Aided Engineering Laboratory

Course Outcomes (COs):

After successful completion of the course, student will be able to-

1. operate CAD packages to prepare solid model of components and assemble them to represent complex mechanical systems,
2. develop computer algorithm for design and analysis of mechanical systems.
3. apply the capabilities of finite element software to solve various engineering problems.
4. interpret and evaluate the quality of results obtained using FE software.

Practical sessions based on CAE software, CAD Modelling, Finite element Analysis on various engineering problems

L=Lecture, T= Tutorial, P=Practical, C=Credit

w.e.f. academic year 2019-20 and onwards

L	T	P	C
0	0	4	2

Course Code	**3ME1116**
Course Title	**Design and Dynamics Laboratory**

Course Outcomes (COs):

After successful completion of the course, student will be able to-

1. apply principles of kinematic analysis and dynamics to planer mechanisms,
2. interpret synthesis of mechanisms for specific applications,
3. formulate the mathematical models of real life engineering systems for vibration study.
4. design mechanical systems considering various aspects.

Practical sessions based on various design and dynamic aspects like Design of machine elements, balancing, vibration, analysis and synthesis of mechanisms, condition monitoring, fatigue.

L=Lecture, T= Tutorial, P=Practical, C=Credit

w.e.f. academic year 2019-20 and onwards

L	T	P	C
3	0	0	3

Course Code	**3ME1117**
Course Title	**Analysis of Manufacturing Processes**

Course Outcomes (COs):

After successful completion of the course, student will be able to-

1. evaluate and select of casting and welding processes by considering the related parameters for specified component,
2. evaluate and select machining and metal forming processes by considering the related parameters for specified component,
3. devise a mathematical model for various manufacturing processes,
4. select and apply modern engineering tools and techniques for analysis of manufacturing processes.

Syllabus **Hours:45**

UNIT-I **10 hours**

Forming: Fundamental theories of plasticity and mechanics of plastic deformation, Methods for solution of problems in metal forming such as slab analysis, upper bound analysis slip line field theory for plastic deformation, Deformation zone, geometry, hydrostatic pressure, workability, residual stresses, classification of metal forming processes and analysis of rolling process. High energy rate forming, metal spinning.

UNIT-II **10 hours**

Casting: Basic concepts of casting, factors influencing casting quality and production, metallurgical factors, melting practices, solidification, gating system design and analysis of casting processes.

UNIT-III **10 hours**

Welding: Introduction to welding processes, General concepts of weld design, permissible stresses, standards, calculation of the size of welds for static and dynamic loading, location and orientation of welds in an assembly, residual stresses and analysis, distortion and control, weldability.

UNIT-IV **10 hours**

Machining: High speed machining, hard turning, Mechanism of EDM, Electro Chemical Machining, AJM and USM processes, applications, effect of process variables on machining characteristics

UNIT-V **10 hours**

Design For Manufacturing: Design for casting, Design for welding

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Suggested Readings:

1. George E Dieter, Mechanical Metallurgy, McGraw hill Education.
2. Rossi B. E., Welding and its Application, McGraw hill Education.
3. P. C. Pandey, H. S. Shan Modern Machining Processes, McGraw hill Education.
   Ghosh and Mallik, Manufacturing Science, Affiliated East-West Press Pvt. Ltd.
4. R.S. Parmar, Welding Engineering and Technology, Khanna Publishers.

L=Lecture, T= Tutorial, P=Practical, C=Credit

w.e.f. academic year 2019-20 and onwards

3ME1211 Robotics and Manufacturing Automation [4 0 0 4]

Course Learning Outcome:

After successful completion of the course, student will be able to

- understand different elements of a robotic system
- analyze the robotic system with respect to kinematics and dynamics
- develop programme to train robotic system
- conceptulize an automatic system for a manufacturing unit.

Syllabus:

Robot technology:

Fundamentals of Robots: Introduction, fundamentals of robot technology, classification, applications, Systems overview of a robot, basic components, control system and components

Robot motion analysis and control:

Robot arm kinematics, direct & inverse kinematics solutions robot arm dynamics, Langrange-Euler formulation, Newton-Euler formulation, Generalized D'Alembert equation of motion, dynamic model of two axis planer, articulated, three axis SCARA robot.

Actuators and sensors in Robot- AC/DC motors, stepper motors and servo motor, direct drive robot, Hydraulic and pneumatic systems.

