THE VISION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

We, at the Department of Mechanical Engineering, Anna University shall strive hard to impart knowledge and state-of-the-art training to our students and expose them to broad areas of Mechanical Engineering, namely Design, Manufacturing, Energy, Thermal Sciences and currently related interdisciplinary areas, so that they can later practice their profession at home or abroad keeping in mind the needs and concern of the society they represent, safeguarding values, ethics and be instrumental in bringing about an overall technological development.

THE MISSION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

1. To deliver knowledge in Mechanical Engineering and Materials Science and Engineering with high educational standards so that the outgoing students are employable and globally competitive.
2. To produce graduate and post graduate engineers with core competency as well as relevant software skills and social responsibility.
3. To be dynamic in imparting knowledge to students depending upon the changing national and International needs
PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
Master of Manufacturing Systems and Management curriculum is designed
I. To prepare students to excel in research and to succeed in the areas of manufacturing systems engineering and manufacturing management.
II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve manufacturing systems engineering related problems.
III. To train students with scientific and engineering knowledge so as to comprehend, analyze, design and solve the real time problems.
IV. To inculcate students with professional and ethical attitude, effective communication skills, teamwork skills and multidisciplinary approach.
V. To develop student with an academic excellence, leadership qualities, leading to life-long learning for a successful professional career.

PROGRAMME OUTCOMES (POs):
After going through the two years of study, our Manufacturing systems and Management Graduates will exhibit ability to:

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<tr>
<th>PO#</th>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
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<td>1</td>
<td>Engineering knowledge</td>
<td>Apply knowledge of mathematics, basic science and engineering science.</td>
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<td>2</td>
<td>Problem analysis</td>
<td>Identify, formulate and solve engineering problems.</td>
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<tr>
<td>3</td>
<td>Design/development of solutions</td>
<td>Design a system or process to improve its performance, satisfying its constraints.</td>
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<td>4</td>
<td>Conduct investigations of complex problems</td>
<td>Conduct experiments &amp; collect, analyze and interpret the data.</td>
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<tr>
<td>5</td>
<td>Modern tool usage</td>
<td>Apply various tools and techniques to improve the efficiency of the system.</td>
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<td>The Engineer and society</td>
<td>Conduct themselves to uphold the professional and social obligations.</td>
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<td>7</td>
<td>Environment and sustainability</td>
<td>Design the system with environment consciousness and sustainable development.</td>
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<td>8</td>
<td>Ethics</td>
<td>Interact in industry, business and society in a professional and ethical manner.</td>
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<td>9</td>
<td>Individual and team work</td>
<td>Function in a multi-disciplinary team.</td>
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<td>Communication</td>
<td>Proficiency in oral and written Communication.</td>
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<td>Project management and finance</td>
<td>Implement cost effective and improved system.</td>
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<td>Life-long learning</td>
<td>Continue professional development and learning as a life-long activity.</td>
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PROGRAMME SPECIFIC OUTCOMES (PSOs):
1. Able to solve real world problems by using appropriate systems principles and management techniques in manufacturing field.
2. Able to apply the comprehensive knowledge gained in various nuances of manufacturing system to manage various simple to complex situations occurring in manufacturing system.
3. Able to pursue professional careers as an individual in their areas of interest in manufacturing industries and as a team member in a multidisciplinary environment and will demonstrate abilities to communicate their creative ideas in the research and manage the development of manufacturing systems.

MAPPING PEO’S WITH PO’S

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## ANNA UNIVERSITY, CHENNAI
### UNIVERSITY DEPARTMENTS
#### REGULATIONS - 2019
##### CHOICE BASED CREDIT SYSTEM

### M.E. MANUFACTURING SYSTEMS AND MANAGEMENT (FULL - TIME)

## SEMESTER I

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### PROGRAM ELECTIVE COURSES

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## AUDIT COURSES (AC)

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COURSE OBJECTIVES:

1. To provide an overview of the quality concepts and statistical methods
2. To familiarize the control chart for variables and six sigma concept
3. To give an insight to control chart for attributes.
4. To attain knowledge of non-shewart control chats and process capability analysis.
5. To learn the different acceptance sampling plan to carry out quality checks.

UNIT – I  INTRODUCTION
Basic concepts of Quality, Meaning and definition of quality, Quality control, objectives of quality control, Quality Characteristics, Quality costs, Quality of Design, Quality of conformance, quality planning, quality measurement, troubleshooting, diagnostic techniques.
Sampling theory – Population, sample, influence of sample size – Estimation of population parameter from samples – Mean, variance, differences of means, ratios of variances. Test of Hypothesis-Null and Alternate Hypothesis, Level of Significance, One tail and two tailed tests, Test of Hypothesis of mean, variance and ratios of variances

UNIT – II  CONTROL CHART FOR VARIABLES
Variation in process – causes for variation – Factors control charts, X-R, X-σ, Run Chart – Tolerance design – Establishing and interpreting control charts – pattern study – Six sigma concept

UNIT – III  CONTROL CHART FOR ATTRIBUTES
Control chart for attributes – Control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – c and u charts, quality rating – Demerit chart – State of control and process out of control identification in charts.

