# M.E. – COMPUTER INTEGRATED MANUFACTURING

## CURRICULUM

**(MINIMUM CREDITS TO BE EARNED: 80)**

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER I** | | | | | | | | |
| Professional Core | Mathematical Optimization | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| Professional Core | Flexible Competitive Manufacturing System | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Professional Elective | Professional Elective Course - I | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| Professional Elective | Professional Elective Course - II | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| Professional Core | Computer Aided Design and Analysis Laboratory | 0 | 0 | 4 | 2 | 40 | 60 | 100 |
| Professional Core | Technical Seminar | 0 | 0 | 4 | 2 | 40 | 60 | 100 |
| Mandatory courses | Research Methodology and IPR | 3 | 0 | 0 | 2 | 40 | 60 | 100 |
| Audit Course | Audit Course - 1 | 2 | 0 | 0 | 0 | 40 | 60 | 100 |
| | | **17** | **3** | **8** | **22** | | | |

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER II** | | | | | | | | |
| Professional Core | Computer Aided Design and Manufacturing | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Professional Core | Production and Operations Management | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| Professional Elective | Professional Elective Course - III | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| Professional Elective | Professional Elective Course - IV | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| Professional Core | Computer Integrated Manufacturing LAB | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| Professional Core | Simulation and Optimization Programming LAB | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| Professional Core | Mini Project | 0 | 0 | 10 | 5 | 40 | 60 | 100 |
| Audit Course | Audit Course – 2 | 0 | 0 | 0 | 0 | 40 | 60 | 100 |
| | | **14** | **0** | **16** | **22** | | | |

| Category | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | | CA | SEE | Total |
| **SEMESTER III** | | | | | | | | |
| Professional Elective | Professional Elective Course - V | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| Open Elective | Open Elective | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| Internship | Internship | 0 | 0 | 4 | 2 | 40 | 60 | 100 |
| Project | Project Work – Phase I | 0 | 0 | 20 | 10 | 40 | 60 | 100 |
| | | **6** | **2** | **20** | **20** | | | |

| Category | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | | CA | SEE | Total |
| **SEMESTER IV** | | | | | | | | |
| Project | Project Work – Phase II | 0 | 0 | 32 | 16 | 40 | 60 | 100 |
| | | **0** | **0** | **32** | **16** | | | |

# M.E. - COMPUTER INTEGRATED MANUFACTURING

# CURRICULUM

**LIST OF PROFESSIONAL CORE COURSES (PCC)**

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| 21MEI101 | Mathematical Optimization | 3 | 1 | 0 | 4 |
| 21MEI102 | Flexible Competitive Manufacturing System | 3 | 0 | 0 | 3 |
| 21MEI103 | Computer Aided Design and Analysis Laboratory | 0 | 0 | 4 | 2 |
| 21MEI104 | Technical Seminar | 0 | 0 | 4 | 2 |
| 21MEI105 | Research Methodology and IPR | 2 | 0 | 0 | 2 |
| 21MEI201 | Computer Aided Design and Manufacturing | 3 | 0 | 0 | 3 |
| 21MEI202 | Production and Operations Management | 3 | 0 | 0 | 3 |
| 21MEI203 | Computer Integrated Manufacturing LAB | 0 | 0 | 4 | 2 |
| 21MEI204 | Simulation and Optimization Programming LAB | 0 | 0 | 4 | 2 |
| 11RMCI21 | Mini Project | 0 | 0 | 10 | 5 |
| 21RMCI31 | Project Work – Phase I | 0 | 0 | 20 | 10 |
| 21RMCI41 | Project Work – Phase II | 0 | 0 | 32 | 16 |

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**LIST OF PROFESSIONAL ELECTIVE COURSES (PEC)**

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| 21MEI101 | Applied Materials Engineering | 4 | 0 | 0 | 4 |
| 21MEI102 | Advances in Metrology and Testing | 4 | 0 | 0 | 4 |
| 21MEI103 | Computer Aided Process Planning | 4 | 0 | 0 | 4 |
| 21MEI104 | Computer Applications in Manufacturing | 4 | 0 | 0 | 4 |
| 21MEI105 | Design of Hydraulic and Pneumatic | 4 | 0 | 0 | 4 |
| 21MEI106 | Mechatronics in Manufacturing Systems | 4 | 0 | 0 | 4 |
| 21MEI107 | Robotics and Sensors | 4 | 0 | 0 | 4 |
| 21MEI108 | Manufacturing System Simulation | 4 | 0 | 0 | 4 |
| 21MEI109 | Machine Vision and its Applications | 4 | 0 | 0 | 4 |
| 21MEI110 | Metal Forming Technology | 4 | 0 | 0 | 4 |
| 21MEI111 | Newer Welding and Casting Processes | 4 | 0 | 0 | 4 |
| 21MEI112 | Design of Cellular Manufacturing System | 4 | 0 | 0 | 4 |
| 21MEI113 | Instrumentation and Experimental Techniques | 4 | 0 | 0 | 4 |
| 21MEI114 | Internet of Things for Manufacturing | 4 | 0 | 0 | 4 |
| 21MEI115 | Flexible Manufacturing Systems | 4 | 0 | 0 | 4 |
| 21MEI116 | Sensors for Manufacturing and Condition Monitoring | 4 | 0 | 0 | 4 |
| 21MEI117 | Industrial Robotics | 4 | 0 | 0 | 4 |
| 21MEI118 | Rapid Prototyping and Tooling | 4 | 0 | 0 | 4 |

**LIST OF OPEN ELECTIVE COURSES (OEC)**

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| 21CMCI11 | Total Quality System and Engineering | 4 | 0 | 0 | 4 |
| 21CMCI12 | Manufacturing Information Systems | 4 | 0 | 0 | 4 |
| 21CMCI21 | Supply Chain Management | 4 | 0 | 0 | 4 |
| 21CMCI22 | Reliability and Total Productive Maintenance | 4 | 0 | 0 | 4 |
| 21CMCI31 | Information Systems Analysis and Design | 4 | 0 | 0 | 4 |
| 21CMCI32 | Productivity Management and Re-Engineering | 4 | 0 | 0 | 4 |

**LIST OF AUDIT COURSES (AC)**

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| 21CACI11 | Constitution of India | 2 | 0 | 0 | 0 |
| 21CACI12 | Safety Management | 2 | 0 | 0 | 0 |
| 21CACI21 | Disaster Management | 2 | 0 | 0 | 0 |
| 21CACI22 | Pedagogy Studies | 2 | 0 | 0 | 0 |
| 21CACI31 | Stress Management by Yoga | 2 | 0 | 0 | 0 |
| 21CACI32 | Value Education | 2 | 0 | 0 | 0 |

# SYLLABUSOF PROFESSIONAL CORE COURSES

**21MEI001 MATHEMATICAL OPTIMIZATION**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**COURSE OBJECTIVE:**

1. To understand the optimization techniques used in compiler design.
2. To be aware of the various computer architectures that support parallelism.
3. To become familiar with the theoretical background needed for code optimization.
4. To understand the techniques used for identifying parallelism in a sequential program.
5. To learn the various optimization.

**UNIT I LINEAR PROGRAMMING 9**

Formulation- Assumption of liner programming**-**linear programming model, terminology for solution of the model- Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems.

**UNIT II UNCONSTRAINED ONE DIMENSIONAL OPTIMIZATION TECHNIQUES 9**

Necessary and sufficient conditions –Unrestricted search methods-Fibonacci and golden section method-Quadratic Interpolation methods, cubic interpolation and direct root methods.

**UNIT III UNCONSTRAINED N DIMENSIONAL OPTIMIZATION TECHNIQUES 9**

Direct search methods –Random search –pattern search and Rosen brooch's hill claiming method-Descent methods-Steepest descent, conjugate gradient, quasi -Newton method.

**UNIT IV CONSTRAINED OPTIMIZATION TECHNIQUES 9**

Necessary and sufficient conditions –Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method.

**UNIT V DYNAMIC PROGRAMMING 9**

Principle of optimality- recursive equation approach-application to shortest route, Backward-Moving Solution Procedure, Forward-Moving Solution Procedure cargo-loading, allocation and production schedule problems.

**TOTAL 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Optimization Techniques course, the student will be able to

CO 1. Understand the basic theoretical principles in optimization and formulation of optimization models
CO 2. Apply basic concepts of mathematics to formulate an optimization problem.
CO 3. Acquire an idea about the various direct and indirect search methods.
CO 4. Visualize advanced optimization applications in Mechanical engineering.
CO 5. Analyse and appreciate variety of performance measures for various optimization problems.

**REFERENCES:**


1. Rao, S.S.,'Optimization :Theory and Application' Wiley Eastern Press, 1978.
2. Taha, H.A., Operations Research –An Introduction, Prentice Hall of India.
3. Fox, R.L., 'Optimization methods for Engineering Design', Addition Welsey, 1971.

**21MEI002 FLEXIBLE COMPETITIVE MANUFACTURING SYSTEM**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

The course serves as an introduction to the modern methods of manufacturing. Its objectives are:

1. To expose the student to the different types of manufacturing available today such as the Special
2. Manufacturing System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS),
3. To learn the fundamentals of computer assisted numerical control programming and programming languages
4. Automated flow lines,
5. The common CAD/CAM data base organized to serve both design and manufacturing, and
6. To practice the PLC control devices and CNC operation skills

**UNIT I MANUFACTURING SYSTEMS & CONTROL 9**

Automated Manufacturing Systems - Modelling - Role of performance modelling -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 networks - Factory net works - Open systems interconnection model - Net work to network interconnections - Manufacturing automation protocol - Database management system.

**UNIT II MANUFACTURING PROCESSES 9**

Examples of stochastic 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 instates - 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.

**UNIT III QUEUING MODELS 9**

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.

**UNIT IV QUEUING NETWORKS 9**

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 networks.

**UNIT V PETRI NETS 9**

Classical Petri Nets - Definitions - Transition firing and reachability – Representational power - properties -Manufacturing models. Stochastic Petri Nets - Exponential timed Petri Nets - Generalized Stochastic Petri Nets - modelling of KANBAN systems - Manufacturing models.

**TOTAL 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Flexible Competitive Manufacturing System course, the student will be able to

CO 1. Understand the modern methods of manufacturing.

CO 2. Apply the concepts of PPC and GT to the development of FMS.

CO 3. Discuss the planning and scheduling methods used in manufacturing systems.

CO 4. Identify different types of manufacturing available today; such as the Special Manufacturing. System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS), etc.

CO 5. Know the fundamentals of computer assisted numerical control programming and programming languages.

**REFERENCES:**

1. Viswanadham, N and Narahari, Y. "Performance Modelling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi, 1994.

2. Trivedi, K.S., "Probability and Statistics with Reliability, Queuing and Computer Science Applications", Prentice Hall, New Jersey, 1982.

3. Gupta S.C., & Kapoor V.K., "Fundamentals of Mathematical Statistics", 3rd Edition, Sultan Chand and Sons, New Delhi, 1988.

**21MEI003 COMPUTER AIDED DESIGN AND ANALYSIS LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**COURSE OBJECTIVE:**

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of analysis tools.

## LIST OF EXPERIMENTS

1. Stress analysis of a plate with a circular hole.
2. Stress analysis of rectangular L bracket
3. Stress analysis of an axi-symmetric component
4. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
5. Thermal stress analysis of a 2D component
6. Conductive heat transfer analysis of a 2D component
7. Convective heat transfer analysis of a 3D component
8. Design and analysis the 3D Model of Fork with stress analysis
9. Design and analysis the 3D Model of Coupling with stress analysis
10. Design and analysis the 3D Model of Bearing with Thermal analysis

**TOTAL: 45 Hours**

**LIST OF EQUIPMENTS** (For a batch of 30 students)

| | |
|---|---|
| **Computer System** | 30 |
| 18” VGA Color Monitor<br>i3 Processor, 5000 GB HDD, 4 GB RAM | |
| Color Desk Jet Printer | 01 |

**COURSE OUTCOMES:**

After successful completion of the Computer Aided Analysis Laboratory course, the student will be able to

**CO1:** Explain the various basic analysis boundary conditions and components of element system.

**CO2:** Carry out mechanism simulation using Multibody Dynamic software.

**CO3:** Solve stress analysis problems of link elements in Trusses, cables, beams, flat plates, simple shells and axi–symmetric components.