Components of electrical controls, Solenoids, Relays, Timers, Electro - hydraulic / pneumatic circuits. Uses of PLCs and Microprocessors in automation construction block diagrams, ladder diagram, latching and sequencing, interfacing, D/A converters and A/D converters, Difference between PLCs and Microprocessors.

Internal sensors, Position, Velocity, Acceleration, Proximity sensors, Touch and Slip sensors, Force and Torque sensors, External sensors, contact and non contact type like Vision, ranging, laser, acoustic, tactile etc. sensor selection and control.

Robot programming & languages.

Types of End Effectors and Design

End effectors , Classification , Force analysis and Gripper design.

Introduction to Mobile robots.

Automation:

Basics of automated work piece handling, preparation for automated handling, working principles and techniques, solution for feeding arrangements, transfer mechanisms, automated feed out of components.

Construction elements for automation, concepts of transfer lines, unit built machines, special purpose machines, Assembly automation, automated packaging, use of pneumatic, hydraulic systems for automation.

Hydraulic & Pneumatic Principles

Elements of system (Pumps, Filters, Seals, Valves and Accumulators etc) study of their functional and design characteristics, Pneumatic & hydro pneumatic circuits, Electro – hydraulic circuit, Electro - pneumatic circuits, Design of systems for specific requirements, introduction to servo systems, Maintenance of systems

Application of Artificial Intelligence to Robots, Robot Task Planning, Application of Expert system for Robot Application and Manufacturing, Introduction to fuzzy logic and Neural network.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. Craig J J, Introduction to Robotics, Mechanics and Control, , Pearson Education, New Delhi.
2. Richard D. Klofter and Thomas A. Chmielewski, Robotic Engg. an Integrated Approach, PHI, N. Delhi
3. M.P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas Godfrey, Industrial Robotics, Mc-Graw Hill Book Company.
4. Fu K.S., Gonzalez R.C., and Lee C.S.G., Robotics control, sensing, vision and intelligence, McGraw-Hill Book Co.
5. S. K. Saha, Introduction to Robotics, Tata McGraw-Hill Publishing Company Ltd., New Delhi
6. Mittal and Nagrath, , Robotics & Control , Tata McGraw-Hill Publishing Company Ltd., New Delhi
7. Ashitava Ghoshal , Robotics Fundamental Concepts & Analysis, Oxford University Press.
8. Geoffry Boothroyd , Automatic Assembly and Product Design
9. R Srinivasan , Hydraulic and Pneumatic Controls, TMH Publications,
10. Vickers , Industrial Hydraulics, TMH Publications
11. John W. Webb and Ronald A Reis, Programmable Logic controller: Principle & Applications, McMillan Publishing Company
12. Rangan, Sharma and Mani, Instrumentation Device & System, ISA Publications
13. FESTO/SMC Handbook

3ME1212 Advanced Machine Design II [3 0 0 3]

Course Learning Outcome:

After successful completion of the course, student will be able to

- design the components of overhead crane.
- design the thick cylinders subjected to external and internal pressure.
- formulate the optimization problems
- recognise the need of correction factor in gears.

Syllabus:

Gear Materials, corrected gear tooth design, power rating of gears as per BIS.

Design and analysis of crane structure. Design of main girder of overhead traveling crane. Testing of crane structure as per BIS.

Rotating Discs and rotating cylinder Discs with uniform thickness. Discs with uniform strength. Stresses in rotating cylinder with and without internal pressures.

Theory of Shells

Design of thick cylinders. Autofrettage. Wire wound cylinders, thick spherical shells.

Design of circular and non-circular plates with different loading conditions and supports.

Johnson's method for mechanical engineering design. Typical design equations, Classification, Examples.

The concept of optimization.

Classification of optimization problems, Engineering applications of optimization, Role of computers in optimization, Mathematical formulation of optimization problems, Graphical methods.

