

I SEMESTER

15ML01 STATISTICS, QUALITY CONTROL AND RELIABILITY ENGINEERING

vide Industrial Engineering 15MN01

15ML02 MANUFACTURING ENGINEERING AND INDUSTRIAL MANAGEMENT

vide Industrial Engineering 15MN01

15ML03 DESIGN OF LEAN PRODUCTION SYSTEM

3 0 0 3

INTRODUCTION: Evolution of manufacturing – Measures of competitiveness - Functional areas of the firm – product design, manufacture, delivery. Production system – Types of production systems – Ten steps to lean production. The role of inventory – types of inventory – inventory costs and tradeoffs. The role of information – Principles of production system. Value added and waste elimination - Types of waste – Lean principles – basic lean tools overview. (5)

LAYOUT AND GROUP TECHNOLOGY: Facilities layout – Group technology - Types of layout: Process layout, product layout, cell layout – Product coding and classification schemes – Part family – Establishing part and machine groups - Performance measure of layouts – Bin and pallet design and calculations. (6)

INTEGRATED QUALITY: Statistical quality control – Integrated quality control – Types of inspection: off-line vs on-line - Process analysis tools and techniques: 100% inspection (screening) – Jidoka – Process capability study – Lean six sigma – Teams and quality circles – self certification attitude – Industry language (SPC) - Quality control departments. (5)

INTEGRATED RELIABILITY: Role of maintenance – Integrated productive maintenance – Total productive maintenance – Downtime – Lean production – Benchmarking – Pilot areas – Predictive maintenance – Computerized maintenance management systems – Continuous improvement – Reliability – TPM implementation. Live case studies. (5)

LEAN SUPPLY CHAIN: Forecasting systems – Supply chain management concepts – Aggregate planning – Master production schedule – Make the vendors lean – Rules for lean cell design – product knowledge and functions. (4)

DECENTRALIZED PULL SYSTEMS: Pull vs Push production system - Pull production - Different models of pull production - Kanban systems – constant work in process pull alternative. (4)

ERGONOMICS IN CELL DESIGN: Lean production and ergonomics – Manufacturing workstation design: anthropometric data – design parameters – workstation dimensions – physical load at work – working posture – workstation design and adjustment – computerized human modeling programs. (5)

SIMULATION: History – Advantages and limitations – 3D computer simulation tools – Virtual manufacturing – Case study. (2)

MULTI STAGE PRODUCTION SYSTEMS: Material requirements planning – Manufacturing resource planning – Capacity planning – Enterprise resource planning – Enterprise resource planning II – Hybrid systems – Managing change. (4)

TOYOTA PRODUCTION SYSTEM TODAY: Eliminating wastes – Roots in Ford's system – TPS – supermarket model – JIT Production – Pull system – Lean manufacturing – Integrated quality – Internal customer satisfaction – Standard work and cell design –Toyota supplier and support. (5)

Total L: 45

REFERENCES:

1. Ronald G Askin, "Design and Analysis of Lean Production system", John Wiley and Sons, New York, 2003.
2. Black J T and Steve L Hunter, "Lean Manufacturing Systems and Cell design", Society of Manufacturing Engineers, USA, 2003.
3. Bedworth D D, "Integrated Production Control Systems Management, Analysis, Design", John Wiley and Sons, New York, 1987.
4. Vollman T E, "Manufacturing Planning and Control Systems", Galgotia Publication (P) Ltd., New Delhi, 2004.
5. Dennis P Hobbs, "Lean Manufacturing Implementation: A complete Execution Manual for any Size Manufacturing", J Rose, Publishing Inc, 2004.
6. Taiichi Ohno, "Toyoto Production System: Beyond Large Scale Production", Productivity Press, New York, 1988.
7. Pascal Dennis, "Lean Production Simplified: A Plain Language Guide To The World's Most Powerful Production System", Shingo, 2007.

