



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

PERFORMANCE MODELING AND ANALYSIS OF MANUFACTURING SYSTEMS								
III Semester: CAD / CAM								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
BCCD26	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes:			Total Classes: 48			
Prerequisites: Special Manufacturing Process								

I. COURSE OVERVIEW:

Manufacturing processes convert raw material to finished product for customer usage. Performance of a product depends on its quality in terms of accuracy of size, shape and constraints/relation between its features. Conversion cost and time can be optimized by judicious usage of energy, motions, resources, time etc without affecting the quality desired by the customer. Objective of learning this subject is to make the automated manufacturing practices/methods being implemented at leading industries across the globe, which ultimately leads to more customer satisfaction in terms of low cost and high quality.

II. COURSE OBJECTIVES:

The students will try to learn:

- I. The importance of automation in manufacturing.
- II. The influences of various stochastic models to industry
- III. The illustrations of Queuing models and Queuing networks in manufacturing systems.
- IV. The definition of Petri Nets and various types of Petri Nets used in manufacturing systems.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

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| CO1 | Recall the basics of Automated manufacturing systems |
| CO2 | Identify a type of system based on type of its dynamics, ways of analyzing system |
| CO3 | Summarize the Work in process, Machine utilization, Flexibility and Performability for industry configurations |
| CO4 | Illustrate Automated Manufacturing and their influence on industries |
| CO5 | Develop simulation model for dynamic discrete-event stochastic system |
| CO6 | Analyze M/M/m Steady state analysis for queuing in manufacturing systems |

IV. COURSE CONTENT:

MODULE -I: Manufacturing Systems and Control (10)

Automated Manufacturing Systems, Modeling, Role of performance modeling, simulation models, Analytical models. Product cycle, Manufacturing automation, Economics of scale and scope, input/output model, plant configurations; Performance measures, Manufacturing lead time, Work in process, Machine utilization, Throughput, Capacity, Flexibility, Performability, Quality Control Systems, Control system architecture, Factory communications, Local area network interconnections, Manufacturing automation protocol, Database management system.

MODULE -II: Manufacturing Processes (09)

Examples of stochastics processes, Poisson process, Discrete time Markov chain models, Definition and notation, Sojourn times in states, Examples of DTMCs in manufacturing, Chapman-Kolmogorov equation, Steady-state analysis. Continuous Time Markov Chain Models, Definitions and notation, Sojourn times in states, examples of CTMCs in manufacturing – Equations for CTMC evolution – Markov model of a transfer line. Birth and Death Processes in Manufacturing – Steady state analysis of BD Processes – Typical BD processes in manufacturing.

MODULE -III: Queuing Model (09)

Notation for queues, Examples of queues in manufacturing systems, Performance measures, Little's result. Steady state analysis of M/M/m queue.

Queues with general distributions and queues with breakdowns – Analysis of a flexible machine center.

MODULE -IV: Queuing Networks (10)

Examples of QN models in manufacturing, Little's law in queuing networks, Tandem queue, An open queuing network with feedback, An open central server model for FMS, Closed transfer line, Closed server model, Garden Newell network

MODULE -V: Petri Nets (10)

Classical Petri Nets, Definition, Transition firing and reachability, Representational power, properties, Manufacturing models. Stochastic Petri Nets, Exponential timed Petri Nets, Generalized Stochastic Petri Nets, modeling of KANBAN systems, Manufacturing models.

V. TEXT BOOKS:

1. N. Viswanadham, Y. Narahari, "Performance Modelling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi, 1st edition, 2013.
2. K. S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", Wiley Publications, 2nd edition, 2013.

VI. REFERENCE BOOKS:

1. S, C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 3rd edition, 2013.

VII. ELECTRONICS RESOURCES:

1. <http://nptel.ac.in/courses/112/103/112103293/>

VIII. MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Assignments
4. Model question paper – I
5. Model question paper – II
6. Lecture notes
7. PowerPoint presentation