UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Title of Course: Advanced Optimization Techniques
Course Code: PE201
L-T-P Scheme: 3-1-0 **Course Credits: 4**

Introduction:

In Engineering Designs, it is often required to arrive at the optimum design with respect to certain objectives and given constraints. Whenever there is more than one feasible design, an optimum design has to be selected. The purpose of this course would be to cover classical techniques, nonlinear techniques, nonlinear programming methods, and linear programming methods with large number of examples and applications. Emphasis of the course would be on actual usage of the above methods on numerical computations and applications. A final project in the area of student's interest would be selected and appropriated methods would be used to arrive at the solution. This course would be of immediate interest to those who have to use optimization methods for the research projects.

Objective: Many decision problems in logistics can be modelled as optimization problems. In manufacturing systems, for example, decisions on the acquisition, utilization and allocation of production resources must be made in the most efficient and effective way. This course covers advanced optimization techniques for problems arising in logistics, manufacturing, transportation, and many other fields. The course provides intense coverage of modelling and optimization problem solving. Optimization methodologies include linear programming, integer programming, and constraint programming. The ultimate goals of this course are: to improve the capacity of modelling complex optimization problems in such a way that they can be solved using standard software packages; to provide an understanding of principal optimization problem solving procedures and to develop specialized solution procedures for non-standard problems.

Learning Outcomes:

1. Apply mathematic foundation to understand the basic knowledge about optimization.
2. Comprehension for the definitions or theories of optimization.
3. Application for the optimization tools to analysis and design of engineering applications. With analysis capability on describing problems, defining specifications and constructing model for engineering optimization.

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Course Description

Course Contents:

Unit –I:
Introduction to Advanced Optimization Techniques, Learning objectives

Unit –II:
Classical optimization techniques for unconstrained optimization. Karush-Kuhn-Tucker conditions.

Unit –III:
Sensitivity analysis for linear programming problems. Non-linear programming.

Unit –IV:
Penalty function methods. Sequential linear programming. Feasible direction methods

Unit –V:
Quadratic programming. Geometric programming. Integer programming. Fuzzy linear programming.

Text Book:

1. Mechanical Design Optimization Using Advanced Optimization Techniques By R. Venkata Rao, Vimal J. Savsani
2. Engineering Optimization: Theory and Practice by S. S. Rao (John Wiley & Sons)

Reference Books:

1. Mechanical Design Optimization Using Advanced Optimization Techniques By R. Venkata Rao, Vimal J. Savsani

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Course Description

Title of Course: Mechatronics
Course Code: PE202
L-T-P Scheme: 3-1-0 **Course Credits: 4**

Introduction:

This course introduces Mechatronics Engineering as a multi-disciplinary professional area. The course shows how to integrate the principles of mechanics, electronics and computing to generate simple, economical and reliable mechatronic systems. The course will then build on your theoretical knowledge to understand how mechatronic systems or robots are programmed. The course will specifically:

- Provide an understanding of the role of mechatronics based technology in industry;
- Develop analytical skills for analysis and synthesis of both DC and AC electric circuits;
- Develop skills required for writing computer programs for embedded systems;
- Practice the art of designing a mechatronics system.

Objective:

Upon completion of this course, the Students will:
1. Have a strong foundation in science and focus in mechanical, electronics, control, software, and computer engineering, and a solid command of the newest technologies.
2. Be able to design, analyze, and test "intelligent" products and processes that incorporate appropriate computing tools, sensors, and actuators.
3. Be able to demonstrate professional interaction and communicate effectively with team members.
4. Be able to work efficiently in multidisciplinary teams.
5. Be prepared for a variety of engineering careers, graduate studies, and continuing education
6. Practice professional and ethical responsibility, and, be aware of the impact of their designs on human-kind and the environment.

Learning Outcomes:

Mechatronics engineer will be able to:

1. Employ the knowledge of mathematics, science, and engineering.
2. Design and conduct experiments to evaluate the performance of a mechatronics system or component with respect to specifications, as well as to analyze and interpret data.
3. Design mechatronics component, system or process to meet desired needs.
4. Define and solve engineering problems.
5. Use the techniques, skills, and modern mechatronics engineering tools necessary for engineering practice.
6. Function effectively as members of multidisciplinary teams.
7. Communicate technical matters effectively in oral, written, and graphical form.

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Course Description

Course Contents:

Unit –I:
Introduction to mechatronic systems and components

Unit –II:
Principle of basic electronics. Microprocessors and their applications, integrated circuits, sensors, actuators, and other electrical/electronic hardware in mechatronic systems.

Unit –III:
Principles of electronic/system communication. Interfacing, DA and AD converters, software and hardware principles and tools to build mechatronic systems.

Unit –IV:
Selection of mechatronic systems, namely, sensors like encoders and resolvers. Stepper and servomotors; Solenoid like actuators; Transmission elements like Ball screw; and Controllers.