15ML04 LEAN TOOLS AND MANAGEMENT SYSTEMS

3 0 0 3

INTRODUCTION TO LEAN MANUFACTURING: Objectives of lean manufacturing - Key principles and implications of lean manufacturing - Traditional Vs lean manufacturing. (3)

LEAN MANUFACTURING CONCEPTS: Value creation and waste elimination – Types of waste - Takt time – Takt time calculation – Practical exercise of an industry - Continuous flow - Continuous improvement / Kaizen- worker involvement - Cellular layout – Administrative lean. (6)

LEAN MANUFACTURING TOOLS AND METHODOLOGIES: Standard work -Communication of standard work to employees - Standard work and flexibility – Spaghetti diagram – Process Map - Visual controls - Quality at the source - 5S principles –Total Productive Maintenance - Overall equipment effectiveness - Total quality management - Changeover/setup time (SMED) - Batch size reduction - Production leveling – Failure mode and effect analysis (FMEA) - Line balancing - Poka-yoke - Information technology aids in all these tools and methodologies – Practical exercise of the above tools from an industry. (15)

VALUE STREAM MAPPING: Current state map – Future state map – VSM symbols – Mapping tips - Comparison of CSVAM and FSVSA – Simulation scenario case studies – Use of eVSM software - Practical exercises from industry. (4)

JUST IN TIME MANUFACTURING: Introduction - Elements of JIT - Uniform production rate - Kanban system - Small lot size - Quick, inexpensive set-up - Continuous improvement. Optimized production technology (6)

ONE-PIECE FLOW: Process razing techniques – Cells for assembly line – Case studies (4)

IMPLEMENTING LEAN: Road map-senior management Involvement - Hoshin planning - Best practices. (4)

RECONCILING LEAN WITH OTHER SYSTEMS: Toyota production system today - Lean six sigma - Lean implementation in ERP and PLM – Lean with ISO9001:2000. (3)

PROJECT: Practical exercise involving above tools and use of Lean factory and/or real-time project execution from industry.

Total L: 45

REFERENCES:

1. Askin R G and Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003.
2. Michael L George, David T Rowlands and Bill Kastle, "What is Lean Six Sigma", McGraw Hill, New York, 2004.
3. Micheal Wader, "Lean Tools: A Pocket Guide to Implementing Lean Practices", Productivity and Quality Publishing Pvt. Ltd., 2002.
4. Kenichi Sekine, "One-Piece Flow", Productivity Press, Portland, Oregon, 1992.
5. Alan Robinson, "Continuous Improvement in Operations", Productivity Press, Portland, Oregon, 1991.
6. Joseph A De Feo and William W Bearnard, "Juran Institute's Six Sigma Break Through and Beyond", Tata McGraw Hill, New Delhi, 2004.
7. Richard B Chase, Robert Jacobs F and Nicholas J Aquilano, "Operations Management for Competitive Advantage", McGrawHill/Irwin, 2003.
8. Poke - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992.

15ML05 INFORMATION TECHNOLOGY IN MANUFACTURING APPLICATIONS

3 0 0 3

INTRODUCTION: Introduction to world wide web – WWW vs traditional application – Web communication protocols. Role of information technology in manufacturing – Role of Internet, Intranet and Extranet - Present market constraints - Extended enterprises - B2C and B2B. Software Engineering: software development life-cycle. Types of server – Client/Server – Client/Server architectures - Database – Data model – DBMS – Basic Entity-Relation (ER) diagram – Primary and Foreign Keys – Normalization – Data association - Security – Data backup – Clustering – Cloud computing – Network basics - Tools to develop client/server models - PDM, CPC and PLM – ERP & ERP II – Virtual manufacturing overview. (11)

FUNDAMENTALS OF NETWORKING: Networking concepts, networking devices – repeaters, bridges, routers, gateways, hubs and switches. MAP, TOP, LAN, WAN. Network topologies – star, bus, ring. Wireless: 902, 802.11 a, b, g, n, n2. OSI – layers of OSI model – TCP/IP. (4)

PRODUCT DEVELOPEMNT AND ISSUES:Product lifecyclemanagement - Sequential engineering vs concurrent engineering - Global product - Product development and its complexity – Quality assurance issues - Information technology tools to easy. Use of CAD, CAE and CAM: Reverse engineering - Modeling of geometry of parts - Modeling of assemblies and disassemblies – Sustainable engineering - Different modeling packages - Data exchange standards between different software - Use of analysis software (FEA) - Use of manufacturing process simulation software – Case studies – Practical exercises from industry. (6)