Optimum Design Concepts

Single variable optimization: optimality criteria, Region elimination method, Point estimation method, gradient based methods. Root finding using optimization techniques.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. G.M.Maitra, Hand book of Gear Design, THM Publication.
2. P. Rudenko, Material Handling Equipment, Mir Publication
3. Burr and Cheathaam, Mechanical Analysis & Design , PHI.
4. Robert D. Cook ,Optimisation in Engg. Design, Wiley Publication
5. J.S.Arora ,Introduction to Optimum Design , Mc Graw Hill.
6. S.S. Rao Optimisation, Theory & Applications, New Age Publications
7. Ravindran ,Optimum Design, Wiley Publication

3ME4215 Supply Chain Management [3 0 0 3]

Course Learning Outcome:

After successful completion of the course, student will be able to

- understand the concept of supply chain management.
- evaluate different supply chain strategies for a given situation.
- decide the appropriate demand forecasting method.
- interpret the need of appropriate production planning and inventory control policies in a supply chain.

Syllabus:

Concept of Supply Chain, integrated supply chain, Growth of Supply chain, Strategic decision in supply chain. Make or Buy Decision, Supplier development

Definition of Supply Chain Management, Scope, Supply Chain Management as a Management Philosophy, Function of SCM, Why Supply Chain Management, Value chain for Supply Chain Management. Customer focus in Supply Chain Management, Buyers Perspective, Suppliers Perspective, Stages of Development in Supplier Relations.

Supply Chain Strategies – (i) Cycle View (ii) Push & Pull View. Achievement of strategic fit through different steps, Obstacles to achieving Strategic Fit.

Supply Chain Drivers and Metrics: Drivers of supply chain performance, Frame work for structuring drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.

Demand Forecasting in Supply Chain: Role of forecasting in a supply chain, Characteristics of forecasts, Component of forecast and forecasting methods, Basic approach to Demand forecasting, Time-series forecasting methods, Measure of forecast errors.

Aggregate Planning in a Supply Chain: Role of Aggregate Planning in a Supply Chain, Aggregate planning problems, Aggregate planning Strategies.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. Sunil Chapra and Peter Meindl, Supply Chain Management, Pearson
2. Dr. R.P. Mohanty and Dr. S.G. Deshmukh, Essentials of Supply Chain Management, Jaico Pub. House.
3. David Simchi-Levi, Philip Kamiusky, Edith Simchi-Levi, Designing & Managing the Supply Chain, McGraw Hill.
4. Rahul V. Alterkar, Supply Chain Management: Concepts and Cases, PHI

3ME4225 Mechatronics [3 0 0 3]

Course Learning Outcome:
After successful completion of the course, student will be able to

- acquire knowledge of mechatronics system
- understand functionality of various components used in mechatronics system
- select the sensors,actuators and controllers for given application
- design and analyze mechatronics system

Syllabus:
Introduction: Definition of Mechatronics, Mechatronics in manufacturing Systems, Measurement Systems, Control Systems, Microprocessor Based Controllers Examples, Comparison between Traditional and Mechatronics approach.Review of fundamental of Electronics, Data conversion devices, sensors, micro sensors, transducers, electrical contacts, actuators and switches, contact less input devices, signal processing devices, timers, output devices**.**

Actuation System:
Mechanical Actuation Systems: Types of motion, Freedom and constraints, Loading, Gear Trains, Pawl & Ratchet, Belt & Chain drive, Bearing, Selection of Ball & Roller bearings, Mechanical aspects of motor selection.
Electrical Actuation Systems: Solenoids, D.C Motors, A.C.Motors Stepper Motors, Specification and control of stepper motors, Servomotors: D.C Servomotor and A.C Servomotor. Pneumatic & Hydraulic Systems: Power supplies, DCV, PCV, Cylinders, Rotary actuators.

System Models:
Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational Transnational Systems, Electromechanical Systems, Hydraulic Systems.

Controllers: System Models Controllers and Programming Logic Controllers Continuous and discrete process Controllers, Control Mode, Two Step mode, Proportional Mode, Derivative Mode, Integral Mode, PID Controllers, Digital Controllers, Velocity Control, Acceleration, force and torque controllers, Adaptive Control, Digital Logic Control, Micro Processors Control, Servo Amplifiers.
Definition, Basic block diagram and structure of PLC, Input/Output processing, PLC Programming: Ladder diagram, its logic functions, latching and sequencing, PLC mnemonics, Timers, internal relays and counters, Shift registers, Master and jump controls Data handling, Analog input/output, Selection of PLC.