UNIT – IV  SPECIAL CONTROL CHART AND PROCESS CAPABILITY

UNIT – V  ACCEPTANCE SAMPLING

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:

1. Realize the quality concepts and use of statistical method in quality control.
2. Design control charts for measurable variables to identify the variation in the process.
3. Apply the control chart for attributes to identify the state of control of the process.
4. Evaluate the natural tolerance and capability of a process in meeting the specification. Also, apply the non-shewart control charts to identify the process out of control in specialized situations.
5. Use the strategies of acceptance sampling plan to perform quality audit in the customer site.
REFERENCES:
5. Grant, Eugene .L “Statistical Quality Control”, TMH, 2005

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CI5251 ADVANCES IN MANUFACTURING TECHNOLOGY

OBJECTIVES:
- To interpret and compare different non-traditional machining processes.
- To recognize different precision machining processes.
- To interpret modern metal forming processes.
- To differentiate between micromachining and microfabrication.
- To formulate smart manufacturing systems.

UNIT I UNCONVENTIONAL MACHINING

UNIT II PRECISION MACHINING

UNIT III MODERN METAL FORMING

UNIT IV MICRO MACHINING AND MICRO FABRICATION
Introduction to micro fabrication - LIGA, surface micromachining - Bulk micromachining - Etching - Sputtering - Chemical vapor deposition - Physical vapor deposition.
UNIT V  INDUSTRY 4.0

Introduction - Industry 4.0 – Smart manufacturing: Smart design, smart machining, smart monitoring, smart control, smart scheduling - Internet of Things - Industrial Internet of Things - Framework: Connectivity devices and services - Intelligent networks of manufacturing - Cloud computing - Data analytics - Cyber physical systems - Machine to Machine communication - case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students shall be able to:
CO1: Categories different non-traditional machining processes.
CO2: Infer the different precision machining processes.
CO3: Recognize the modern metal forming processes.
CO4: Interpret different micro machining and micro fabrication techniques.
CO5: Demonstrate the Industry 4.0 and smart manufacturing system concepts.

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MS5151  MANUFACTURING MANAGEMENT  L T P C
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OBJECTIVES
1. Students will be able to study the concepts in facility planning.
2. Students will be able to study types of plant layout and capacity planning methods.
3. Students will be able to study the concepts of Project management.
4. Students will be able to study the concepts and methods in production planning and control.
5. Students will be able to study the concepts in Inventory and maintenance management.

UNIT-I  FACILITY PLANNING
Facility planning – Factors affecting selection of plant location, Factor rating analysis: Break – even analysis, Load distance model, closeness ratings – case study

UNIT-II  CAPACITY & LAYOUT PLANNING
Types of plant layout, criteria for good layout, Process layout, Assembly line balancing. Computer based solutions to layout problems such as CRAFT, ALDEP, CORELAP and PREP. Capacity planning – Analysis of designed capacity, installed capacity, commissioned capacity, utilized capacity, factors affecting productivity and capacity expansion strategies.
UNIT-III PROJECT MANAGEMENT
Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, Project management – its role in functional areas of management, network representation of a project, CPM and PERT techniques – case study

UNIT-IV PRODUCTION PLANNING & CONTROL
Aggregate production planning, production planning strategies, Disaggregating the aggregate plan, Materials Requirement Planning (MRP), MRP-II, Supply chain management, Operation scheduling, prioritization.

UNIT-V INVENTORY AND MAINTENANCE MANAGEMENT
Introduction to EOQ models, Inventory control techniques – ABC, FSN, VED etc. Types of inventory control – Perpetual, two-bin and periodic inventory system – JIT, SMED, Kanban, Zero inventory, Maintenance strategies and planning, Maintenance economics: quantitative analysis, optimal number of machines, Replacement strategies and policies – economic service life, opportunity cost, replacement analysis using specific time period.

OUTCOMES:
On Completion of the course the student will be able to
1. Able to acquire knowledge on facility, and problems associated with it.
2. Ability to learn the various capacity and layout planning models
3. Understand the concepts of demand forecasting and project management with relevant case studies.
4. Able to understand the concepts of production planning and scheduling.
5. Understand the various inventory and maintenance management techniques.

TOTAL = 45 PERIODS

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S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)
OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Applying the fundamental principles of Statistics, Sampling, ANOVA and Regression Analysis in the design of experiments.
2. Applying the concept of various factorial design principles and methods in the design of experiments.
3. Applying the concept of blocking, confounding and fractional factorial in the design of experiments.
4. Applying the concept of Regression Approach, Response Surface Methodology, Robust Design, and Orthogonal Array in the design of experiments.
5. Applying the concept of Experiments with Random Factors, Nested and Split-Plot Designs, Grey Relational Analysis, Multivariate Analysis of Variance in the design of experiments.