Unit –V:
Analysis and synthesis of mechatronic systems with applications to robotics, CNC systems, and others.

Text Book:

1. A Text Book of Mechatronics 3rd Edition (ER. R. K. RAJPUT)
2. Mechatronics by Singh Kumar Ashok (Author)

Reference Books:

1. Mechatronics: Principles and Applications by Onwubolu (Author)
2. Introduction to Mechatronics by Appukuttan (Author)

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Course Description

Title of Course: MACHINE TOOL DESIGN
Course Code: PE203
Year: 1st **Sem: Second**
L-T Scheme: 3-1 **Course Credits: 4**

Course Objectives:

- To Show the students configuration of basic machine tools and state their uses. Machine tools - specification and classifications and to familiarize with the concept of Generatrix and Directrix and tool – work motions in different operations.
- To introduce about General constructions and function of various machine tools with applications.
- To introduce the students with automation technique applied to machine tools & its merits
- To show the students basic configuration & Kinematic structure of centre lathe ,shaping, planning and slotting machine, milling machine, capstan lathe ,turret lathe.
- To enable the students to determine time required for various operations like turning , drilling , shaping , milling.
- To illustrate the students with the basic feature of Computer numerical controlled machine tools.
- Learn about the design procedures for complex machine members like Gears, spindle and guide ways Parts etc.
- Use standard design hand books and codes rather than simple strength of materials approach.
- Be exposed to the System Design concept in place of element design approach.

Course Outcomes:

At the end of this lesson, the student would be able to :

- Differentiate between Machine and Machine tool. Describe various types of mahine tools with its applications.
- Describe the advantages of automation and how its affects production rate.
- Draw & explain Kinematic structure of centre lathe ,shaping, planning and slotting machine, milling machine, capstan lathe ,turret lathe.

Course Description

- Evaluate time and power required for various operations like turning , drilling , shaping , milling.
- Design spindle, gear and gear box subjected to static and dynamic loads.
- Design engine parts including connecting rod, crank shaft, pistons and cylinders.
- Design power transmission systems including head stock, tail stock, carriage, table, knee, column and over arms to achieve desired static & fatigue strength,
- Design machine tool elements including beds guide ways.

Course Contents:

Design requirements of machine tools. A design approach for machine tools. Identification and quantification of objectives and constraints in machine tool design. Estimation of power requirements and selection of motor for metal cutting machine tool spindles. Design of gearbox, spindle and guide ways. Principles of design of structural components, namely, head stock, tail stock, carriage, table, knee, column and over arms to achieve desired static & fatigue strength, stiffness, dynamic characteristics and other requirements.

Text Books:

1. Devris W R, “Analysis of Material Removal Processes”, Springer – Verlag, 1992.

2. N Acherkan , “Machine Tool Design” , Volume- 1-4, MIR Publishers, Moscow, 1969

3. Mishra P K, “Non Conventional Machining”, Narosa Publishing House, New Delhi

4. Panday P C, Shan H S, “Modern Machining

5. Schey A, John, “Introduction to Manufacturing Processes”, McGraw Hill Book Company, New York, 1987.

6. Jain R K, “Production Technology”, Khanna Publishers Delhi, 1995.

7. HMT Bangalore, “Production Technology”, Tata McGraw Hill, New Delhi, 1980.

References Books :

1. Manufacturing Engineering and Technology by Kalpakjian

2. Stephenson & Agapion, Metal Cutting Theory and Practice, Taylor and Francis, NY.

3. M.C. Shaw, Metal Cutting Principles and Practices, Oxford University Press.

4. G.C. Sen and A. Bhattacharyya, Principles of Machine Tools,
5. Acharkan, Machine Tool Design, Vol. I, II, III and IV, Mir Publication, Moscow.
6. A.B. Chattopadhyay, Machining and Machine Tools, Wiley India
7. Mehta, NK, "Machine Tool Design and Numerical Control" Tata McGraw Hill

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Title of Course: COMPUTER INTEGRATED MANUFACTURING SYSTEMS
Course Code: PE204
L-T Scheme: 3-1 **Course Credits: 4**

Introduction:

This course provides in-depth coverage of Computer Integrated Manufacturing system. It contains a high proportion of hands-on study, particularly in the areas of Computer Aided Manufacturing (CAM), and Computer Numerical Control (CNC). Apart from the key area of CAD/CAM and CNC it includes studies of Concurrent Engineering, Group Technology, Computer Aided Process Planning and Flexible Manufacturing Systems. You will work in computer labs and workshops to complete group projects by using knowledge gained from a wide range of other subjects previously or concurrently studied which include mechanical design, process planning, CNC tool path generation, and CNC machine tool operation.

Course Objectives:

- To develop an understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques.
- To develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.
- To Obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc, as they apply to factory management and factory floor operations.
- To Describe the integration of manufacturing activities into a complete system
- Acquire sensitivity to human-factors related issues as they affect decision making in the factory environment.
- To develop an understanding of classical and state-of-the-art production systems, control systems, management technology, cost systems, and evaluation techniques.