**CO4:** Solve thermal stress and heat transfer analysis of plates, cylindrical shells.

**CO5:** Examine the model analysis of beams and harmonic, transient and spectrum analysis of simple systems.

**21MEI004 TECHNICAL SEMINAR**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**COURSE OBJECTIVE:**

- To identify a specific topic/ area/ problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To train the students in preparing reports and to face reviews and examination for the first semester.

**SYLLABUS:**

The student individually select a specific topic approved by the head of the division under the guidance of a faculty member of the particular subject or who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners of the same department.

**COURSE OUTCOMES:**

After successful completion of Seminar I, the student will be able to

**CO 1:** The Seminar engages students in the integrated activities of reading, research, discussion, and composition around a modern manufacturing environment.

**CO 2:** Students will gain a deeper appreciation of the role of writing in scholarly investigation, as they refine, adapt, and expand their abilities to absorb, synthesize and construct arguments in close-knit community.

**CO 3:** To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.

**CO 4:** To set the stage for future recruitment by potential engineer.

**CO 5:** Students will demonstrate the ability to prepare appropriately to participate effectively in class discussion.

**21MEI005 RESEARCH METHODOLOGY AND IPR**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**COURSE OBJECTIVE:**

1. To Understand research problem formulation and analyze research related information with research ethics.
2. To Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

**UNIT I INTRODUCTION TO RESEARCH 7**

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques – Need for theoretical frame work – Hypothesis development – Hypothesis testing with quantitative data. Research design – Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

**UNIT II EXPERIMENTAL DESIGN 7**

Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales – Validity testing of scales – Reliability concept in scales being developed – Stability Measures

**UNIT III DATA COLLECTION METHODS 7**

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design – Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques – Probabilistic and non-probabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size

**UNIT IV DATA ANALYSIS ANDRESEARCH REPORT 7**

Data Analysis – Factor Analysis – Cluster Analysis – Discriminant Analysis – Purpose of the written report – Concept of audience – Basics of written reports. Integral parts of a report – Title of a report, Table of contents, Abstract, Synopsis, Introduction, Body of a report – Experimental, Results and Discussion – Recommendations and Implementation section – Conclusions and Scope for future work.

**UNIT V INTELLECTUAL PROPERTY RIGHTS 7**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**TOTAL: 35 Hours**

**COURSE OUTCOMES:**

After successful completion of Research Methodology and IPR course, the student will be able to

**CO 1:** Understand research problem formulation.

**CO 2:** Analyze research related information and Follow research ethics

**CO 3:** Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

**CO 4:** Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right

to be promoted among students in general & engineering in particular.

**CO 5:** Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

**REFERENCES:**


1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.

**21MEI006 COMPUTER AIDED DESIGN AND MANUFACTURING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- On completion of the course the students are expected to be knowledgeable in 2 dimensional and 3 dimensional transformations, modeling and analysis, CAD/CAM integration, CNC machine tool building, CNC programming using manual method and generation of CNC codes using CAM software.

**UNIT-ITWODIMENSIONALANDTHREEDIMENSIONALTRANSFORMATIONS 8**

2D–Representationand Transformationsofpoints–TransformationsofLines–Rotation,Reflection,Scalingandcombinedtransformations,3D–Scaling–Shearing–Rotation-Reflection–Translation–Projectionsparametricrepresentationof Ellipse, parabola,Hyperbola-PracticeonsateoftheartCADsoftware.

**UNIT–II MODELLINGANDANALYSIS 8**

Wireframe, surfaceandsolidmodeling–solidmodelingpackages – FiniteElement analysis (FEA)–Introductionandprocedures–solutionTechniques –Introductionto FEApackages.

**UNIT–III CAD/CAMINTEGRATION 9**

Networking- networking techniques, LAN, components, wiring methods, network interfacecards,network standards,Graphicsstandards–Data exchangeformat, evolution- features of various interfaces GKS, IGES, DXF, PDES, STEP etc., Processplanning,ComputerAided processplanning(CAPP)- variant,generative approaches

**UNIT–IV COMPUTERNUMERICALCONTROLMACHINES 10**

CNCMachineBuilding,structuraldetails – configurationanddesign, friction andanti frictionLMguideways,Ballscrew,torquetransmissionelements,Spindledrives, Feed drives,Positionalmeasuringtransducers-gratings,encoders,induction,laser interferometer,Spindle,ATC,APC,Tooling–qualified, presettooling.

**UNIT–IV CNC PROGRAMMING 10**

Structure of CNC program, Coordinate system, G& M codes, cutter radius compensation, tool nose radius compensation, tool wear compensation, canned cycles,subroutines,do loop,mirroringfeatures,Manualpart programmingforCNC turningand machining centre,Generation of CNCprogramusing popular CAMsoftware.

**TOTAL: 45Hours**

**COURSE OUTCOMES:**

After successful completion of Computer Aided Design and Manufacturing course, the student will be able to

**CO 1:** Understand 2 dimensional and 3 dimensional transformations, modeling and analysis and CAD/CAM integration.

**CO 2:** Use basic and advanced features of current CAD software.

**CO 3:** Understand how CAD technology can be leveraged in the design process

**CO 4:** Design a part or assembly of parts using Computer-Aided Design software.

**CO 5:** Apply top-down design principles to model a design.

**REFERENCES:**


1. David F.Rogersand Alan Adams.J, “Mathematical Elements for Computer Graphics”,McGraw–HillPublishingCompanyInternationalEdition,1990.
2. P N Rao, “CAD/CAM: Principles and Applications”, Tata McGraw –Hill Ed., 2004
3. Groover M.P., Automation, “Production Systems and Computer Integrated Manufacturing”, Prentice-Hall of India Pvt.Ltd, New Delhi, 1996.
4. Sadhu Singh, :Computer Aided Design and Manufacturing”, Khanna publications,2000
5. Warren S Seames,Computer Numerical Control Concepts and Programming, Thomson Delmar, fourth Edition, 2002
6. Ibrahim Zeid, “Mastering CAD/CAM”, Tata McGraw –Hill Ed., 2007
7. HMT, “Mechatronics”, Tata McGraw –Hill Ed., 1998
8. P Radhakrishnan, S Subramanyan, “CAD/CAM/CIM”, New Age Publishers, 1994.

**21MEI007 PRODUCTION AND OPERATIONS MANAGEMENT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE:**

- To impart knowledge on Manufacturing strategies and compositeness, Designing of Products, facilities and jobs, Inventory systems, MRP and revising the systems.

**UNIT I FORECASTING AND FACTORY LAYOUT 9**

Introduction, measures of forecast, accuracy, forecasting methods - time series smoothing - regression models - exponential smoothing - seasonal forecasting – cyclic forecasting. Location factors, location evaluation methods, different types of layouts for operations and production, arrangement of facilities within departments.

**UNIT II INVENTORY ANALYSIS AND CONTROL 9**

Definitions - ABC inventory system - EOQ models for purchased parts - inventory order policies - EMQ models for manufactured parts - lot sizing techniques, inventory models under uncertainty.

**UNIT III JUST IN TIME AND SCHEDULING 9**

Elements of JIT - uniform production rate - pull versus push method - Kanban system - small lot size - quick, inexpensive set-up - continuous improvement, optimized production technology. Objectives in scheduling - major steps involved -information system linkages in production planning and control - production control in repetitive, batch and job-shop manufacturing environment.

**UNIT IV AGGREGATE PLANNING AND PROJECT PLANNING 9**

Approaches to aggregate planning - graphical, empirical, and optimization, development of a master production schedule, materials requirement planning (MRP- I) and manufacturing resource planning (MRP -II), ERP. Evolution of network planning techniques - CPM – PERT- Network stochastic consideration, project monitoring, line of balance.

**UNIT V SCHEDULING WITH RESOURCE CONSTRAINTS 9**

Allocation of units for a single resource - allocation of multiple resources - resource balancing, line balancing - helgeson brine approach - region approach, stochastic mixed - product line balancing, flexible manufacturing system - concepts - advantages and limitation - computer integration and AI in manufacturing and operations, electronic data interchange.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Production and Operations Management course, the student will be able to

**CO 1:** Understand the role of operations management in the overall business strategy of the firm.

**CO 2:** Explain the major concepts in the functional areas of accounting, marketing, finance, and management.

**CO 3:** Evaluate the legal, social, and economic environments of business.

**CO 4:** Apply decision-support tools to business decision making.

**CO 5:** Construct and present effective oral and written forms of professional communication.

**REFERENCES:**


1. Thomas E Vollmann, William I Berry, "Manufacturing Planning and Control Systems", Galgotia Publication (P) Ltd., New Delhi, 2003.
2. Panneerselvam R., “Production and Operations Management”, Prentice-Hall of India Pvt.Ltd., New Delhi, 2002.
3. Elwood S Buffa, Rakesh K Sarin, “Modern Production and Operations Management”, JohnWiley& Sons Inc, 2002.
4. Everette E Adam, Ronald J Ebert, “Production and Operations Management: Concepts Models and Behavior”, Prentice Hall, Inc., 2002.
5. James D Dilworth, "Production and Operations Management ", Tata McGraw Hill, Inc, New Delhi, 1993.
6. Bedworth D.D., "Integrated Production Control Systems Management, Analysis, Design", John Wiley & Sons, New York, 1982.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **21MEI008** | **COMPUTER INTEGRATED MANUFACTURING LAB** | **0** | **0** | **4** | **2** |

**COURSE OBJECTIVE:**

- To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's and to impart knowledge on the use of Finite Element Analysis software to solve various field problems in mechanical engineering to optimize and verify the design of machine elements.

1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving & canned cycle
2. Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle.
3. Nonlinear analysis (Exercise must include plastic deformation of simple objects or crash analysis simple structures.
4. 3 Axis CNC code generations for CNC machining.
5. CNC Machining of complex features like machining of hemispherical cavity, tapered hole, hole of parabolic shape etc.

**LIST OF EQUIPMENTS REQUIRED:**

1. Computers 18
2. CAD Workstation
3. FEA Software
4. CAM Software for 3 axis machining or more
5. CNC Production type lathe or Milling Machine

**COURSE OUTCOMES:**

After successful completion of Computer Integrated Manufacturing lab, the student will be able to

**CO 1:** Impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's.

**CO 2:** To impart knowledge on the use of Finite Element Analysis software to solve various field problems in mechanical engineering to optimize and verify the design of machine elements.

**CO 3:** Identify the main elements in computer integrated manufacturing systems; Apply knowledge of computer aided process planning, feature and group technology, and data exchange in manufacturing processes.

**CO 4:** Apply the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion;

**CO 5:** Process product models with CAM tools and CNC machines.

**21MEI009 SIMULATION AND OPTIMIZATION PROGRAMMING LAB**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**OBJECTIVES:**

- To be familiar with the MATLAB GUI and basic tool boxes
- To be exposed to vector and matrix operations
- To be familiar with arithmetic, logical and relational operations on matrix

**LIST OF EXPERIMENTS:**

1. Introduction to SDK of MATLAB
2. Basic Syntax and scalar arithmetic operations and calculations
3. Working with formulas
4. Arithmetic operations in matrix data
5. Matrix operations (Inverse, Transpose)
6. Reading an image file
7. Reading from and writing to a text file
8. Introduction to toolboxes
9. Data visualization and plotting
10. Relational operators in data
11. Logical operation in data
12. Loops in MATLAB
13. Computing Eigen value for a matrix
14. Random number generation - Montecarlo methods

**TOTAL: 40 PERIODS**

**COURSE OUTCOMES:**

After successful completion of the Simulation and Optimization Programming LAB course, the student will be able to

**CO 1:** Understanding of MATLAB environment

**CO 2:** Perform data handling in MATLAB environment

**CO 3:** Solve simple matrix problems

**CO 4:** Write simple program

**CO 5:** Use built-in toolboxes

**REFERENCES:**


1. Holly Moore, " MATLAB for Engineers" Third Edition – Pearson Publications
2. Stephen J. Chapman, "MATLAB Programming for Engineers" Fourth Edition – Thomson learning.

**21RMCI21 MINI PROJECT**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 10 | 5 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to provide hands on training to the students in:

1. Dicovering potential research areas in the field of Mechanical Engineering.
2. Comparing and contrast the several existing solutions for the problem identified.
3. Formulating and propose a plan for creating a solution for the research plan identified.
4. Conducting the experiments as a team and interpret the results.
5. Reporting and presenting the findings of the work conducted.

