Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NMSC501	Manufacturing Systems Engineering	3	1	0	4

Course Objective

This Course on Manufacturing Systems Engineering will help the M.Tech. Industrial Engineering students to understand the system dynamics involved in manufacturing systems, viz., Process systems, automation systems, information systems, model-based system engineering and system dynamics modelling simulation.

Learning Outcomes

After attending this course, the students will be expected to get a developed understanding on:
- Managing the technological flow, plan, design and dynamics, and optimizing the workflow and cost of the manufacturing system.
- The models and RFLP approach to prepare the model-based systems engineering models using Capella software.
- Hands-on experience in simulating causal flow diagrams on Vensim software.

Unit	Topics to be Covered	Lecture Hours (L) and Tutorial Hours (T)	Learning Outcome
1	**System Representations:** Functional diagram representation of systems with examples, Input-Output models, system simulation. Fundamentals of Manufacturing and Introduction to Manufacturing Systems, Fundamentals of Systems, Types of Production, and Structure of Manufacturing Systems by covering the discussion on the relevant case studies.	6 L	Understanding the meaning of systems, how manufacturing and production segments have been considered as systems, and their structure in detail.
2	**Identifying Stakeholders and their Preferences:** Covers the systems design and its requirements engineering and modeling as per the stakeholders' requirement through case studies.	3 L+1 T	Understanding the motivation behind why systems are built; why and how stakeholders' preference is acquired and modeled.
3	**Process Systems of Manufacturing Systems:** Material and technological information flow in manufacturing systems, Product and process planning and design, and Manufacturing optimization through case studies.	8 L+1 T	Understanding of the basic principles of production process technology to develop a product. Manufacturing optimization for deciding optimum machining conditions.
3	**Introduction to System Dynamics Modelling:** Techniques to model the dynamics of manufacturing systems by causal mapping, Simulation of causal loop and flow diagrams using Vensim Software by covering different scenarios and examples.	4 L+3 T	Understanding the system dynamics and its modelling using causal mapping using Vensim software to prepare the simulation of causal loop diagrams.

4	**Automation systems for manufacturing:** Industrial automation, Principles of Computer-Integrated Manufacturing, Factory automation, Role of robotics in automation in manufacturing firms, Computer-aided Manufacturing, Flexible Manufacturing System; discussions on examples from different manufacturing companies.	6 L+2 T	Understanding the present state of factory automation and computer-integrated manufacturing for automated flows of materials and technological information, the Role of Robotics in automation in manufacturing firms with the discussion of relevant case studies
5	**Information Systems for Manufacturing:** Computer-based Production Management Systems, Integration with other Industry information systems such as ERP, PLM, etc., and case discussions.	5 L+2 T	Understanding the fundamentals of the role of information systems in efficiently planning production schedules and online production control.
6	**Introduction to Model-based Systems Engineering:** Various approaches for representing system development lifecycle, such as waterfall model, Vee model and their applications. Systems modelling language (SysML), SysML structure Diagrams, Requirement-Functional-Logical-Physical (RFLP approach), Introduction to MBSE Modelling.	6 L+3 T	Understanding the systems modelling language. Understanding a digital-modelling environment, MBSE creates a common standards-based approach to documenting the system that can be programmatically validated to remove inconsistencies within the models. Hands-on working on Capella (MBSE software) for systems modelling.
7	**Manufacturing Strategy:** Role of the industrial revolution, Industrial Structure and manufacturing efficiency, Approaches to manufacturing excellence and case discussions.	4 L+2 T	Understanding the evolving manufacturing systems and strategies with the industrial revolutions and technology enhancements with relevant case discussion.
	Total	42 L+14 T	

Textbooks:

1. Katsundo Hitomi, Manufacturing Systems Engineering, Second edition, Taylor & Francis, 2017.
2. Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, Pearson, 2018.

Reference Books:

1. Jon Holt and Simon Perry, SysML for Systems Engineering, A model-based approach, 3rd Edition (2018).
2. Craig W. Kirkwood, System Dynamics: A Quick Introduction, Arizona State University (1998).