MANUFACTURING MODELS: Engineer to order - Make to order - Assemble to order - Made to stock - Configure to order. Case studies. (2)

AUTOMATED PROCESS PLANNING: Process planning - Structure of process planning software - Information requirements for process planning - Operation to a typical computer aided process planning software – Case studies. (3)

PLANNING OF RESOURCES FOR MANUFACTURING THROUGH IT: Background – Role of MRP, MP-II, ERP, ERP II – Software packages of each: Manufacturing applications - Engineering applications - Financial applications - Marketing applications - Dynamic enterprises. (5)

COLLABORATIVE ENGINEERING: Faster design throughput - Web based design - Changing design approaches - Engineering change management - Product configuration management - Extended enterprises - Enterprise application integration for PLM – Risk Management. Case studies. (5)

PROJECT: Practical execution of a project based on above tools from industry.

(10)

Total L: 45

REFERENCES:

1. John Stark, "Global Product Strategy, Product Lifecycle Management and Billion Customer Question", Springer Publisher, 2007
2. John Stark, "Product Lifecycle Management: 21 century for Product Realisation", Springer Publisher, 2005.
3. Radhakrishan P, Subramanyan P and Raju V, "CAD/CAM/CIM", New Age International Publishers, 2002.
4. Cornelius Leondes, "Computer Aided Design – Vol 2; Computer Integrated Manufacturing", CRC Press, 2001.
5. Mikell P Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall, 1998.
6. Puente E and Macconail P, "Computer Integrated Manufacturing" Springer-Verlag, 1998.

13ML51 LEAN MANUFACTURING LABORATORY

0 0 4 2

1. Facility layout design and study of layout performance.
2. Implementation of 5S. Identification of VA, NVA, Standard time calculation and Line balancing.
3. Value Stream Mapping: Study of current state and future state diagram.
4. Ergonomics study of human performance using IDEEA sensor
5. Study of Inventory management system using load cell and LabView.
6. Study of Lean factory (cycle time, WIP, time and motion study, Poka-Yoke).
7. RF-ID simulation.
8. Process capability study and use of six sigma.
9. Design of experiments/ANOVA.
10. Implementation of Root Cause Analysis.
11. Study of failure mode and effect analysis.

Total P : 60

15ML61 INDUSTRY VISIT & TECHNICAL SEMINAR

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The student will be required to visit at least two industries and observe the industry functions.

The student will be required to present at least two technical presentations during this course on current topics related to his or her specialization. The same will be assessed by a committee appointed by the department. The student is expected to submit at least two reports based on the above guidelines.

Total P : 60

II SEMESTER

15ML06 COST MANAGEMENT AND LEAN ACCOUNTING

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INTRODUCTION: Cost management vs. Lean accounting – Factors affecting cost management – Role of the management accounting – Accounting and ethics – Lean accounting importance: standard cost drive wrong behavior, financial impact of lean improvements, understanding product costs, lean performance measurements, eliminate waste from accounting processes and systems. (6)

COST CONCEPTS: Cost structure – Labor, material, overhead cost – Nature of overhead cost – Overhead absorption methods: Direct labor, direct material, number of pieces, labor hour rate, machine hour rate methods – Cost control: labor, material, overhead variance analysis. (10)

ACTIVITY BASED COSTING: Concept – Objectives – Comparison with conventional costing – Activity cost drivers – Resource mapping – Resource driver – Activity cost – Shifting costs to activities – Designing the optimal ABC system. (10)

ACTIVITY BASED MANAGEMENT: Concept – Value added analysis tree – Value added activity, strategic activity, support activity – Value added analysis in manufacturing. (3)

TARGET COSTING AND TOTAL COST MANAGEMENT: Concept – Different approaches – Price based, cost based, value based target costing - Strategies for achieving target cost – Value analysis and value engineering. Vendor development, outsourcing, core competence. (4)

LEAN ACCOUNTING: Internet accounting – Eliminate waste from the financial accounting processes – Account payable process – Account receivable process – The general ledger – Month-end closing – Lean tools to create change: Value stream mapping and process maps: assign and improvement team, start with the customer, identify the tasks within the process, gather data, analyze the data – Kiazen: establish the team, develop performance measurements, develop future state process maps, implement the future state, repeat the process. (7)