**SYLLABUS:**

A project topic must be selected by the student individually in consultation with their guides. The ultimate aim of the project work is to deepen comprehension of mechanical principles by applying them to a newproblem which may be the design and develop of a device for a specific application.

**TOTAL:60 Hours**

**COURSE OUTCOMES:**

After successful completion of Mini Project, the student will be able to

**CO 1:** Discover potential research areas in the field of Mechanical Engineering.

**CO 2:** Compare and contrast the several existing solutions for the problems identified.

**CO 3:** Formulate and propose a plan for creating a solution for the research plan identified.

**CO 4:** Conduct the experiments as a team and interpret the results.

**CO 5:** Report and present the findings of the work conducted.

**21RMCI31 PROJECT WORK – Phase I**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 20 | 10 |

**COURSE OBJECTIVES:**

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

**SYLLABUS:**

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

**TOTAL:180 Hours**

**COURSE OUTCOMES:**

After successful completion of Project Work – Phase I, the student will be able to

**CO 1:** Identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.

**CO 2:** Develop the methodology to solve the identified problem.

**CO 3:** Train the students in preparing project reports and to face reviews and viva-voce examination.

**CO 4:** Getclear idea about the project work and they are in a position to carry out the remaining phase II work in a systematic way.

**CO 5:** Able to identify one's need for further knowledge and continuously develop one's own competencies.

**21RMCI41 PROJECT WORK – Phase II**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 32 | 16 |

**COURSE OBJECTIVES:**

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

**SYLLABUS:**

The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report submitted and the viva-voce examination by a panel of examiners including one external examiner

**TOTAL:360 Hours**

**COURSE OUTCOMES:**

After successful completion of Project Work – Phase II, the student will be able to

**CO 1:** Continue the phase I work on the selected topic as per the formulated methodology under the same supervisor.

**CO 2:** The identified problem based on the formulated methodology.

**CO 3:** Develop skills to analyze and discuss the test results, and make conclusions.

**CO 4:** On completion of the project work student will be in a position to take up any challenging practical problems in the field of construction engineering and management and find better solutions to it.

**CO 5:** Ability to evaluate, and critically assess one's own and others' results.

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# SYLLABUSOF PROFESSIONAL ELECTIVE COURSES

**21MEI101 APPLIED MATERIALS ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- This course provides knowledge in the areas of Industrial metallurgy, advanced materials and selection of materials for industrial applications.

**UNITI PLASTICBEHAVIOUR&STRENGTHENING 8**

MechanismofPlastic deformation,roleofdislocations,yield stress,shearstrengthof perfect and real crystals –Strengthening mechanism, work, hardening, solid solutioning,grainboundarystrengthening,Polyphasemixture,precipitation,particle fibreanddispersionstrengthening.Effectoftemperature,strainandstrainrateon plasticbehaviour– Superplasticity.

**UNITII FRACTUREBEHAVIOUR 8**

Griffith'stheory stress intensity factor and fracturetoughness-Toughening mechanisms– Ductile,brittletransition insteel-Hightemperature fracture,creep– Larson-Miller,Parameter– Deformationandfracturemechanismmaps–Fatigue.
Lowandhighcyclefatiguetest,crackinitiationandpropagationmechanismsand Parislaw– Effectofsurfaceandmetallurgicalparametersonfatigue–fractureof non- metallicmaterials– Failureanalysis, sources offailure, procedureoffailureanalysis.

**UNITIII SELECTIONOF MATERIALS 8**

Motivation for selection, cost basis and service requirements – selection for Mechanical properties, strength, toughness, fatigue and creep – Selectionfor surfacedurabilitycorrosionand wearresistance–Relationshipbetweenmaterials selectionandprocessing– CasestudiesinmaterialsselectionwithRelevanceto aero,auto,marine,machineryandnuclear applications**.**

**UNITIV MATERIALPROCESSING 9**

Processingofengineeringmaterials–PrimaryandSecondaryprocesses–astability, Weldability,forgeabilityandmalleabilityCriteria–Process induceddefects– Monitoringandcontrol.

**UNITV MODERNMATERIALSANDTREATMENT 12**

Dual phase steels, high strength lowalloy (HSLA) Steel transformation included plasticity(TRIP),Steel,maragingsteel,shapememoryalloys,propertiesapplicationsofengineeringplastic sandcompositesmaterials advancedstructuralceramics– WC,Tic,Tac,$Al_2O_3$,Sic,$Si_3N_4$,CBNdiamond,heat treatmentalloyandtoolsteels,vapourdeposition – Plasma, PVD- thick and thin film deposition – Nano materials- productionofNanosizedmaterials.

**TOTAL:45Hours**

**COURSE OUTCOMES:**

After successful completion of Applied Materials Engineering course, the student will be able to

**CO 1:** Apply core concepts in Materials Science to solve engineering problems.

**CO 2:** Understand the professional and ethical responsibilities of a materials scientist and engineer.

**CO 3:** Classify different mechanical properties and how they can influence the materials behavior with respect to applied load.

**CO 4:** Know the principles of metallurgical microscope, X-ray Diffractrometer (XRD), scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Thermal analysis

and dilatometer.

**CO 5:** Determine the crystal structure, lattice parameter, surface topography using different methods.

**REFERENCES:**


1. TheHandbookofAdvanceMaterials,Jamesk.Wessel, Wiley, Intersam, john,WilsonPublishers.,2004.
2. SurfaceEngineeringofMaterials- PrinciplesofEquipmeTechniques,Tadensz.
3. Burakonsa&T.Wierzchan.Thoash.Courtney ,“MechanicalBehaviourofMaterials”,(secondedition), McGrawHill,2000.
4. Flinn,R.A.andTrojan,P.K..,“EnggMeterialsandtheirApplication(fourthEdition),Jaico, 1999.
5. Metalshand book,vol. 10, “FailureAnalysisandPrevention”,(tenthedition)1994.
6. GeorgeE.Dieter,“MechanicalMetallurgy”,McGrawHill,1988.
7. Charles,J.A.,Crane,F.A.AandFurness,J.A.G.,“SelectionanduseofEngineeringMaterials”,(thirdEdition),Butterworth–Heiremann,1977.

**21MEI102 ADVANCES IN METROLOGY AND TESTING**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- To educate students with the NDT methods include ultrasonic, magnetic-particle, liquid penetrant, radiographic, remote visual inspection (RVI).

**UNIT I MEASURING MACHINES 9**

Tool Maker'smicroscope - Co-ordinate measuring machines - Universal measuring machine-Laserviewersforproductionprofilechecks-Imageshearingmicroscope-Useofcomputers-Machinevision technology-Microprocessorsinmetrology.

**UNIT II STATISTICALQUALITYCONTROL 9**

Datapresentation-Statisticalmeasuresandtools-Processcapability -Confidenceand tolerance limits - Control charts for variables and forfraction defectives - Theory of probability -Sampling-ABCstandard-Reliabilityand lifetesting.

**UNIT III LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS 9**

Characteristics of liquid penetrants - different washable systems - Developers - applications - Methods of production of magnetic fields - Principles of operation of magnetic particletest-Applications-Advantagesandlimitations.

**UNITIVRADIOGRAPHY 9**

Sources of ray-x-rayproduction -properties of d and x rays - Film Radiography- filmcharacteristics - use of film, characteristic curves (H & D curve) - latent image formation on film - radiographic exposure, reciprocity law, photographic density exposure charts - contrasts - operational characteristics of x ray equipment -Radiographic Image Quality and Radiographic Techniques-applications.

**UNITVULTRASONICANDACOUSTICEMISSIONTECHNIQUES 9**

Productionof ultrasonicwaves -different typesof waves -general characteristicsof waves-pulseechomethod- A,B,Cscans-Principlesofacoustic emissiontechniques-Advantagesandlimitations-Instrumentation-applications.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Metrology and Non Destructive Testing course, the student will be able to

**CO 1:** Knowledge of surface NDE techniques; which enables to carry out various inspections in accordance with the established procedures.

**CO 2:** Differentiate various defect types and select the appropriate NDT methods for better evaluation.

**CO 3:** Ability to communicate their conclusions clearly to specialist and non-specialist audiences.

**CO 4:** Understand the eddy current instrument and perform inspection of weldments with unknown defects.

**CO 5:** Provide knowledge and enrich ideas about the conventional NDT techniques and develop to inspecting and evaluating components in accordance with industry specifications.

**REFERENCES:**

1. JAIN, R.K. " Engineering Metrology ", Khanna Publishers, 1997.

2. Barry Hull and Vernon John, " Non Destructive Testing ", MacMillan, 1988.

3. American Society for Metals, " Metals Hand Book ", Vol.II, 1976.

4. Progress in Acoustic Emission, " Proceedings of 10th International Acoustic Emission Symposium ", Japanese Society for NDI, 1990.

**21MEI103 COMPUTER AIDED PROCESS PLANNING**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- To familiarize the students with process planning in the manufacturing cycle, design, drafting, geometric modeling, systems in CAPP and report generation.

**UNIT I INTRODUCTION 9**

ThePlaceofProcessPlanningintheManufacturingcycle-Process Planningand Production Planning–Process PlanningandConcurrentEngineering,CAPP,Group Technology.

**UNITIIPARTDESIGNREPRESENTATION 9**

Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input / output devices - topology - Geometric transformation - Perspective transformation - Data structure - Geometric modelling for process planning - GT coding - The optiz system - The MICLASS system.

**UNITIIIPROCESSENGINEERINGANDPROCESSPLANNING 9**

Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, Al.

**UNIT IV COMPUTER AIDED PROCESS PLANNING SYSTEMS 9**

Logical Design of a Process Planning - Implementation considerations - manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

**UNIT V AN INTERGRADED PROCESS PLANNING SYSTEMS 9**

Totally integrated process planning systems - An Overview - Modulus structure - Data Structure, operation - Report Generation, Expert process planning.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Computer Aided Process Planning course, the student will be able to

**CO 1:** Generate the structure of automated process planning system and uses the principle of generative and retrieval CAPP systems for automation.

**CO 2:** Predict the effect of machining parameters on production rate, cost and surface quality and determines the manufacturing tolerances.

**CO 3:** Explain the generation of tool path and solve optimization models of machining processes.

**CO 4:** Create awareness about the implementation techniques for CAPP

**CO 5:** Understand about group technology, computer aided process planning, material requirement planning (MRP) Enterprise resource planning (ERP), Computer aided quality control and Flexible manufacturing systems, Artificial intelligence and Expert systems.

**REFERENCES:**


1. GideonHaleviandRolandD.Weill,"PrinciplesofProcessPlanning",Alogical approach,Chapman&Hall,1995.
2. Tien-ChienChang, Richard A.Wysk, "An Introduction to automated processplanning systems",PrenticeHall,1985.
3. Chang,T.C.,"AnExpertProcessPlanningSystem",PrenticeHall,1985.

4.NanuaSingh,"SystemsApproachtoComputerIntegratedDesignandManufacturing",JohnWiley&Sons,1996.

5.Rao,“ComputerAidedManufacturing",TataMcGrawHillPublishingCo.,2000.

**21MEI104 COMPUTER APPLICATIONS IN MANUFACTURING**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- On completion of the course the students are expected to be knowledgeable in Engineering product specification, CAD/CAM integration, CNC machine tool building, CNC programming using manual method, generation of CNC codes using CAM software, Tooling and work holding devices.

**UNIT I Introduction to Cam, Geometric Dimensioning and Tolerance 9**

CNC machine tools, Principle of operation of CNC,Construction features including structure, drives and CNC controllers, 2D and 3Dmachining on CNC Geometrical dimensioning andtolerancing, Tolerance stacking – types and remedies

**UNIT II CNC Part Programming 9**

Detailed Manual part programming on Lathe & Millingmachines using G & M codes, FAPT programming (FANUC). Generation of tool path, generation of G & M codes, Optimization of tool path (to reduce machining time)

**UNIT III CNC Tooling 9**

Different types of tools and tool holders used onCNC Machines, parameters for selection of configuration of cutting tools, work holding devices used on CNC machines

**UNIT IV Advanced CNC Processes 9**

Introduction to advanced CNC processes, EDM, Wire EDM, Abrasive water jet, LASERcutting, RPT, (Working principles, construction or set up of process, applications)

**UNIT V APT Programming 9**

APT language structure, APT geometry: Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to-point motion commands, continuous path motion commands. Post processor commands, complication control commands. Macro subroutines. Part programming preparation for typical examples

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Computer Applications in Manufacturing course, the student will be able to

**CO 1:** Design and develop Computer Integrated Manufacturing systems using the knowledge of mathematics, science, engineering and IT tools.