Design of Mechatronics Systems:
Design process stages, Traditional Vs Mechatronics designs, Possible design solutions: Timed switch, Wind-screen wiper motion, Bath room scale - Case studies of mechatronics systems: A pick-and-place robot, Car park barrier, Car engine management system, Automatic Camera and Automatic Washing Machine only

Mechatronics Controls in Manufacturing Automation: Monitoring of manufacturing processes, On-line quality monitoring, Model-based systems, Hardware-in-the-loop simulation, Supervisory control in manufacturing inspection, Integration of hetrogeneous systems.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. HMT, Mechatronics, 1st Edition 1998, Tata McGraw Hill, New Delhi.
2. Devdas Shetty and Kolk, Mechatronics System Design, 1st Reprint, 2001, PWS Publishing Co., Boston.
3. James H.Harter, Electromechanics, 1st Edition 2003, Prentice-Hall of India, New Delhi.

4. M.D.Singh and J.G.Joshi, Mechatronics, 1st Edition 2006, Prentice-Hall of India, New Delhi.
5. W.Boltan, Mechatronics, 2nd Edition, Addition-Wesley Longman Ltd, New York,1999.

L	T	P	C
3	0	2	4

Course Code	**3ME1213**
Course Title	**Computer Aided Manufacturing**

Course Outcomes (COs):
After successful completion of the course, students will be able to-

1. illustrate the basic principles of part programming for CNC machining,
2. select and apply appropriate operations, cutting parameters, cutting tools and software to machine a part,
3. create and optimize a part program for machining a component,
4. justify the importance of FMS and CIM in manufacturing industry.

Syllabus: **Teaching Hours: 45**

Unit I **05 hours**

Numerical Controls: Types, evolution of controllers, components of NC/CNC system, specification of CNC system, classification of NC /CNC machines, transducers used, salient features, constructional details of CNC machines, axis designation, NC/CNC tooling.

Unit II **20 hours**

Fundamentals of Part Programming: Types of format, word address format, manual part programming for lathe and milling machine operations, subroutines, do loops, canned cycles, parametric subroutines. Computer-assisted programming languages, Automatically Programmed Tools language-types of statement, command and programming, CAD based CNC programming using CAM software.

Unit III **10 hours**

Flexible Manufacturing System: Definition, Group Technology, description and need of FMS, manufacturing cell, FMS application, System support equipment: Automated Guided Vehicle, Automated Storage and Retrieval Systems, Coordinate Measuring Machine, Cleaning and Washing stations, Analysis of FMS, Application of JIT and GT to FMS.

Unit IV **10 hours**

Computer Integrated Manufacturing: Scope, need and benefits of CIM, CIM wheel, CIM database and database management systems, Fundamentals of networking and networking technologies.

Self-study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory work:
Laboratory work will be based on above syllabus with minimum 10 experiments/exercise to be incorporated.

Suggested Readings:

1. M P Groover, Automation, Production Systems, and Computer-Aided Manufacturing, Prentice-Hall.
2. T.K. Kundra, P.N.Rao, N.K. Tewari, Numerical Control and Computer Aided Manufacturing, Tata McGraw Hill Education.
3. S.K.Sinha, CNC Programming, Galgotia Publications.
4. P.Rathakrishnan, Computer Numerical Control (CNC) Machines, New Central Book Agency.
5. William W. Luggen, Flexible Manufacturing Cells and System, Prentice Hall
6. P. Radhakrishan and S. Subramanyam, CAD CAM and CIM, New Age International.
7. S. Kant Vajpayee, Computer Integrated Manufacturing, Prentice Hall of India.

L=Lecture T= Tutorial P=Practical, C=Credit

w.e.f. academic year 2019-20 and onwards

L	T	P	C
3	0	2	4

Course Code	3ME12D103
Course Title	Computer Aided Production and Quality Management

Course Outcomes (COs):

After successful completion of the course, students will be able to-

1. utilize principles of production management,
2. formulate and solve forecasting and scheduling problems for the given situation using computational tools,
3. evaluate the inventory models for various applications,
4. analyze and interpret the quality issues using statistical software.

Syllabus: **Teaching hours: 45**

UNIT-I **08 hours**

Production Management: Introduction, concept of production systems, types of production systems

Forecasting Techniques: Quantitative and Qualitative forecasting, Forecasting error measures, Selection of forecasting techniques, usage of computational tools

UNIT-II **07 hours**

Scheduling: Introduction to scheduling, Deterministic scheduling for single machine, parallel machine, flow shop, open shop and job shop

UNIT-III **12 hours**

Inventory Planning and Control: Inventory models, inventory control systems, selective inventory control techniques, Just in Time

MRP: Introduction, objectives, benefits, structure and management of MRP, inputs, computational procedure, capacity planning.