CELL PERFORMANCE MEASUREMENTS: Traditional measurements vs lean cell measurements: day-by-the hour report – First-time-through (FTT) report – WIP to SWIP report – Operational equipment effectiveness (OEE) – Other measurements: Cross-training chart – 5S – Safety – Absenteeism – Setup times. Non-production cells and developments. (3)

ELIMINATING WASTE TRANSCATIONS: Type of waste – Accounting cost of wastes – Labor tracking – Material costs – Inventory tracking – The internal control system. (2)

Total L: 45

REFERENCES:

1. Brian H Maskell, Bruce Baggaley and Larry Grass, "Practical Lean Account: A Proven System For Measuring and Managing The Lean Enterprise", CRC Press, 2011.
2. Blocher Chen and Lin, "Cost Management – A Strategic Emphasis", McGraw Hill Irwin, 2002.
3. Monden Y, "Cost Management in the New Manufacturing Age", Productivity Press, 1992.
4. Cooper R and Slagmulder R, "Target Costing and Value Engineering", Productivity Press, 1997.

15ML07 LEAN SUPPLY CHAIN AND LOGISTICS MANAGEMENT

3 0 0 3

INTRODUCTION: Lean Supply Chain (SC) and Logistics Management, Lean Opportunities in SC and logistics, Examples of JIT in the Supply Chain, Competitive strategy, logistics and customer value, measuring logistics cost and performance (5)

INVENTORY MANAGEMENT AND LOT SIZING : Traditional Inventory Management, Lean Inventory Management, Kanban Sizing,WIP Inventory: FIFO Management, Lot Sizing in Lean ,One Piece, Every Part Every Interval (EPEI),Lot Sizing as Part of Scheduling, Applying the EPEI to Traditional Planning Systems: The Period Order Quantity, Interval as Goal Setting, High-Mix Interval, Determining the Interval ,Interval in Value Stream Loops, Reducing Pipeline Inventory: Kanban—Visual Car, Inventory Reduction through Reducing Lot Sizes , Point of Sale Data (9)

LEAN SUPPLY CHAIN DESIGN: Principles, Lean Layouts, Lean Production Schedules, Lean service, Traditional Physical Control of Inventories ,Traditional Relationships Packaging—Readying an Item for Shipment, Overall Warehouse Setup and Item Locations ,Traditional Logistics ,Skill, Freight Cost, Distribution Requirements Planning, Lean Warehousing, space, labor, Lean Logistics ,Product Availability and Its Effect on Logistics ,Collaboration -Visibility and Reliability (9)

LEAN SUPPLIERS, LEAN CHANNELS AND LEAN CUSTOMERS: The Impact of Globalization, Enterprise Resource Planning, Leveraging ERP in Supply Chain Planning, Sales and Operations Planning, Lean Supply Chain Tools for the Perfect Order (5)

E-PROCUREMENT AND GLOBAL SUPPLY CHAIN: Electronic Data Interchange (EDI), E-Commerce, QR, ECR, and CPFR, Collaborative Planning, Forecasting, and Replenishment, Vendor-Managed Inventory, Other Potential Areas for Collaboration, Future Opportunities , Logistics of a Global Supply Chain, Value Stream Mapping to Identify Waste, Areas to Reduce Waste (6)

LEAN SUPPLY CHAIN EXECUTION : Policies and Procedures, Relevant Lean Supply Chain and Logistics Metrics, Balanced Scorecard, Display and Control Metrics, Barriers to Supply Chain Integration ,Trends in Lean Supply Chain, Data Analytics, Supply Chain Analytics and Lean, Potential Obstacles to Lean Thinking in the Supply Chain (6)

CASE STUDY: Reverse Logistics, Warehouse management using lean concept, Lean supply chain management of an automotive industry, Introducing lean concept in E-Procurement. (5)

Total L: 45

REFERENCES:

1. Paul Myerson "Lean Supply Chain and Logistics Management" , McGraw-Hill Education, LLC ISBN: 9780071766265
2. Martin Christopher, "Logistics and Supply Chain Management (Financial Times Series), 2011 ISBN-13: 978-0273731122 ISBN-10: 0273731122, 2012.
3. Robert Jacobs F and Richard B Chase "Operations and Supply Chain Management" McGraw-Hill Irwin, 2012.
4. Bill Kerber and Brian J Dreckschage , "Lean Supply Chain Management Essentials: A Framework for Materials Managers", CRC Press, ISBN 9781439840825, 2011.
5. Baudin Michel, "Lean Logistics: The Nuts and Bolts of Delivering Materials and Goods", Productivity Press, New York, 2005.