**CO 2:** Communicate ideas effectively with diversified groups to become lead professionals in academia and industry in advanced areas of manufacturing.

**CO 3:** Apply knowledge of manufacturing engineering and management principles to design and evaluate automated manufacturing systems.

**CO 4:** Analyze problems of manufacturing and industrial systems to formulate the design requirements for CIM systems.

**CO 5:** Formulate competitive priorities and manufacturing strategy for a given production system to derive strategic advantage.

**REFERENCES:**


1. Jon Stenerson and Kelly Curran “Computer Numerical Control”, Prentice-Hall ofIndia Pvt. Ltd. New Delhi, 2008
2. Ibrahim Zeid “CAD/CAM - Theory and Practice” Mc Hill, International edition,1998
3. P. N. Rao “CAD/Cam principles and operations”, Tata McGraw Hill
4. Reference Manuals of FANUC, Siemens, Mazak, etc.
5. Thomas M. Crandell “ CNC Machining and Programming, Industrial Press ISBn-0-8311-3118-7
6. Bedworth, Wolfe and Henderson - “Computer aided design and manufacturing” -McGraw Hill
7. “Manufacturing Science” - A. Ghosh and Malik - Affiliated East West Press Pvt.Ltd.
8. Tilak Raj - “CNC Technology and Programming”, Dhanpat Rai PublicationCompany.

**21MEI105 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- To study the principles, practices and techniques of Design of Hydraulic and Pneumatic Systems.

**UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 6**

HydraulicPowerGenerators–Selectionandspecificationofpumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

**UNIT II CONTROL AND REGULATION ELEMENTS 12**

Pressure-directionandflowcontrolvalves-reliefvalves,non-returnand safetyvalves-actuation systems.

**UNITIIIHYDRAULICCIRCUITS 6**

Reciprocation,quickreturn,sequencing,synchronizingcircuits-accumulatorcircuits-industrialcircuits-presscircuits-hydraulicmillingmachine-grinding,planning, copying,-forklift,earthmovercircuits-designandselectionofcomponents-safety andemergencymandrels.

**UNITIVPNEUMATIC SYSTEMSANDCIRCUITS 15**

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

**UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS 7**

Pneumatic equipments- selection of components - design calculations – application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Design of Hydraulic and Pneumatic Systems course, the student will be able to

**CO 1:** Understand the principles, practices and techniques of Design of Hydraulic and Pneumatic Systems.

**CO 2:** Explain and design the physical and technological basis of hydraulic and pneumatic devices.

**CO 3:** Describe development and application of hydraulic and pneumatic systems,

**CO 4:** Interpret the acquired data and results,devise independently simple hydraulic and pneumatic systems,

**CO 5:** Create solutions in analysis, design and development of components, devices and equipment of hydraulic and pneumatic systems.

**REFERENCES:**


1. AntonyEspossito, “FluidPowerwithApplications”,PrenticeHall,1980.
2. Dudleyt,A.Peaseand JohnJ.Pippenger,“Basicfluidpower”, Prentice Hall,
3. AndrewParr,“Hydraulicand Pneumatics” (HB),JaicoPublishingHouse,1999.
4. Bolton. W.,“PneumaticandHydraulicSystems“,Butterworth–Heinemann,1997.
5. K.ShanmugaSundaram, “Hydraulic and Pneumatic Controls: Understanding madeEasy"S. Chand &Co Bookpublishers,NewDelhi,2006(Reprint2009).

**21MEI106 MECHATRONICS IN MANUFACTURING SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- This syllabus is formed to create knowledge in Mechatronic systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives a framework of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

**UNIT I INTRODUCTION 5**

Introduction to Mechatronics - Systems- Need for Mechatronics - Emerging area of Mechatronics - Classification of Mechatronics - Measurement Systems – Control Systems.

**UNIT II SENSORS AND TRANSDUCERS 12**

Introduction - Performance Terminology – Potentiometers - LVDT – Capacitance sensors - Strain gauges - Eddy current sensor - Hall Effect sensor – Temperature sensors - Light sensors - Selection of sensors - Signal processing.

**UNIT III ACTUATORS 12**

Actuators – Mechanical - Electrical - Fluid Power - Piezoelectric – Magnetostrictive - Shape memory alloy - applications - selection of actuators.

**UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 8**

Introduction - Basic structure - Input and output processing - Programming - Mnemonics-Timers, counters and internal relays - Data handling - Selection of PLC.

**UNIT V DESIGN AND MECHATRONICS CASE STUDIES 8**

Designing - Possible design solutions-Traditional and Mechatronics design concepts - Case studies of Mechatronics systems - Pick and place Robot - Conveyor based material handling system - PC based CNC drilling machine – Mechatronics Control in automated Manufacturing – Data Acquisition Case studies.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Mechatronics in Manufacturing Systems course, the student will be able to

**CO 1:** Generate conceptual design for Mechatronics products based on potential customer requirements

**CO 2:** Design a control system for effective functioning of Mechatronics systems using digital electronics, microprocessors, microcontrollers and programmable logic controllers

**CO 3:** Determine the performance of a Mechatronics system

**CO 4:** Compute forward and inverse kinematics of robots and determine trajectory plan.

**CO 5:** Design and select robots for Industrial and Non-Industrial applications.

**REFERENCES:**

1. Bolton.W, “Mechatronics”, Pearson education, second edition, fifth Indian Reprint, 2003

2. Smaili.A and Mrad.F , "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.

3. Devadas Shetty and Richard A.Kolk, “Mechatronics systems design”, PWS Publishing company, 2007.

4. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006.

5. NitaigourPremchandMahalik, “Mechatronics Principles, Concepts and applications” Tata McGraw-Hill Publishing Company Limited, 2003

**21MEI107 ROBOTICS AND SENSORS**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- On completion of the course the students are expect to the knowledgeable in Robot anatomy, end effectors, sensors, vision systems, and kinematics.

**UNIT I INTRODUCTION 5**

An Introduction to sensors and Transducers, History and definitions, Smart Sensing, AI sensing, Need of sensors in Robotics.

**UNIT II SENSORS IN ROBOTICS 9**

Position sensors - optical, non-optical, Velocity sensors, Accelerometers, Proximity Sensors - Contact, non-contact, Range Sensing, touch and Slip Sensors, Force and Torque Sensors

**UNIT III MISCELLANEOUS SENSORS IN ROBOTICS 11**

Different sensing variables - smell, Heat or Temperature, Humidity, Light, Speech or Voice recognition Systems, Tele-presence and related technologies.

**UNIT IV VISION SENSORS IN ROBTICS 10**

Robot Control through Vision sensors, Robot vision locating position, Robot guidance with vision system, End effectors camera Sensor.

**UNIT V MULTISENSOR CONTROLLED ROBOT ASSEMBLY 10**

Control Computer, Vision Sensor modules, Software Structure, Vision Sensor software, Robot programming, Handling, Gripper and Gripping methods, accuracy - A Case study.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Robotics and Sensors course, the student will be able to

**CO 1:** Classify robots based on joints and arm configurations.
**CO 2:** Design application specific End Effectors for robots.
**CO 3:** Program robot to perform typical tasks including Pick and Place, Stacking and Welding.
**CO 4:** Design and select robots for Industrial and Non-Industrial applications.
Understand many modern devices and technologies used in sensors.
**CO 5:** Understand the application of various sensors for direct contact and non-contact measurements.

**REFERENCES:**


1. Paul W Chapman, "Smart Sensors", an Independent Learning Module Series, 1996.
2. Richard D. Klafer, Thomas a. Chmielewski; Michael Negin, "Robotic Engineering - An integrated approach", Prentice Hall of India Private Limited, 1989.
3. John Iovice, "Robots, Androids and Animalrons", McGraw Hill, 1998.
4. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, "Robotics - Control Sensing, Vision and Intelligence", McGraw Hill Internation Editions, 1987.
5. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G. Odrey, "Industrial Robotics - Technology, Programming and Applications", Mc Graw Hill, International Editions, 1986.
6. SabricSoloman, "Sensors and Control Systems in Manufacturing", Mc Graw Hill, International Editions, 1994.

**21MEI108 MANUFACTURING SYSTEM SIMULATION**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- To provide knowledge in the concept of manufacturing system simulation environment through the simulation languages and case studies.

**UNIT IINTRODUCTION 8**

Basicconceptsofsystem–elementsofmanufacturingsystem-conceptofsimulateon–simulationasadecisionmakingtool–typesofsimulation–Monte-Carlosimulation- system modeling – types of modeling – Limitations and Areas of application of simulation.

**UNIT II RANDOM NUMBERS 9**

Probabilityandstatisticalconceptsofsimulation–Pseudorandomnumbers–methods of generating random numbers – discrete and continuous distribution – testing of randomnumbers–kolmogorov-Smirnovtest,theChi-Squaretest-sampling-simple, random andsimulated.

**UNIT IIIDESIGNOFSIMULATIONEXPERIMENTS 10**

Problem formulation – data collection and reduction – time flow mechanical – key variables -logic flow chart starting condition – run size – experimental design consideration – output analysis, interpretation and validation – application of simulation in engineering industry.

**UNIT IVSIMULATIONLANGUAGE 9**

Comparisonandselectionofsimulationlanguages-StudyofGPSS(Basicblocksonly) Generate,Queue, Depart, Size, Release,Advance, Terminate,Transfer,Enter andLeave.

**UNIT VCASESTUDIES 9**

Development of simulation models using GPSS for queuing, production, inventory, maintenance and replacement systems – case studies.

**TOTAL:45Hours**

**COURSE OUTCOMES:**

After successful completion of Manufacturing System Simulation course, the student will be able to

**CO 1:** Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.

**CO 2:** Apply the processes, procedures and techniques which are required for the successful execution of systems engineering methodology to resolve different types of complex problems faced by senior manager, at an earlier stage of system design.

**CO 3:** Create system reports and system specification documents.

**CO 4:** Interpret the model and apply the results to resolve critical issues in a real world environment.

**CO 5:** Design and analyse control mechanism and management function to ensure that the system achieves its purpose.

**REFERENCES:**


1. JerryBanksandJohnS.Carson,“Discreteeventsystemsimulation”,PrenticeHall1991
2. JohnH.MizeandJ.GradyCox,“Essentialsofsimulation”–Prenticehall 1989.
3. GeoffreyGordon“System simulation” –PrenticeHall ofIndia, 1992
4. JeffreyL.Written,LonnieD,BentleyandV.M.Barice,“SystemanalysisandDesign Methods”,Galgotiapublication, 1995
5. AverillM.LawandW.DavidKelton,“SimulationModelingandanalysis”,McGrawHill International Editions, 1991.
6. hannonR.E.,“Systemsimulation”,Prentice Hall1993.

**21MEI109 MACHINE VISION AND ITS APPLICATIONS**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- To familiarize the students with machine vision system through the various image processing utility and knowing the application of machine vision system.

**UNITI BASIC PRINCIPLE OF MACHINE VISION CONCEPT 8**

Introduction to Machine Vision - Advantages of Machine vision - Applications of machine vision. Image Processing- Binary Algorithms- Morphological Operators- Optical Character Recognition.

**UNIT II FUNDAMENTALS OF IMAGE PROCESSING 8**

Image acquisition Principles and Devices -Binary image processing - Digital Imaging - Grey Scale Modification -Sharpening and Smoothing the images - Regions and Edges - Region representation - image storage - Image enhancement - Image Filtering.

**UNIT III DYNAMIC VISION AND OBJECT RECOGNITION 10**

Histogram modifications, linear systems and filters. Image Detection -Edge detection- Contours, geometry of curves, Digital curves, Curve fitting, Circular arcs, Conics and Spline curves - Surfaces, representations, interpolation, Approximation, Segmentation, Registration.

**UNIT IV IMAGE PROCESSING DEVICES 9**

Introduction to Texture, Statistical and Model based analysis of Texture, Structural analysis of ordered texture - Model-Based Methods for Texture Analysis - Shape from Texture, Photometric stereo. Dynamic Vision - Segmentation using Motion and Moving camera Motion.