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Course Description

Course Outcomes:

At the end of this lesson, the student would be able to :

- Relate concepts and components of computer integrated manufacturing (CIM) and computer Aided Manufacturing (CAM) to practical challenges
- Demonstrate the knowledge of computer numerical control (CNC) and CNC programming
- Use commercial CAD/CAM software to process product models
- Demonstrate the knowledge of the operation of CNC machines.
- Analyze and evaluate layouts of automated industrial/manufacturing systems.
- Define Computer Integrated Manufacturing (CIM) and describe its main features.
- Demonstrate an awareness of personal and process safety practices and procedures.
- Set up, configure, troubleshoot, and program a miniature production system in the lab.
- Identify and describe the components and processes of a Flexible Manufacturing System.
- Evaluate various Inspection Technologies and choose appropriate ones for a given application.
- Describe the role of Manufacturing Production Planning and Scheduling System in a CIM environment.
- Analyze and explain the links between Computer Aided Design, Engineering, and Manufacturing; and CIM.
- Describe the processes involved in the design, manufacture, and demand fulfillment of a typical product in a CIM environment.

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Course Description

Course Contents:

Evolving manufacturing environment, New competitive challenges, Evolving Role of Information Technology, CIM Systems: Flexibility, Integration and Automation Opportunities, Automation of information and manufacturing systems, Automation strategies, Towards Flexible Automation, Islands of automation, Evolution Towards CIM systems, Computer based integration between various functions - manufacturing, sales, design, materials etc Flexible Manufacturing Systems (FMS) as mini CIM, Computer Integrated Production Management, ERP, Group technology, Concurrent Engineering, Simulation and AI in CIM systems, CIM and Beyond.

Text Books:

1. Goldratt, Eliyahu M. (1992) **The Goal**. North River Press.

2. Groover, Mikell P. (2007). **Automation, Production Systems, and C.I.M**. Prentice-Hall: Englewood Cliffs, N.J.

3. Computer Integrated Manufacturing System- Y. Koren, McGraw-Hill.

References Books :

1. CAD/CAM/CIM- P. Radhakrishnan, S. Subramanyan and V. Raju- New Age International. 2. Computer Integrated Manufacturing- Paul G. Ranky, Prentice Hall International.

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Course Description

Title of Course: Computer-Aided Manufacturing Lab
Course Code: PE291
Year: 1st Year **Semester: Second**
L-T-P Scheme: 4-0-0 **Course Credits: 2**

Introduction:

Computer-aided technologies is the use of computer technology to aid in the design, analysis, and manufacture of products.

Advanced CAx tools merge many different aspects of the product lifecycle management (PLM), including design, finite element analysis (FEA), manufacturing, production planning, and product.

Objective:

The CAD/CAM Lab is located in 119 and is available for the development of designs utilizing both 2D and 3D Software. The lab is available to graduate students in the Department of Mechanical Engineering. Student technicians are available 30 hours each week to assist in the Computer Aided Design (CAD) package has three components: a) Design, b) Analysis, c) Visualization. Specially trained graduate students with a strong understanding of the Computer-aided design (CAD) is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design and Computer-aided manufacturing (CAM) is the use of computer systems to plan, manage, and control the operations of a manufacturing plant through direct or indirect computer interface with plant's resources.

CAD/CAM LAB Equipment & Software's:

- Ansys 12.1
- Pro Engineering Wildfire 5.0
- CATIA V5
- Auto CAD 2011
- LCD Mounting Projector
- HP Printer 1020, 1008 Epson 2090 .

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Course Description

Course Contents:

- Setting up of drawing environment by setting drawing limits, drawing naming the drawing, naming layers, setting line types for different layers using
- Various type of lines in engineering drawing, saving the file with .dwg extension.
- To make an isometric dimensional drawing of a connecting rod using isometric grid and snap.
- Draw Different type's bolts and nuts with internal and external threading in Acme and Square threading standards. Save the bolts and nut as blocks suitable for insertion.
- To model and assemble the flange coupling as per the dimensions given and also convert the 3D model into different vies with Bill of materials.
- To model and assemble the Screw jack as per the dimensions given and also convert the 3D model into different vies with Bill of materials.
- To model and assemble the strap joint of Gib & cotter as per the dimensions given and also convert the 3D model into different vies with Bill of materials.
- To write the manual part program to the given dimensions and execute in CNC Lathe for Box Turning Cycle.
- To write the manual part program to the given dimensions and execute in CNC Lathe for Multiple Turning Cycle.
- To write the manual part program to the given dimensions and execute in CNC Lathe for Taper Turning Cycle.
- write the manual part program to the given dimensions and execute in CNC Lathe for Multiple Grooving Cycle.