

## **M.Tech Production Engineering 1<sup>st</sup> year (2<sup>nd</sup> semester)**

**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.

### **Course Outcome:**

- CO1.** Students will able to apply knowledge of optimization in industry as well as research fields
- CO2.** Students will able to understand various software tools.
- CO3.** Students will able to recognize and formulate problems that arise in engineering in terms of optimization problems
- CO4.** Students will able to get experience of how such problems are solved .
- CO5.** Students will able to do programming.

**Course Mapping:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3				3	3
CO2		3	3	3	3					3	
CO3	3	3	3		3	3	3				
CO4	3	3	3		3	3	3		3	3	3
CO5	3	3	2	3	3				3		1
CO6			3	3	3				3		3

3 - High; 2 - Medium; 1 - Low

**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

**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.

**Course Outcomes:**

Mechatronics engineer will be able to:

- CO1.** Generate conceptual design for Mechatronics products based on potential customer requirements
- CO2.** Select appropriate sensors and transducers and devise an instrumentation system for collecting information about processes
- CO3.** Design a control system for effective functioning of Mechatronics systems using digital electronics, microprocessors, microcontrollers and programmable logic controllers
- CO4.** Determine the performance of a Mechatronics system
- CO5.** Understand MEMS fabrication techniques

## Course Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3			3	3		3
CO2	3		3	3		3		3	3		3
CO3	3	3	3		3			3	3		1
CO4		3	2	3	3			3	3		3
CO5	3	3	3			3	3				3

3 - High; 2 - Medium; 1 - Low

## 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:

3. A Text Book of Mechatronics 3rd Edition (ER. R. K. RAJPUT)
4. Mechatronics by [Singh Kumar Ashok](#) (Author)

### Reference Books:

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

**Title of Course: MACHINE TOOL DESIGN**

**Course Code: PE203**

**Year: 1<sup>st</sup>**

**L-T Scheme: 3-1**

**Sem: Second  
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, planing 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 :**

**CO1.** Understand basic motions involved in a machine tool.

**CO2.** Design machine tool structures.

**CO3.** Design and analyze systems for specified speeds and feeds.

**CO4.** Select subsystems for achieving high accuracy in machining.

**CO5.** Understand control strategies for machine tool operations.

**CO6.** Apply appropriate quality tests for quality assurance.

**Course Mapping:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	3	-	-	-	-	3	3	3
CO2	3	3	-	3	-	3	-	-	-	-	3
CO3	3	3	-	3	3	-	3	-	-	-	3
CO4	3	3	2	3	3	3	-	-	2	3	3
CO5	3	3	-	3	3	3	3	-	3	-	3
CO6	3	3	3	3	3	-	-	-	3	3	1

**3 - High; 2 - Medium; 1 - Low**

**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

**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.

**Course Outcomes:**

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

**CO1:** Understand the effect of manufacturing automation strategies and derive production metrics.

**CO2:** Analyze automated flow lines and assembly systems, and balance the line.

**CO3:** Analyze automated flow lines and assembly systems, and balance the line.

**CO4:** Design a manufacturing cell and cellular manufacturing system.

**CO5:** Develop CAPP systems for rotational and prismatic parts.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	3	3	-	-	3	3	3	3
CO2	3	3	3	3	3	-	-	3	-	3	3
CO3	3	3	3	3	3	3	3	-	-	3	1
CO4	3	3	2	3	3	3	3	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	3	-

**3 - High; 2 - Medium; 1 - Low**

### **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.

**Title of Course: Computer-Aided Manufacturing Lab**

**Course Code: PE291**

**Year: 1<sup>st</sup> Year**

**L-T-P Scheme: 4-0-0**

**Semester: Second**

**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 .

**Course Outcomes:**

**CO1.** Develop Auto LISP programs for drawing machine elements.

**CO2.** Develop codes for analytical and synthetic curves.

**CO3.** Draw machine elements in sketcher, part and assembly modes.

**CO4.** Generate automated tool paths and G-codes for machining components.

**CO5.** Validate DXF, IGES and STEP formats for exchange of CAD files.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-		-	3	-	-	-	-	3
CO2	3	3	-	3	-		-	-	-	-	3
CO3	3	3	-		-	3	-	-	3	-	3
CO4	3	3	-	3	-	3	-	-	1	-	3
CO5	2	3	-	3	-	3	-	-	3	-	2

**3 - High; 2 - Medium; 1 - Low**

## **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.