ERP: Introduction, objectives, benefits, guidelines and implementation, hardware requirements, ERP software and tools, case studies

UNIT- IV **18 hours**

Quality Engineering: Quality Control, Quality Assurance, Quality Improvement, Total Quality Concept, Acceptance sampling methods, Control charts for variables and fraction defectives, Process capability studies; Statistical Process control: Concepts, Various SPC tools, Fishbone diagram, measures of central tendency, measures of dispersion; Design of Experiments: Completely randomized design, Factorial experiments; Introduction to Lean Six Sigma, Analysis using statistical software

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory work:

Laboratory work will be based on above syllabus with minimum 10 experiments/exercise to be incorporated.

Suggested Readings:

1. E S Buffa, Modern Production Management, Wiley.
2. P B Mahapatra, Computer-Aided Production Management, Prentice-Hall of India.
3. R J Ebert & E E, Adam, Production and Operations Management: Concepts, Models, and Behavior. Prentice Hall.
4. D C Montgomery, Design and Analysis of Experiments, John Wiley
5. D C Montgomery, Introduction to Statistical Quality Control, John Wiley
6. R Panneerselvam, & P Sivasankaran,, Quality Management, Prentice Hall India

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w.e.f. academic year 2019-20 and onwards

L	T	P	C
3	0	0	3

Course Code	3ME12D201
Course Title	Pressure Vessel and Piping Design

Course Outcomes (COs):

After successful completion of the course, students will be able to-

1. explain fundamentals of pressure vessel and piping design,
2. make use of the codes (ASME section VIII) for pressure vessels and piping design,
3. analyze pressure vessels and piping for internal and external pressure,
4. design various components of pressure vessel and piping subjected to fluctuating load.

Syllabus **Hours: 45**

UNIT-I **10 hours**

Stresses in Pressure Vessels: Stress categories, stress intensities, design of shell and tube under external and internal pressure, design of formed head, reinforcement required for openings, weld joint categories and weld design for pressure vessel, layered vessel.

UNIT-II **10 hours**

Design of Pressure Vessels as per ASME Codes: Design of pressure vessel components such as shell, heads, nozzles, flanges as per ASME codes.

UNIT-III **10 hours**

Design Considerations for Pressure Vessels: Design of externally pressurized vessels, tall vertical vessels while considering various loadings such as internal pressure, external pressure, wind load, seismic load, snow load, etc and combined load, design of support for vertical & horizontal vessels.

UNIT-IV **15 hours**

Piping System Design: Piping elements, materials used for piping, pipe size techniques, stresses in pipe, thermal stresses in pipe, pipe support design, stress analysis in piping, and dynamic analysis of piping

Self-study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings:

1. M.V. Joshi & V.V. Mahmani, Process Equipment Design, Macmillan
2. J.F. Harvey, Theory and Design of Pressure Vessels, CBS Publishers
3. Brownell and Young, Process Equipment Design, John Wiley.
4. Denis R. Moss, Pressure Vessel Design Manual, Gulf Publishing Company.
5. ASME Code Section VIII, The American society of Mechanical Engineers.
6. IS 875 for Design Loads (other than Earth quake) for Building and Structures, Bureau of Indian Standard.
7. IS 1893 Criterion for Earth Quake Resistant Design of Structures, Bureau of Indian Standard.
8. ASME Code for Piping Design, The American Society of Mechanical Engineers.

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w.e.f. academic year 2019-20 and onwards

L	T	P	C
3	0	0	3

Course Code	3ME12D302
Course Title	Finite Element Analysis

Course Outcomes (COs):

After successful completion of the course, students will be able to-

1. formulate the structural engineering and heat transfer problems into finite element model,
2. derive and solve the stiffness matrix, displacement matrix and load vectors for one/two dimension structural and heat transfer problems,
3. apply the finite element software to solve the structural engineering, heat transfer and manufacturing issues,
4. appraise the applications and limitations of FEA.

Syllabus **Teaching Hours: 45**

UNIT-I **05 hours**

Introduction to FEM: General applicability, Engineering Applications, General description of FEM, Comparison of FEM with other methods of analysis.