15ML08 LEAN SIX SIGMA IN MANUFACTURING AND SERVICE

3 0 0 3

INTRODUCTION: Overview - Six sigma definition – Background – Six sigma compared to total quality management (quality) – traditional vs. Manufacturing lean six sigma – Common terms, foundations of lean six sigma – four keys, five laws of Lean six sigma – Lean six sigma tools – COPQ – Total quality cost – Understanding variation – Value stream mapping – Types of Lean six sigma: DMAIC vs DFSS – Lean six sigma project selection. (6)

PREPARATION PHASE: Organizational success factors – leadership, six sigma as strategic initiative, internal communication strategy and tactics, formal launch, organizational structure, six sigma training plan, project selection, assessing organizational readiness, pitfalls. work as a process – vertical functions and horizontal processes. Project management – challenges, culture, project management processes, selection of team members, team typing, team stages, characteristics of effective teams. (8)

DEFINE PHASE: Overview – Customer identification, feedback, requirements – Problem statement - Voice of customer – importance, collect VOC data, critical to quality CTQ – Affinity process – Pareto diagrams – BRD – Project scope - Project charter – Voice of the customer – High level process map – Project team – SIPOC – Process map – Practice live exercises. (6)

MEASURE PHASE: Overview – Types of measures – Introduction to statistical methods – Sampling plan – Population or sample – Central limit theorem - Types of data - Data collection – Choosing statistical software – Measure tools – Cause and effect diagrams – Line , bar, stacked bar graphs – Pie chart – Histograms - Control charts. Six sigma measurements – Quality cost - Cost of poor quality – Quality loss function. Measurement system analysis –Process capability calculations – Short-term vs long-term capability – Process performance vs specification - Practice live exercises. (6)

ANALYSE PHASE: Overview – Process analysis – Correlation coefficient – Regression - Hypothesis testing applications (DOE/ANOVA, Chi square test) – Failure mode and effects analysis - Statistical tests and tables – Tools for analyzing relationships among variables – Gap analysis – Root cause analysis – Waste analysis - Survival analysis - Practice live exercises. (3)

IMPROVE PHASE: Overview – Process redesign – Generating improvement alternatives – Design of experiments – Waste elimination – Cycle time reduction – Theory of constraints - Pilot experiments – Cost/benefit analysis – Implementation plan – Risk analysis and mitigation. (3)

CONTROL PHASE: Overview – Process scorecard – SPC: selection of chart and selection of analysis – TPM – Sustain improvement - Final project report and documentation. Roadmap to implementation. (3)

DESIGN FOR SIX SIGMA (DFSS): Overview – DFSS methodologies: DMADV vs DMADOV - overview of Quality Function Deployment (QFD) - Theory of Inventive Problem Solving (TRIZ) - overview of Failure Modes and Effects Analysis (FMEA) - Design for XDFX – Robust design and process – Software tools for DMAIC and/or DFSS. (3)

LEAN SERVICING: Lean production – Overview – Lean history – Manufacturing vs service – Lean servicing case study. (4)

LEAN SIXSIGMA IMPLEMENTATION: Roadmap for implementation. Common Implementation issues and management strategies. (3)

Total L: 45

REFERENCES:

1. Joseph De Feo, William Barnard and Juran Institute, "Juran Institute's Six Sigma Breakthrough and Beyond", The McGraw-Hill Companies, 2004.
2. Betsiharris Ehrlich, "Transactional Six Sigma and Lean Servicing", St. Lucia Press, 2002.
3. Jay Arthur, "Lean Six Sigma – Demystified", Tata McGraw Hill Companies Inc, 2007.
4. Michael L George, David T Rowlands and Bill Kastle, "What is Lean Six Sigma", McGraw Hill, New York, 2004.
5. Kai Yang and Basem El Haik, "Design for Six Sigma", McGraw Hill, New York, 2004.
6. Thomas Pyzdek, "Six Sigma Handbook: Complete Guide for Greenbelts, Blackbelts and Managers at All Levels", Tata McGraw Hill Companies Inc, 2003.
7. Donald W Benbow and Kubiak T M, "Certified Six Sigma Black Belt Handbook", Pearson Education, 2007.