**UNIT V APPLICATION AND INTERFACING 10**

Object recognition - Object Representation, Feature Detection, Recognition Strategies, Verification and their applications with examples, two and three dimensional measurements, Inter facing a robot with a Vision system.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Machine Vision and its Applications course, the student will be able to

**CO 1:** Apply the concepts of calibration, traceability and uncertainty for accurate and reliable measurements.

**CO 2:** Identify and estimate measurement errors and suggest suitable techniques to minimize them.

**CO 3:** Enhance digital image using various algorithms with the help of computer programming.

**CO 4:** Understand the role of image processing in different fields such as medical, engineering, space, biotechnology, ocean, agriculture, food industry, etc.

**CO 5:** Realize the significance of digital image processing in automation.

**REFERENCES:**


1. Pham. D.T., Dimov. S. S., 'Rapid manufacturing: the technologies and applications of RPT and rapid tooling', Springer, London, 2001.
2. Hilton.P.D., 'Rapid Tooling', Marcel Dekker, 2000.
3. Chua.C.K., 'Rapid Protyping', Wiley, 1997.
4. Beaman.J.J. et all, 'Solid freeform fabrication', Kluwer, 1997.
5. Burns.M, 'Automated Fabrication', PHI, 1993..

**21MEI110 METAL FORMING TECHNOLOGY**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- At the end of the course the student should be able to understand the advances in metal forming.

**UNIT I THEORY OF PLASTICITY 9**

Theoryof plasticdeformation – Yield criteria –TrescaandVon-mises–Distortion energy – Stress-strainrelation–Mohr'scircle representationofastateofstress– cylindricalandsphericalco-ordinatesystem–upperandlowerboundsolutionmethods –OverviewofFEMapplicationsinMetal Forminganalysis.

**UNIT II HEORY AND PRACTICE OF BULK FORMING PROCESSES 9**

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming.

**UNIT III SHEET METAL FORMING 9**

Formability studies – Conventional processes – H E R F techniques – Super plastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application

**UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES 9**

Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling – Tooling, process parameters and applications. - Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming

**UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9**

Experiment techniques of evaluation of friction in metal forming selection – influence of temperature and gliding velocity – Friction heat generation – Friction between metallic layers – Lubrication carrier layer – Surface treatment for drawing, sheet metal forming, Extrusion and hot and cold forging. Processing of thin Al tapes – Cladding of Al alloys – Duplex and triplex steel rolling – Thermo mechanical regimes of Ti and Al alloys during deformation – Formability of welded blank sheet – Laser structured steel sheet - Formability of laminated sheet.

**TOTAL:45 Hours**

**COURSE OUTCOMES:**

After successful completion of Metal Forming Technology course, the student will be able to

**CO 1:** Understand the theoretical foundations and methodology necessary for solving metal-forming technologies on the principles of plastic deformation and theory of plasticity.

**CO 2:** Know the necessary for a creative and complex engineering solution of the technologies of metal-forming processes.

**CO 3:** Understand the fundamental principles such as the physical, chemical, mechanical and thermodynamic principles of metallic bodies changing from the elastic into the plastic state, and when these bodies are plastically deformed into the required shape.

**CO 4:** Explain the elements of the theory of plasticity, fundamentals of metal working, forging process, rolling process, extrusion process, drawing of rods, wires and tubes, sheet metal forming process, high energy rate forming.

**CO 5:** Understand the loading of the forming tool or machine, and how to determine the critical values of deformation.

**REFERENCES:**


1. Dieter G.E.,Mechanical Metallurgy(RevisedEditionII) McGrawHill Co.,2004
2. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003.
3. ASM Hand book, Forming and Forging, Ninth edition, Vol – 14, 2003
4. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T,Metal forming and Finite Element Method, Oxford University Press, 2001.
5. ALTAN.T, SOO-IK-oh, GEGEL, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio, 1983.
6. Marciniak,Z., Duncan J.L., Hu S.J., 'Mechanics of Sheet Metal Forming', Butterworth-Heinemann An Imprint of Elesevier, 2006
7. Proc. Of National Seminar on "Advances in Metal Forming" MIT, March 2000
8. SAE Transactions, Journal of Materials and Manufacturing Section 5, 1993-2007

**21MEI111 NEWER WELDING AND CASTING PROCESSES**

| L | T | P | C |
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| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- At the end of the course the student should be able to understand the welding and various casting processes in production environment.

**UNIT I CASTING DESIGN 8**

Heattransfer betweenmetal andmould—Designconsiderationsincasting–Designing fordirectionalsolidificationandminimumstresses-principlesanddesignofgatingand risering

**UNIT II CASTING METALLURGY 8**

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification –Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.

**UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 8**

Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

**UNIT IV WELDING METALLURGY AND DESIGN 10**

Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.

**UNIT V RECENT TRENDS IN WELDING 11**

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

**TOTAL:45Hours**

**COURSE OUTCOMES:**

After successful completion of Newer Welding and Casting Processes course, the student will be able to

**CO 1:** Understand basic definitions the Welding and casting process

**CO 2:** Describe the Melting Furnaces & Special moulding Process

**CO 3:** Classify various manufacturing process and list the types of patterns and binders

**CO 4:** List types of moulds and cores and classify types of sand used for preparing the same. Sketch the types of mould machine, casting defects

**CO 5:** Define and classify various welding process and sketch the special t ype of welding process

**REFERENCES:**


1. ASMHandbook,Vol 15,Casting,2004
2. ASMHandbookvol.6,weldingBrazing&Soldering,2003
3. Parmer R.S.,WeldingEngineeringandTechnology,KhannaPublishers,2002
4. SrinivasanN.K.,WeldingTechnology,KhannaTechPublishers,2002
5. HEINELOPER& ROSENTHAL,PrinciplesofMetal Casting,TataMcGrawHill,2000.
6. JainP.L.,PrinciplesofFoundryTechnology,TataMcGrawHillPublishers, 2003
7. CarrryB.,ModernWeldingTechnology,PrenticeHall PvtLtd., 2002
8. IOTROWSKI–Roboticwelding–Aguidetoselectionandapplication–Societyof mechanicalEngineers, 1987.
9. SCHWARIZ, M.M. – Sourcebookon innovative weldingprocesses–American Society for Metals(OHIO),1981.
10.CORNU.J.Advancedweldingsystems–VolumesI,IIandIII,JAICOPublishers,1994.
11.LANCASTER.J.F.–Metallurgyofwelding–GeorgeAlien&UnwinPublishers,1980

| | | L | T | P | C |
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| **21MEI112** | **DESIGN OF CELLULAR MANUFACTURING SYSTEM** | **4** | **0** | **0** | **4** |

**COURSE OBJECTIVE:**

At the end of this course the student should be able to understand

- Concepts and applications of Cellular manufacturing systems
- Traditional and non-traditional approaches of Problem solving
- Performance measurement
- Human and economical aspects of CMS.

**UNITI INTRODUCTION** **12**

Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristicsanddesignofgroups,benefitsofGTandissues inGT.

**UNIT II CMS PLANNING AND DESIGN** **10**

Problems in GT/CMS - Design of CMS - Models, traditional approaches and non- traditional approaches -Genetic Algorithms, Simulated Annealing, Neural networks.

**UNIT III IMPLEMENTATION OF GT/CMS** **10**

Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS.

**UNIT IV PERFORMANCE MEASUREMENT AND CONTROL** **8**

MeasuringCMSperformance-Parametricanalysis-PBCinGT/CMS,cellloading,GT andMRP-framework.

**UNIT V ECONOMICS OF GT/CMS:** **5**

ConventionalVsgroupuseofcomputermodelsinGT/CMS,HumanaspectsofGT/CMS- cases.

**TOTAL:45 Hours**

**COURSE OUTCOMES:**

After successful completion of Design of Cellular Manufacturing System course, the student will be able to

**CO 1:** Understand the effect of manufacturing automation strategies and derive production metrics.

**CO 2:** Analyze automated flow lines and assembly systems, and balance the line.

**CO 3:** Design automated material handling and storage systems for a typical production system.

**CO 4:** Develop CAPP systems for rotational and prismatic parts.

**CO 5:** Classify and distinguish NC, CNC and DNC systems, Understand CNC machine structures and system drives and develop interpolation algorithms for control loops.

**REFERENCES:**


1. Burbidge,J.L.Group"TechnologyinEngineeringIndustry",MechanicalEngineeringpub. London, 1979.
2. Irani,S.A."CellularManufacturingSystems", HandBook
3. Askin,R.G.andVakharia,A.J.,G.T"PlanningandOperation,inTheautomated factory-HandBook:TechnologyandManagement",Cleland.D.I.andBidananda,B(Eds),TABBooks,NY, 1991.
4. Kamrani,A.K,Parsaei,H.RandLiles,D.H.(Eds),"Planning,designandanalysis ofcellularmanufacturingsystems",Elsevier,1995.

**21MEI113 INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES**

| L | T | P | C |
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| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- To enhance the knowledge of the students about various measuring instruments, operation of different measurement technology, instruments transducers and their application in automotive industry.
- To understand the various steps involved in error analysis and uncertainty analysis of the automotive industry

**UNIT I MEASUREMENT SYSTEMS 6**

Static and Dynamic Measurement systems- Requirements and characteristics – Analysis of experimental detail, Error analysis.

**UNIT II TRANSDUCERS, MODIFIERS AND TERMINATING DEVICES 8**

Transducers for Automotive Applications – Amplifiers- filters –data Acquisition- Indicators, Printers and displays –Signal Analyzing.

**UNIT III MECHANICAL MEASUREMENT 10**

Instrumentation For Measuring Weight , Force, torque , pressure power, temperature, fluid flow, vibration, rotational speed , velocity, acceleration and angular motion.

**UNIT IV ENGINE EXPERIMENTAL TECHNIQUES 12**

I.S Code for Engine testing – Instrumentation for performance testing of engine, Instrumentation for Research and development, Instrumentation for noise, vibration, in cylinder gas flow, flame temperature Dynamic Cylinder pressure measurements.

**UNIT V VEHICLE EXPERIMENTAL TECHNIQUES 9**

Introduction to various vehicle experimental techniques, Laboratory tests- vehicle tracks test - Vehicle endurance Tests- Vehicle crash tests- Vehicle wind tunnel tests- Vehicle Brake tests.

**TOTAL : 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Instrumentation and Experimental Techniques course, the student will be able to

**CO 1:** Develop among the students, the competence to analyze systems, develop models, design controllers and configure automation systems.

**CO 2:** Impart practical knowledge in process control and design of instrumentation systems.

**CO 3:** Prepare students' to have successful career in industry / R&D organization and academic institutions.

**CO 4:** Enhance the knowledge of the students about various measuring instruments, operation of different measurement technology, instruments transducers and their application in automotive industry.

**CO 5:** Understand the various steps involved in error analysis and uncertainty analysis of the automotive industry.

**TEXT BOOKS:**


1. J.G. Giles, ‘Engine and Vehicle Testing’, Illiffe books Ltd., London,1968.
2. T.G. Beckwith and Buck, ‘Mechanical Measurements’, Oxford and IBH Publishing House, New Delhi, 1995


**REFERENCES:**


1. A.W. Judge, ‘Engineering Precision Measurement’, Chapman and Hall Ltd, Essex Street W.C.,1951,
2. D.Patambis, ‘Principle of Industrial Instrumentation’, Tata McGraw Hill Publishing Co, New Delhi, 1990.
3. Rangan, Sharma and Mani, ‘Instrumentation Devices and systems’, Tata McGraw Hill Publishing Co., Ltd., 1990
4. Anthony Martyr, Michael Alexander Plint, ‘Engine Testing’, Elsevier, 2012.

**21MEI114 INTERNET OF THINGS FOR MANUFACTURING**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**OBJECTIVES:**

To discover key IoT concepts including identification, sensors, localization, wireless protocols

To explore IoT technologies, architectures, standards, and regulation

To realize the value created by collecting, communicating, coordinating, and leveraging data

To examine developments that will likely shape the industrial landscape in the future;

**UNIT I INTRODUCTION** **9**

Technology of the IoT and applications,. IoT data management requirements, Architecture of IoT, Security issues Opportunities for IoT -Issues in implementing IoT. Technological challenges, RFID and the Electronic Product Code (EPC) network, the web of things.