UNIT-II **15 hours**

Formulation Techniques: General procedure of finite elements method. Discretization, interpolation polynomials, formulation of element characteristic matrices & vectors –direct approach, variational approach, weighted residual approach. Assembly of element matrices & vectors and derivation of system of equations, solution of FE equations, computation of element resultants.

UNIT-III **10 hours**

Isoparametric Element Formulations: Higher order and isoparametric element formulations, continuity conditions, numerical integration.

UNIT-IV **10 hours**

Solid and Structural Mechanics Applications: One dimensional problems static analysis of trusses. Analysis of plates, solid of revolution, and Dynamic analysis: Dynamic equations of motion, consistent & lumped mass matrices, consistent mass matrices in global co-ordinate system, free vibration analysis, Eigen value problems, dynamic response calculations, Scalar fields problems: Steady state heat transfer (two dimensional problems), torsion, potential flow seepage, fluid flow in ducts.

UNIT-V **05 hours**

Applications: FEA in heat transfer, metal forming and metal cutting processes.

Self-study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings:

1. S.S. Rao,The Finite Element Method in Engg., B H Publication.
2. C.S. Desai C.S. and J.T.Abel, Introduction to Finite Element Method, CBS Publication.
3. Robert Cook, Makas ,David Malkus and Michel Plesha. Concept & Application of Finite Element Analysis, Wiley

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w.e.f. academic year 2019-20 and onwards

L	T	P	C
0	0	10	5

Course Code	**3ME1215**
Course Title	**Minor Project**

Course Outcomes (COs):

After successful completion of the course, students will be able to-

1. compile information related to recent trends in the industry and society,
2. formulate the problem definition,
3. design, implement, test and verify the proposed solution related to problem definition,
4. compile, comprehend and present the work carried out,
5. mange the project within the given timeline.

The minor project shall be based on the recent trends in technology, system/process analysis, construction/fabrication/production techniques, design methodologies etc. The student(s) shall carry out a comprehensive project at relevant Academic/R&D/Industrial organization based on one or more of the aspects such as prototype design, product preparations, working models, fabrication of set-ups, laboratory experiments, process modification/development, simulation, software development, integration of software and hardware, data analysis, survey etc.

The student is required to submit comprehensive project report based on the work.

L=Lecture T= Tutorial P=Practical, C=Credit

w.e.f. academic year 2019-20 and onwards

3ME1302 Major Project Part I – Full Time [0 0 0 15]

Course Learning Outcome

The course provides an opportunity to the student to explore their knowledge in the area of their interest. Student will apply idea into application through experiments/ simulation. It will also help them to decide the project area / topic for further research work in their life. . As an outcome of the course, student will be able to develop:

- Problem formulation techniques.
- Analysis techniques of published data.
- Identification of scope and objectives of research work.
- Techniques for the design of experiments.
- Associated administration for project work.
- Development of compilation skill.
- Writing skill.
- Presentation skill.
- Technical Paper writing.
- Report preparation techniques.
- Fundamentals, information, reviews and in-depth knowledge in the desired area.

Syllabus

The Major Part I is aimed at training the students to analyze independently any problem in the field of CAD/CAM. The project may be analytical or computational or experimental or combination of them based on the latest developments in the said area. At the end of the semester, the students will be required to submit detailed report. The Major Project Part I should consists of objectives of study, scope of work, critical literature review of the Major Project and preliminary work pertaining to the said work.

3ME1402 Major Project Part II – Full Time [0 0 0 15]

Course Learning Outcome

The course provides an opportunity to the student to explore their knowledge in the area of their interest. Student will apply idea into application through experiments/ simulation. It will also help them to decide the project area / topic for further research work in their life. . As an outcome of the course, student will be able to develop:

- Problem formulation techniques.
- Analysis techniques of published data.
- Identification of scope and objectives of research work.
- Techniques for the design of experiments.
- Associated administration for project work.
- Development of compilation skill.
- Writing skill.
- Presentation skill.
- Technical Paper writing.
- Report preparation techniques.
- Fundamentals, information, reviews and in-depth knowledge in the desired area.

Syllabus

Major Project Part II is a continuation of the work done by the student during semester III. The student is required to submit thesis as a partial fulfillment of the M. Tech degree. The thesis should consist of detailed study of the problem under taken, concluding remarks and scope of future work, if any. The project report (thesis) is expected to show clarity of thought and expression, critical appreciation of the existing literature and analytical, computational and experimental aptitude of the student.