15ML09 ENTERPRISE RESOURCE PLANNING

3 2 0 4

INTRODUCTION TO ERP SYSTEMS: ERP an overview – enterprise an overview – ERP as integrated management information system – evolution of ERP – benefits of ERP – ERP vs. traditional information systems – advantages of ERP – MRP II model and organizational processes. (6)

BUSINESS PROCESS REENGINEERING (BPR): Need and challenges – management concerns about BPR – BPR to build business – model for ERP – basic constituents of ERP – selection criteria for ERP – packages – procurement process for ERP package – features of various modules of ERP. (7)

ERP IMPLEMENTATION: ERP – implementation – lifecycle – implementation methodology – hidden costs in implementation – organizing the implementation – vendors – consultants and users – project management and monitoring – issues in customizing ERP systems for organizations – need for training. (6)

THE BUSINESS MODULES IN AN ERP PACKAGE: Finance – manufacturing – human resource – plant maintenance – materials management – quality management – sales and distribution. (9)

OVERVIEW OF ERP PACKAGES: SAP-R/3 – SAP B1 – MFG/PRO – IFS/AVALON – ORACLE. Comparison between different ERP packages. Survey of Indian ERP packages regarding their coverage, performance and cost – top management concerns and ERP systems – extended ERP (ERP II)/advanced planning systems. (9)

ERP CASE STUDIES: HRM, finance, production, materials, sales and distribution. (8)

Total : L: 45

REFERENCES:

1. Alexis Leon, "ERP Demystified", Tata McGraw-Hill Publishing Company, 2003.
2. Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning-Concepts and Practice", Prentice Hall of India Private Limited, 2003.
3. David L OLSON, "Managerial Issues of Enterprise Resource Planning Systems", Tata McGraw Hill Edition, 2004.
4. Rahul V Altekar, "Enterprise Wide Resource Planning – Theory and Practice", Prentice Hall of India, New Delhi, 2004.

5. <http://www.technologyevaluation.com/landing/select.asp>
6. <http://www.managingautomation.com/maonline/>

15ML10 GLOBAL INTEGRATED MANUFACTURING

3 0 0 3

INTRODUCTION: Evolution of manufacturing, CAD/CAM and CIM – Globalization - Scope of CIM - Segments of generic CIM, computers and workstations, an overview of CIM software. World class manufacturing and its importance. (2)

GLOBAL MANUFACTURING ENTERPRISE: Global manufacturing revolution – Reconfigurable machine – Reconfigurable manufacturing system - Production design for globalization – Location of manufacturing plants – Global business strategies – Global strategic alliance – IT-based enterprise – Information transfer in manufacturing systems - PRIDE – Competitive advantage: Logistics – Strategic sourcing - Supply chain - The dilemma of globalization – Where manufacturing enterprises heading? (6)

INTERNATIONAL LOGISTICS: Introduction – supply chain background - outbound logistics functions – inbound logistics functions – overall logistics activities – logistics intermediates. Economic importance. Logistics media: ocean ships (cargo types), air transportation, surface transportation. Terms of sale and payment. Documentation and insurance: cargo, hull, air, land transport – settlement of insurance – claims. Famine relief logistics – demand forecasting – sourcing models – packaging – managing inventories - site/route selection – warehousing and storage. (4)

INTERNAL SOURCING: Introduction – why sourcing is global? – design of global sourcing system – global sourcing and procurement – issues in import and export. (1)

FUTURE ISSUES IN INTERMEDIATE LOGISTICS: Overview – increase use of world-class logistics practices – multi-country trade alliances – one stop shopping concept – amodalism – environmental concerns – space transportation and exploration – The internet. (1)