**UNIT II DESIGN OF IoT** **9**

Design challenges in IoT -Standardization, Security and privacy, Infrastructure, Analytics. Design steps for implementing IoT.

**UNIT III PROTOTYPING OF IoT** **9**

Design principles for connected devices -Embedded devices, physical design, online components, embedded coding system. Informed Manufacturing plant – Elements, IoT implementation in Transportation and logistics, Energy and utilities, Automotive Connected supply chain, Plant floor control automation, remote monitoring, Management of critical assets, Energy management and resource optimization, proactive maintenance.

**UNIT IV PREREQUISITES FOR IoT** **9**

IOT Technologies Wireless protocols low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and data-intensive IoT for continuous recognition applications Data storage and analysis Localization algorithms Localization for mobile systems

**UNIT V APPLICATION IN MANUFACTURING** **9**

Applications HCI and IoT world - Multilingual interactions Robotics and Autonomous Vehicles Sensing and data processing-Simultaneous mapping and localization-Levels of autonomy, Smart factories, Future research challenges

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

After successful completion of INTERNET OF THINGS FOR MANUFACTURING course, the student will be able to

- **CO 1:** Utilizing sensors to gain greater visibility and real-time situational awareness
- **CO 2:** Vertical applications that provide a clear business case and a pressing opportunity
- **CO 3:** Emerging technologies to address IoT challenges
- **CO 4:** Application and interactions robotics and autonomous vehicles.
- **CO 5:** Design principles of manufacturing plant

**REFERENCES:**

1. Adrian McEwan and Hakim Cassimally, “Designing the internet of things”, Wiley, 2013

2. Code Halos: How the Digital Lives of People, Things, and Organizations are Changing the Rules of Business, by Malcolm Frank, Paul Roehrig and Ben Pring, published by John Wiley & Sons.

3. Internet of Things: A Hands-On Approach by Vijay Madisetti, ArshdeepBahga, VPT; 1st edition 2014.

4. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, StamatisKarnouskos, Stefan Avesand, David Boyle, “From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence” Elsevier

5. Meta Products -Building the Internet of Things by WimerHazenberg, Menno Huisman, BIS Publishers 2014.

**21MEI115 FLEXIBLE MANUFACTURING SYSTEMS**

| L | T | P | C |
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| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- To introduce the various Modern manufacturing systems.
- To understand the concepts and applications of flexible manufacturing systems

**UNIT I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS** **9**

Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge based scheduling system.

**UNIT II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS** **9**

Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.

**UNIT III FMS SIMULATION AND DATA BASE** **9**

Application of simulation – model of FMS– simulation software – limitation – manufacturing data systems – data flow – FMS database systems – planning for FMS database.

**UNIT IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS** **9**

Introduction – matrix formulation – mathematical programming formulation –graph formulation – knowledge based system for group technology – economic justification of FMS- application of possibility distributions in FMS systems justification.

**UNIT V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE** **9**

FMS application in machining, sheet metal fabrication, prismatic component production – aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of the Product Development and Manufacture course, the student will be able to

**CO1:** Perform Planning, Scheduling and control of Flexible Manufacturing systems

**CO2:** Perform simulation on software's use of group technology to product classification

**CO3:** Make a prototype of a FMS simulation and data base.

**CO4:** Make Group Technology and justification of FMS layout

**CO5:** Identify the applications of FMS and factory of the future

**TEXT BOOKS:**


1. Jha, N.K. “Handbook of flexible manufacturing systems”, Academic Press Inc., 1991.
2. DR. H.K. Shivanand, M.M. Benal, V. Koti, “Flexible Manufacturing Systems”, New Age International (P) Limited, Publishers, 2006.


**REFERENCES:**


1. Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd., New Age International Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
3. Groover M.P., “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpakjian, “Manufacturing Engineering and Technology”, Addison-Wesley Publishsing Co., 1995.
5. TaiichiOhno, “Toyota Production System: Beyond large-scale Production”, Productivity Press (India) Pvt. Ltd. 1992.

**21MEI116 SENSORS FOR MANUFACTURING AND CONDITION MONITORING**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**OBJECTIVE:**

To impart knowledge of sensor technologies used in the manufacturing industry for monitoring workpieces, machine tools, machining processes and advanced sensors.

**UNIT I INTRODUCTION TO SENSORS** **9**

Role of sensors in manufacturing and condition monitoring – Principles – Classification Applications – Basic requirements of sensor – Signal processing and decision making.

**UNIT II SENSORS FOR WORKPIECE MONITORING** **9**

Mechanical, Electrical, Electro-mechanical, Opto-electrical, Optical, Pneumatic, Capacitance, Eddy-current and Magnetic sensors.

**UNIT III SENSORS FOR MACHINE TOOL MONITORING** **9**

Position measurements: Linear, angular and velocity sensors – Calibration of machine tools – Collision detection measurements.

**UNIT IV SENSORS FOR MACHINING PROCESSES** **9**

Sensors for condition monitoring: Force, torque, power, temperature, vibration, acoustic emission, tool sensors, chip control sensors – Adaptive control system – Intelligent systems for machining processes.

**UNIT V ADVANCED SENSORS** **9**

Optical and machine vision sensors – Smart/Intelligent sensors – Integrated sensors – Robot sensors – Micro-sensors – Nano-sensors.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

After successful completion of SENSORS FOR MANUFACTURING AND CONDITION MONITORING course, the student will be able to

**CO 1:** Understand and applications of various sensors

**CO 2:** Working principle of workpiece monitoring sensor

**CO 3:** Working principle of machine tool monitoring sensor

**CO 4:** Understand and principles of intelligent machining system.

**CO 5:** Develop knowledge about advanced sensor

**REFERENCES**

1. Considine, D.M. and Glenn, D., “Standard Handbook of Industrial Automation: Advanced Industrial Technology 01”, Chapman and Hall, New York, DOI: 10.1017/S0263574700004392, 1987.

2. Sinclair, I.R., “Sensors and Transducers” Elsevier India Private Limited, New Delhi, India, ISBN: 978-0-7506-4932-1, 2001.

3. Tönshoff, H.K. and Inasaki, I., “Sensors in Manufacturing: Sensors Applications- Volume1”, Wiley-VCH Verlag GmbH, Weinheim, ISBNs: 3-527-29558-5 (Hardcover); 3-527-60002-7 (Electronic), 2001.

4. Venkatesh, V.C. and Chandrasekaran, H., “Experimental Techniques in Metal Cutting”, Prentice-Hall of India Private Limited, New Delhi, India, ISBN: 0-87692-449-6, 1987.
5. Wang, L. and Gao, R.X., “Condition Monitoring and Control for Intelligent Manufacturing”, Springer-Verlog London Limited, ISBN-13:978-1-84628-263-3, 2006.

**21MEI117 INDUSTRIAL ROBOTICS**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- The objective of the course is to provide a mathematical introduction to the mechanics and control of robots that can be modeled as kinematic chains.

**UNIT I INTRODUCTION** **9**

Introduction to Robotics- Robot, Robotics, Types of Robot, Robot classification, Types of Robot, Degrees of freedom.

**UNIT II KINEMATICS AND DYNAMICS OF ROBOTIC LINKS** **9**

Kinematics and Dynamics of Robotic linkages (open ended type manipulators)- Frames, Transformations: Translation and rotation, Denavit-Hartenberg parameters, Forward and Inverse Kinematics, Jacobian, Dynamics: Equations of motion, Newton-Euler formulation.

**UNIT III SENSORS AND ACTUATORS** **9**

Sensors and actuators- Strain gauge, resistive potentiometers, Tactile and force sensors, tachometers, LVDT, Piezoelectric accelerometer, Hall effect sensors, Optical Encoders, Pneumatic and Hydraulic actuators, servo valves, DC motor, stepper motor, drives.

**UNIT IV CONTROLLERS** **9**

Control of Manipulators- Feedback control of II order linear systems, Joint control, Trajectory control, Controllers, PID control.

**UNIT V ROBOT PROGRAMMING** **9**

Robot Programming-Language-overview, commands for elementary operations.

**TOTAL: 45 Hours**

**COURSE OUTCOMES**

After successful completion of the Industrial Robotics course, the student will be able to

**CO1:** Identify the electrical, electronic and mechanical components and use of them design or machine elements and transmission system.
**CO2:** Understand the features and operation of automation products.
**CO3:** Identify the various sensors and actuators using in the manufacturing cells with robotic control.
**CO4:** Understand the various controllers’ manipulators using in industrial robotics.
**CO5:** Write the programming for the industrial robotics.

**TEXT/REFERENCE BOOKS:**

1. Fu. K.S, Gonzalez. R.C, Lee. C.S.G “Robotics – Control, Sensing, Vision, and Intelligence”, McGraw Hill, 2015.

2. GrooverMikell .P, “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2014.
3. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2009.
4. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.

**21MEI118 RAPID PROTOTYPING AND TOOLING**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields.

**UNITI INTRODUCTION 7**

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping andToolingonProductDevelopment–Benefits-Applications–Digital prototyping-Virtualprototyping.

**UNITIILIQUIDBASEDANDSOLIDBASEDRAPIDPROTOTYPING SYSTEMS 10**

StereolithographyApparatus,Fused depositionModeling, Laminated objectmanufacturing,Three dimensionalprinting: WorkingPrinciples,detailsofprocesses, products,materials,advantages,limitationsandapplications-Casestudies.

**UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS: 10**

SelectiveLaserSintering,DirectMetalLaser Sintering,ThreeDimensionalPrinting, LaserEngineered Net Shaping, Selective Laser Melting, Electron BeamMelting: Processes, materials, products, advantages, applications and limitations – Case Studies.

**UNITIVREVERSEENGINEERING ANDCADMODELING 10**

Basicconcept-Digitization techniques–ModelReconstruction –Data Processingfor Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques:Wireframe,surfaceandsolidmodeling–dataformats-Data interfacing, Part orientationandsupportgeneration,Supportstructuredesign,Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

**UNITVRAPIDTOOLING 8**

Classification:Softtooling,Productiontooling, Bridgetooling;directandindirect– Fabricationprocesses, Applications.Casestudies-automotive,aerospaceand electronicindustries.

**TOTAL:45Hours**

**COURSE OUTCOMES:**

After successful completion of Rapid Prototyping and Tooling course, the student will be able to

**CO 1:** Describe tool design methods and punch and die manufacturing techniques.

**CO 2:** Select material for cutting tools and gages; classify various cutting tools and gages and identify their nomenclature

**CO 3:** Interpret the principles of clamping, drill jigs and computer aided jig design

**CO 4:** Design fixtures for milling, boring, lathe, grinding, welding; identify fixtures and cutting tools for NC machine tools

**CO 5:** Ability to apply the fundamentals of rapid prototyping techniques.

**REFERENCES:**


1. Rapidprototyping, AndreasGebhardt,HanserGardenerPublications,2003.
2. RapidPrototypingand Engineeringapplications:Atoolboxforprototype development,LiouW.Liou,FrankW.Liou, CRCPress,2007.
3. RapidPrototyping:Theoryandpractice,AliK.Kamrani,EmadAbouelNasr,Springer,2006
4. Rapidprototyping:Principlesandapplications, secondedition, ChuaC.K., LeongK.F.,and LimC.S., WorldScientificPublishers,2003.
5. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

# SYLLABUS
# GENERIC ELECTIVE COURSES

**21CMCI11 TOTAL QUALITY SYSTEM AND ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

To study the principles practices and techniques of quality systems and engineering.

**UNIT I INTRODUCTION** **10**

PrinciplesofQualityManagement -PioneersofTQM-Qualitycosts–CustomerOrientation-Benchmarking-Re-engineering-ConcurrentEngineering.

**UNITII PRACTICESOFTQM** **10**

Quality system - ISO 9001:2000 - QS 9000, ISO 14000 - Quality Auditing - Leadership - Organizational Structure - Team Building - Information Systems and Documentation.

**UNITIIITECHNIQUESOFTQM** **10**

Single VendorConcept - J.I.T.-QualityFunctiondeployment-QualityCircles -KAIZEN-SGA-POKAYOKE-TaguchiMethods.

**UNIT IVQUALITYBYDESIGN** **8**

Introduction –Rationaleforimplementation–Benefits–Teams–Communication models Implementation–Tools–MisconceptionsandPitfalls.

**UNIT V PRODUCTS LIABILITY** **7**

Introduction–Productsafetylaw–productsliabilitylaw–defenses–Proofandthe expertwitness–FinancialLoss–Thefutureofproductsliability–Prevention.

**TOTAL:45 Hours**

**COURSE OUTCOMES:**

After successful completion of Total Quality System and Engineering course, the student will be able to

CO 1. Understand the philosophy and core values of Total Quality System and Engineering.

CO 2. Determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization; apply and evaluate best practices for the attainment of total quality.

CO 3. Imparting total quality system in education to develop innovative, entrepreneurial and ethical future professionals fit for globally competitive environment.

CO 4. Develop in-depth knowledge on various tools and techniques of Total Quality System and Engineering.

CO 5. Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.

**REFERENCES:**


1. HarvidNooriand Russel,"ProductionandOperations mangement- TotalQualityand Responsiveness",McGraw-Hill Inc,1995.
2. SureshDalelaandSaurabh,ISO9000"AManualforTotalQualityManagement" S.Chandand CompanyLtd.,1997.
3. John Bank,"TheEssenceofTotalQualityManagement",PrenticeHallofIndiaPvt.Ltd.,1995.
4. Mohamed Zairi, " Total Quality Management for Engineers ", WoodheadPublishing Limited1991.
5. BesterfieldD.H.,BesterfieldC.M,BesterfieldG.HandBesterfieldM.S.,“TotalQuality Management",PearsonEducation,2002.
6. R. Pugazhenthi,A. Baradeswaran, K. Balachandran, and P. Balamurali, “Total Quality Management”, sams publications, 2015.

**21CMCI12 MANUFACTURING INFORMATION SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**COURSE OBJECTIVE:**

- The purpose of the course is to provide an importance of databases and its application in manufacturing systems that prepare students for their engineering practice by organization by conversant with order policies, data base terminologies, designing, manufacturing considerations.

**UNIT I INTRODUCTION** **5**

The Evolution of order policies, from MRP to MRP II, the role of Production organization,Operationscontrol.

**UNIT IIDATABASE** **7**

Terminologies–Entitiesandattributes–Datamodels,schemaandsubschema- DataIndependence–ERDiagram– Trendsindatabase.

**UNIT III DESIGNINGDATABASE** **13**

Hierarchicalmodel–Networkapproach-RelationalDatamodelconcepts, principles, keys,relationaloperations– functionaldependence–Normalizationtypes–Query

**UNIT IV MANUFACTURINGCONSIDERATION** **10**

Theproductanditsstructure,inventoryandprocessflow –ShopfloorcontrolData structureandprocedure –variousmodel–theorderschedulingmodule,Input/output analysis modulethestockstatusdatabase–thecomplete IOM database.

**UNIT V INFORMATION SYSTEM FOR MANUFACTURING 10**

Parts oriented production information system – concepts and structure – Computerized productionscheduling,onlineproductioncontrolsystems;Computer based production managementsystem, computerizedmanufacturinginformationsystem–casestudy.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Manufacturing Information Systems course, the student will be able to

**CO 1:** Provide an importance of databases and its application in manufacturing systems that prepare students for their engineering practice by organization by conversant with order policies, data base terminologies, designing, manufacturing considerations.

**CO 2:** Understand the role of non-IT managers in information systems planning, systems development, and hardware and software selection.

**CO 3:** Discuss and evaluate engineering data management issues across the extended enterprise.

**CO 4:** Demonstrate an appreciation of the complex relationship between information systems and organisation.

**CO 5:** Define problems and the current environment for existing business systems in the areas of accounting, finance, marketing, and manufacturing.

**REFERENCES:**


1. Kerr.R,"KnowledgebasedManufacturingManagement",Addison-Wesley,1991.
2. RFIDinManufacturing,GuntherOliver,KlettiWolfhard,Kubach.vwe.,2008
3. ManufacturingInformation &DataSystemsAnalysis,Design&Practice, CECELJAFRANJO,2002.
4. Luca G.Sartori, "Manufacturing InformationSystems", Addison-WesleyPublishing Company,1988.
5. Date.C.J.,"AnIntroductiontoDatabaseSystems"AddisonWesley,8th Edn,.2003
6. Orlicky.G.,"MaterialRequirementsPlanning",McGraw-Hill,1994.

**21CMCI21 SUPPLY CHAIN MANAGEMENT**

| L | T | P | C |
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**COURSE OBJECTIVE:**

At the end of this course the student should be able to understand

1. Importance of supply chain
2. Logistics management
3. Design factors of supply chain
4. Sourcing and revenue management
5. Managing the supply chain.

**UNIT I INTRODUCTION 6**

DefinitionofLogisticsandSCM:Evaluation,ScopeImportance&Decisionphases– DriversofSCperformanceandObstacles-Development trends-Centralized vs Decentralized Planning and Scheduling-Green Paradigms

**UNIT II LOGISTICS MANAGEMENT 10**

Factors – Modes of transportation – Design options for transportation Networks - Routing and Scheduling – Inbound and outbound logistics –Reverse Logistics – 3PL– Integrated Logistics concepts- Integrated Logistics Model – Activities – Measuring logistics cost and performance – Warehouse Management – Case Analysis.

**UNIT III SUPPLY CHAIN NETWORK DESIGN 10**

Distribution in supply chain – Factors in Distribution network design – design Options– Network Design in supply chain – A facility location model featuring supply chain aspects, Multi-period supply chain planning, A heuristic for the multi-period SCND problem- Framework for network Decisions – Managing cycle inventory and safety.

**UNIT IV SOURCING AND PRICING IN SUPPLY 9**

Supplier Selection and contracts – design collaboration – Procurement process, the progression from a procurement focus to strategic sourcing focus Supplier Management- Supplier Relationship Management- Supply Base Management. Revenue management in supply chain- Realize the benefits- Impact the Bottom-line/

**UNIT V COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN 10**

Supply Chain Coordination – Bullwhip effect of lack of Coordination and obstacles – IT and SCM – supply Chain IT frame work. E Business & SCM. Metrics for SC performance – Case Analysis.

**TOTAL:45 Hours**

**COURSE OUTCOMES:**

After successful completion of Supply Chain Management course, the student will be able to

**CO 1:** Develop a systematic framework for analyzing the behavior of large and complex supply chain networks.

**CO 2:** Utilize information technology and various quantitative and qualitative approaches that reduce production, inventory and transportation costs, and improve service levels and profitability.

**CO 3:** Acquire familiarity and a working knowledge of the principles and practice of operations management as applied to the service industries.

**CO 4:** Understand terminology, applications, and tools which are essential for managing operations in service industries.

**CO 5:** Design factors of supply chain, implement the logistics management, managing the supply chain and Sourcing and revenue management

**REFERENCES:**

1.Logistics,DavidJ.Bloomberg, StephenLemayandJoeB.Hanna,PHI2002.

2.LogisticsandSupplyChainManagement–StrategiesforReducingCostandImprovingService.MartinChristopher,PearsonEducationAsia,Second Edition.

3.ModelingthesupplyChain,JeremyF.Shapiro,ThomsonDuxbury,2002.

4.HandbookofSupplyChainManagement,JamesB.Ayers,St.Lucle Press,2000.

5.Supplychainmanagement,Strategy,Planning,andOperation–SunilChopra and Peter Meindl–PHI,Secondedition, 2004.

| 21CMCI22 | RELIABILITY AND TOTAL PRODUCTIVE MAINTENANCE | L | T | P | C |
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**COURSE OBJECTIVE:**

- To teach the essentiality of reliability engineering, reliability prediction and the implementation of total productive maintenance.

**UNIT I RELIABILITY AVAILABILITY AND MAINTAINABILITY ENGINEERING 9**

Reliability engineering fundamentals and applications -Reliabilityfunction-MTBF-MTTF-mortalitycurve-availability-Maintainability Definition and application of Maintainability Engineering-Factors affecting Maintainability- Maintainability design criteria, operating and down time categories,

**UNIT II FAILURE DATA ANALYSIS 9**

Repair time distributions - exponential, normal, log normal, gamma, and Weibull - reliability data requirements - Graphical evaluation.

**UNIT III RELIABILITY PREDICTION 9**

Failure rate estimates - Effect of environment and stress - Series and Parallel systems - RDB analysis – Standby Systems - Complex Systems.

**UNIT IV RELIABILITY MANAGEMENT 9**

Reliability demonstration testing - Reliability growth testing - Duane curve -Risk assessment FMEA, Fault tree.

**UNIT V TOTAL PRODUCTIVE MAINTENANCE: 9**

Causes of Machine Failures - Downtime - Maintenance policies - Restorability predictions - Replacement models - Spares provisioning -Maintenance management– Total Productive Maintenance – Maximizing equipment effectiveness – Organizing for TPM implementation – Implementation – TPM small group activities.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Reliability and Total Productive Maintenance course, the student will be able to

**CO 1:** Problem solving and decision making (analysis and synthesis, analytical and system thinking, intuition, judgment, result interpretation).

**CO 2:** Advanced technical competence (engineering science, modeling, simulation, testing, correlation, validation, result interpretation).

**CO 3:** Develop your ability in formulating suitable maintenance strategies to achieve reliable a manufacturing system.

**CO 4:** Understand the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment.

**CO 5:** Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies.

**REFERENCES*:***


1. PaulKales,“ReliabilityfortechnologyEngineeringandManagement",PrenticeHall,NewJersey,1998.
2.Gopalakrishnan.P,andBanerjiA.K.,“MaintenanceandSparePartsManagement",PrenticeHallofIndia, NewDelhi,1996.
3. Modarres,"ReliabilityandRiskAnalysi",MeralDekkerInc.,1993.
4. Nakajima,Seiich,“IntroductiontoTPM”,ProductivityPress,1988.

**21CMCI31 INFORMATION SYSTEMS ANALYSIS AND DESIGN**

| L | T | P | C |
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**COURSE OBJECTIVE:**

- To provide knowledge in the concept of information system processing, decision making, analysis and design, quality assurance and knowledge based systems.

**UNIT I COMPUTER BASED INFORMATION SYSTEM 7**

Conceptofinformationandsystem–systemclassification–Thechallengeof informationsystem–Computersandinformationprocessing–managingdata resource–organizing datainatraditionalfileenvironment–amoderndatabase environment–designingdatabase.

**UNIT II MANAGEMENT INFORMATION SYSTEM 10**

Concepts – Design and implementation of MIS – Information system for decision making, types and levels of decision making – MIS as a technique for making programmed decisions – Decision – Assisting information systems – Conceptual system design – detailed system design.

**UNIT III OVERVIEW OF SYSTEM DEVELOPMENT 10**

System analysis – System Design – Completing the system development process the traditional system life cycle – Stages and limitations of life cycle approach – case study.

**UNIT IV QUALITY AND SERVICES 10**

TraditionaltoolandMethodologiesforqualityassurances–New approachesto quality – Informationsystemfailurecauses–theconceptofimplementation– controllingriskfactor.

**UNIT V KNOWLEDGE – BASED SYSTEMS 8**

Decision Support Systems – Group DSS – ESS – Artificial Intelligence – Expert System – Other intelligent technique – Neural network, Genetic Algorithm, Fuzzy Logic.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Information Systems Analysis and Design course, the student will be able to

CO 1. Provide knowledge in the concept of information system processing, decision making, analysis and design, analysis the information systems.
CO 2. Define and describe the five phases of the system development life cycle.
CO 3. Describe how systems analysts interact with users, management, and other information systems professionals.
CO 4. Develop data flow diagrams, decision tables and Perform a feasibility study.
CO 5. Determine methods for evaluating the effectiveness and efficiency of a system.

**REFERENCES:**


1. KennethC.LaudonandJaneP.Laudon,“ManagementInformationSystems”, PrenticeHallofIndiaPvt.Ltd.,10th Edn.,2007.
2. RobertG.Mudrick,JoelE.RossandJamesR.Clagget,“InformationSystem for ModernManagement”,PrenticeHallofIndiaPvt.Ltd.,1995.
3. Chung.P.W.HandLovegroveG.,“IndustrialandEngineeringApplicationofAl andExpertsystems”,GardonBreachScience Publication,1993.
4. Davis.G.B. MIS, “Conceptual Foundation, Structure and Development” McGraw-HillPublishingCo.,1985.