CNC TECHNOLOGY AND ROBOTIC SYSTEMS: Principles of numerical control, types of CNC machines, features of CNC systems, programming techniques, capabilities of a typical NC, CAM software, integration of CNC machines in CIM environment, DNC – FMS – objectives – components – FMS layout configurations – FMS classification – ERP. Material handling systems – basics and advanced: conveyor analysis, AGV analysis. Warehousing – storage and retrieval systems: AS/RS analysis. Overview of JIT. Robotic systems-types of robots and their performance capabilities, programming of robots, hardware of robots, kinematics of robots, product design for robotized manufacturing, applications of robots in manufacturing and assembly. Process planning, variant and generative process planning methods – manual vs CAPP - AI in process planning. (12)

MANUFACTURING SYSTEM SOFTWARE: CIM architecture - Production management system (PMS) - forecasting, master production schedule, MRP, capacity planning, shop floor control (SFC), factory data collection system (FDS) – Automatic data capture (ADC) method and its techniques – Bar code – types of bar codes – Data acquisition system - inventory management, product routing, job costing, marketing applications – Applications of ADC - Basics of networking concepts, networking devices. (12)

RAPID PROTOTYPING SYSTEMS: Rapid prototyping techniques, software for rapid prototyping, process optimization - Practical exercises of using rapid prototyping. (4)

VIRTUAL ORGANISATION: Paperless factory – Mobile office - Introduction of virtual reality and application - Virtual prototyping – Virtual manufacturing - Virtual instrumentation and measurement - Virtual enterprises (3)

PROJECT: Practical exercise involving study of logistics in a company, use of CAD/CAM/CAE, and CNC for a selected product from industry. Practical exercises of using simple NC programming. Industry visit.

Total L: 45

REFERENCES:

1. Donal F Wood, Anthony P Barone, Paul R Murthy and Daniel L Wardlow, "International logistics", AMACOM, 2007.
2. Voram Koren, "The Global Manufacturing Revolution: Product – Process – Business Integration and Reconfigurable Systems", Kindle Edition, 2011.
3. Mikell P Groover, "Automation of Production Systems and Computer Integrated Manufacturing", Pearson Education, New Delhi, 2001.
4. Lee Kunwoo, "CAD/CAM/CAE Systems", Addition, Wesley, USA, 1999.
5. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall, India, New Jersey, 2003.
6. Radhakrishnan P, Subramanyan S and Raju V, "CAD/CAM/CIM", New Age International Pvt. Ltd, New Delhi, 2008.

13ML52 MANUFACTURING SIMULATION LABORATORY

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1. Solving inventory problems using software (Arena)
2. Manufacturing system simulation and its performance measurement using software (Arena)
3. Manufacturing system simulation and its performance measurement using software (WITNESS)
4. Gauge repeatability and reproducibility.
5. Solving Transportation and Assignment problems using Excel solver
6. Project evaluation and review based on time and cost (MS Project)
7. Measurement System Analysis and Process capability study using Statistical Software(MiniTAB)

Total P: 30

III SEMESTER

15ML53 MANUFACTURING SYSTEMS DESIGN LABORATORY

vide Industrial Engineering 15MN53

15ML71 PROJECT WORK I

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- ❖ Identification of a real life problem in thrust areas
- ❖ Developing a mathematical model for solving the above problem
- ❖ Finalisation of system requirements and specification
- ❖ Proposing different solutions for the problem based on literature survey
- ❖ Future trends in providing alternate solutions
- ❖ Consolidated report preparation of the above

Total P: 90

IV SEMESTER

15ML72 PROJECT WORK II

0 0 28 14

- ❖ **The project work involves the following:**
 - ❖ **Preparing a project - brief proposal including**
 - ❖ Problem Identification
 - ❖ A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
 - ❖ List of possible solutions including alternatives and constraints
 - ❖ Cost benefit analysis
 - ❖ Time Line of activities
 - ❖ **A report highlighting the design finalization [based on functional requirements & standards (if any)]**
 - ❖ **A presentation including the following:**
 - ❖ Implementation Phase (Hardware / Software / both)
 - ❖ Testing & Validation of the developed system
 - ❖ Learning in the Project
- ❖ **Consolidated report preparation**

Total P:420