**21CMCI32 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING**

| L | T | P | C |
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**COURSE OBJECTIVE:**

- To educate students in productivity management and re-engineering environment.

**UNIT I PRODUCTIVITY 5**

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle Productivity Measurement at International, National and Organisation level - Productivity measurement models

**UNIT II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT 12**

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector.

**UNIT III ORGANISATIONAL TRANSFORMATION 8**

Elements of Organisational Transformation and Reengineering-Principles of organizational transformation and re-engineering, fundamentals of process reengineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, LMI CIP Model – DSMC Q & PMP model

**UNIT IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS 10**

PMI models - Edosomwanmodel - Moen and Nolan strategy for process improvement-LMICIPmodel-NPRDCmodel.

**UNIT V RE-ENGINEERING TOOLS AND IMPLEMENTATION 10**

Analytical and process tools and techniques - Information and communication technology - Enabling role of IT, RE-opportunities, process redesign - cases. Softwaremethods inBPR-specificationofBP,casestudy-Orderprocessing-user interfaces -maintainabilityandreusability.

**TOTAL: 45 Hours**

**COURSE OUTCOMES:**

After successful completion of Productivity Management and Re-Engineering course, the student will be able to

**CO 1:** Understanding of the interaction of organisational goals and objectives and how engineering companies should be structured to efficiently achieve these goals in the prevailing industrial environment.

**CO 2:** Understanding of the importance of product and service development and their effects on the management, operations, and personnel of engineering organizations.

**CO 3:** Develop analytical and problem solving skills in dealing with legacy systems and software integration challenges.

**CO 4:** Develop on hands experience in reverse engineering and reengineering existing software systems.

**CO 5:** Apply the methods learned to assess the situation of a small-scale legacy system and decide a suitable reengineering strategy for it, in the light of the objectives of the reengineering/renovation effort.

**REFERENCES:**


1. Edosomwan,J.A.,“Organisationaltransformationand processre-engineering", BritishLibrarycatalogginginpub. data, 1996.
2. Premvrat,Sardana,G.D.andSahay,B.S,“ProductivityManagement-Asystems approach”,NarosaPub.NewDelhi,1998.
3. Sumanth,D.J.,“Productivityengineering andmanagement”,TMH,NewDelhi,1990.
4. Rastogi,P.N.“Re-Engineeringand Re-inventingtheenterprise”,Wheelerpub.NewDelhi,1995.

# SYLLABUSOF
# AUDIT COURSES

**21CACI11 CONSTITUTION OF INDIA**

| L | T | P | C |
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**COURSE OBJECTIVE:**

- The purpose of the course is to acquaint the students with basic principlesof the Constitution of India and its working.

**UNIT I NATURE, OBJECT AND SCOPE OF THE CONSTITUTION 6**

Nature, object and scope of Constitutional Law and Constitutionalism – Historical Perspective of the Constitution of India – Salient Features and Characteristics of Constitution of India.

**UNIT II FUNDAMENTAL RIGHTS 6**

Nature and scope of Fundamental Rights – Scheme of Fundamental Rights – Right to Equality – Right to Freedom of Speech and Expression – Right to Life – Right against Exploitation – Right to Religious Freedom – Minority Rights.

**UNIT III DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES 6**

Directive Principles of State Policy – Importance and Implementation – Scheme of Fundamental Duties and its Legal Status.

**UNIT IV FEDERAL STRUCTURE 6**

Federal Structure – Distribution of Legislative and Financial Powers between the Union and the States – Parliamentary Form of Government in India – Constituent Powers and Status of the President of India.

**UNIT V AMENDMENT AND EMERGENCY PROVISIONS 6**

Amendment of the Constitution – Procedure – Historical Perspective of the Constitutional Amendments in India – Emergency Provisions – National Emergency – President Rule – Financial Emergency – Local Self Government – Constitutional Scheme in India.

**TOTAL: 30 Hours**

**COURSE OUTCOMES:**

After successful completion of the Constitution of India course, the student will be able to

**CO1:** Understand the historical perspective of the Constitution of India and Meaning of the constitution law.

**CO2:** Know the Fundamental Rights and Fundamental Duties and its legal status

**CO3:** Understand the Federal structure and distribution of legislative and financial powers between the Union and the States.

**CO4:** Know the Parliamentary Form of Government in India; The constitution powers and status of the President of India.

**CO5:** Understand the Emergency Provisions of National Emergency, President Rule, and Financial Emergency.

**REFERENCE BOOKS:**


1. V.N. Shukla, “Constitutional Law of India”, Eastern Book Company, 1982.
2. D.D. Basu, “Commentary on the Constitution of India”; Vol 12; LexisNexis, 2018.
3. S Pal, “India’s Constitution –Origins and Evolution”, LexisNexis, 2018.
4. Dr J N Pandey, “Constitutional Law Of India”, Central Law Agency, 2020.
5. V.D. Mahajan, “Constitutional Law of India”, Eastern Book Company, 19991.

| 21CACI12 | SAFETY MANAGEMENT | L | T | P | C |
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**COURSE OBJECTIVE:**

- To provide the necessary basic concepts of safety in the industrial environment
- To enable the students to learn about various functions and activities of safety department.
- To have knowledge about sources of information for safety promotion and training.
- To familiarize students with evaluation of safety performance in manufacturing environment.

**UNIT I SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES 6**

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines.

**UNIT II PRINCIPLES OF MACHINE GUARDING 6**

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening Selection and suitability: lathe-drilling-boring-milling -grinding-shaping

**UNIT III SAFETY IN WELDING AND GAS CUTTING 6**

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – leak detection-pipe line safety-storage and handling of gas cylinders.

**UNIT IV SAFETY IN COLD FARMING AND HOT WORKING OF METALS 6**

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls.

Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills Safety in gas furnace operation.

**UNIT V SAFETY IN FINISHING, INSPECTION AND TESTING 6**

Heat treatment operations, electro plating, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing

Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal.

**TOTAL: 30 Hours**

**COURSE OUTCOMES:**

After successful completion of the Industrial Safety course, the student will be able to

**CO1:** Understand the safety measures in metal & wood machinery
**CO2:** Know the principles of machineguarding
**CO3:** Acquire the knowledge in welding & gas cutting
**CO4:** Understand Safety precautions in cold & hot farming metals
**CO5:** Gain knowledge in inspection & testing

**REFERENCE BOOKS:**


1. John V. Grimaldi and Rollin H. Simonds, “Safety Management” , All India Travelers Book seller, New Delhi, 1989.
2. N.V. Krishnan, “Safety in Industry” JaicoPublishery House, 1996.
3. “Accident Prevention Manual” – NSC, Chicago, 1982.
4. “Occupational safety Manual” BHEL, Trichy, 1988.

5. Indian Boiler acts and Regulations, Government of India.
6. Safety in the use of wood working machines, HMSO, UK 1992.
7. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989.

**21CACI21 DISASTER MANAGEMENT**

| L | T | P | C |
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**COURSE OBJECTIVE:**

1. To provide basic conceptual understanding of disasters.
2. To understand approaches of Disaster Management
3. To build skills to respond to disaster

**UNIT I Definition and types of disaster** **6**

Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

**UNIT II Study of Important disasters** **6**

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management.

**UNIT III Environmental impact of disasters** **6**

Drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics Causes.

**UNIT IV Mitigation and Management techniques of Disaster** **6**

Basic principles of disasters management, Disaster Management cycle, Disaster management policy, National and State Bodies for Disaster Management, Early Warming Systems, Building design and construction in highly seismic zones, retrofitting of buildings.

**UNIT V Training, awareness program and project on disaster management** **6**

Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management, Mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

**Text Books:**


1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013) Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
4. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
5. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD

**21CACI22 PEDAGOGY STUDIES**

| L | T | P | C |
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**Course Objectives:**
Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers. Identify critical evidence gaps to guide the development.

**UNIT I Introduction and Methodology**
Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Model Curriculum of Engineering & Technology PG Courses

**UNIT II Overview of methodology and Searching**
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

**UNIT III Evidence on the effectiveness of pedagogical practices**
Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

**UNIT IV Professional development:**
Alignment with classroom practices and follow-up support Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

**UNIT V Research gaps and future directions**
Research design, Contexts , Pedagogy ,Teacher education , Curriculum and assessment ,Dissemination and research impact.

**Course Outcomes:**
Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

**REFERENCE BOOK**


1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International
5. Journal Educational Development, 33 (3): 272–282. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

6. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

**21CACI31 STRESS MANAGEMENT BY YOGA**

| L | T | P | C |
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**COURSE OBJECTIVE:**

1. Meaning of yoga, Importance of yoga in our daily life, important aspects during of yoga.
2. Different type of yoga.
3. Renowned Yogies of India.
4. Importance of Way of Meditation.
5. Knowledge of Samadhi and Nabhi- Pariksha.

**COURSE CONTENT**

Meaning & Importance of Yoga, Importance of Precautions of Place. Time and Food. Helpful and disturbing aspects during practice of yoga.Various Kinds of yoga:-Bhakti Yoga, Karma Yoga, Hatha Yoga &Ashtang Yoga. Introduction of some prominent yogis-Maharishi Patanjali SwamiShivananda. Chakras and their importance,Kundalini,Five Kleshs,Five States (Bhumies) of Chitra.

**REFERENCES:**

1. Ghosh,A.K., “A Synthetic approach to Diet and Nutrition”, Swami MangalteerthamaNutan Publication, Deoghar, 2005.
2. Iyengar, B.K.S., “Astadal Yoga Mala, (Vol I – VIII)”, Allied publishers Pvt. Ltd., Lucknow, 2009.
3. Dr. RakheeMehra, “Ayurveda EkaParichaya”, MDNIY, New Delhi, 2010.
4. Goel, Aruna&Goel, S. L., “Stress Management and Education”, Deep & Deep Publications New Delhi, 2005.

**21CACI32 VALUE EDUCATION**

| L | T | P | C |
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**COURSE OBJECTIVE:**

1. To understand importance and need for value education.
2. Appreciate various activities organized by the schools to develop desirable values in the students
3. Conduct various talks and programs for value education and gain knowledge of various models for value education
4. Understand role of teachers for inculcation of values in the students

**UNIT I Value Education & Need**

Concept of Values and Value Education; Historical Background of Value Education Aims and Objectives of Value Education Need, Importance and Role of Value Education in the present emerging Indian society Classification of Values

**Unit II Theories & Model of Value Development**

Theories of Value Development: Psycho-analytic, Learning theory – social learning Cognitive development , Piaget an Kohlberg Models of Value Development : Value Analysis, Rationale Building, Social Action , The Consideration Model

**Unit III Types of Values & Profession**

Constitutional or national values - Democracy, socialism, secularism, equality, justice, liberty, freedom and fraternity. Professional Values-Knowledge thirst, sincerity in profession, regularity, punctuality and faith. Religious Values - Tolerance, wisdom, character. Modernity vs. Value crisis, Issues and challenges Value orientation of Teacher education curricula in India

**Unit IV Value & Character Building**

Concept of Morality and Moral Judgment Aspects of Moral Education – Liberal, Social, Religious, Psychological Development of Moral Character And Attitude Role of Media in developing values and morality

**UINT V Transactional Strategies**

Discussions, lectures, debates, workshops, conduct of various speeches and talks .

**Course Outcomes:**

**After successful completion of this course the students will be able to**:

1. Understand importance and need for value education
2. Appreciate various activities organized by the schools to develop desirable values in the students
3. Conduct various talks and programs for value education
4. Gain knowledge of various models for value education
5. Understand role of teachers for inculcation of values in the students

**REFERENCE BOOKS:**


1. Josta,H.R.(1991).Spiritual values and education. Ambala Cantt: Associated Publishers.
2. Kluckhokhn, C.(1961). The Study of Values. In D.N. Barett (ed), value in America. Norte Dame:University of Norte Dame Press.
3. Kothari D.S. Education and Values, Report of the orientation course-cum-workshop on Education in Human Values. New Delhi.
4. Malhotra P.L. Education, Social Values and Social Work-the Task for the New Generation, New Delhi: N.C.E.R.T..
5. Morris, Charles (1956). Varieties of human values. Chicago: University of Chicago press.
6. Mukerjee, R.K., (1969). Social structure of values. New Delhi: S. Chand and Co.

7. NCERT (1992).Education in values, New Delhi.