UNIT – I  FUNDAMENTALS

UNIT – II  FACTORIAL DESIGN I
The Randomized Complete Block Design - The Latin Square Design - The Graeco-Latin Square Design - Balanced Incomplete Block Designs - Basic Definitions and Principles of Factorial Design - The Advantage of Factorials - The Two-Factor Factorial Design - The General Factorial Design - Fitting Response Curves and Surfaces - Blocking in a Factorial Design - The 2^2 Design - The 2^3 Design - The General 2^n Design - A Single Replicate of the 2^k Design - The Addition of Center Points to the 2^k Design - Problems

UNIT – III  FACTORIAL DESIGN II
Blocking a Replicated 2^k Factorial Design - Confounding in the 2^k Factorial Design - Confounding the 2^k Factorial Design in Two Blocks - Confounding the 2^k Factorial Design in Four Blocks - Confounding the 2^k Factorial Design in 2^p Blocks - Partial Confounding - The One-Half Fraction of the 2^k Design - The One-Quarter Fraction of the 2^k Design - The General 2^k-1 Fractional Factorial Design - Resolution III Designs - Resolution IV and V Designs - The 3^k Factorial Design - Confounding in the 3^k Factorial Design - Fractional Replication of the 3^k Factorial Design - Factorials with Mixed Levels - Problems

UNIT – IV  REGRESSION APPROACH, RESPONSE SURFACE METHODOLOGY, ROBUST DESIGN, AND ORTHOGONAL ARRAY

UNIT – V  EXPERIMENTS WITH RANDOM FACTORS, NESTED AND SPLIT-Plot DESIGNS, GREY RELATIONAL ANALYSIS, MULTIVARIATE ANALYSIS OF VARIANCE
The Random Effects Model - The Two-Factor Factorial with Random Factors - The Two-Factor Mixed Model - Sample Size Determination with Random Effects - Rules for Expected Mean
Squares - Approximate F Tests - Some Additional Topics on Estimation of Variance Components
Disruptive - The Two-Stage Nested Design - The General m-Stage Nested Design - Designs with
Both Nested and Factorial Factors - The Split-Plot Design - Other Variations of the Split-Plot
Design - Nonnormal Responses and Transformations - Unbalanced Data in a Factorial Design -
The Analysis of Covariance - Repeated Measures - Grey relational analysis – Multivariate analysis
of variance (MANOVA) – One way MANOVA – Factorial MANOVA with 2 factors – Problems.

TOTAL : 60 PERIODS

OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the fundamental principles of Statistics, Sampling, ANOVA and Regression Analysis
   in the design of experiments.
2. Apply the concept of various factorial design principles and methods in the design of
   experiments.
3. Apply the concept of blocking, confounding and fractional factorial in the design of
   experiments.
4. Apply the concept of Regression Approach, Response Surface Methodology, Robust
   Design, and Orthogonal Array in the design of experiments.
5. Apply the concept of Experiments with Random Factors, Nested and Split-Plot Designs,
   Grey Relational Analysis, Multivariate Analysis of Variance in the design of experiments

REFERENCES:
   2012.
   Applications to Engineering & Science”, Wiley Series on Probability & Statistics, John Wiley

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RM5151                    RESEARCH METHODOLOGY AND IPR                    L T P C
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COURSE OBJECTIVES:
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.
UNIT I  RESEARCH PROBLEM FORMULATION  6  
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

UNIT II  LITERATURE REVIEW  6  
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III  TECHNICAL WRITING/ PRESENTATION  6  
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV  INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)  6  

UNIT V  INTELLECTUAL PROPERTY RIGHTS (IPR)  6  

TOTAL: 30 PERIODS

COURSE OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

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REFERENCES:
COURSE OBJECTIVES:
To get hands on experience of the various aspects involved in manufacturing systems in the following areas
1. Incoming product inspection
2. Manufacturing a product to the given specification
3. Quality checks on the manufactured product
4. Measurement system analysis
5. Process capability study, time study and machine maintenance

LIST OF EXPERIMENTS
1. Performing quality checks on given raw materials (hardness, tensile strength, etc.)
2. Interpretation of dimensional and geometric tolerances in the given component drawing and prepare process plans to manufacture the component.
3. Manufacturing the component according to the prepared process plan by selecting appropriate process parameters
4. Measurement of typical dimensional parameters in a machined component.
5. Measurement of typical GD&T in a Machined component
6. Measurement of surface finish in a given component
7. Perform Measurement system analysis for a typical measurement process.
8. Process capability studies for the a given machining process
9. Time study of typical machining processes (standard time calculation)
10. Condition based monitoring of machine tools

TOTAL: 60 PERIODS

OUTCOMES: Upon completion of this course, the students will be able to:

- Interpret engineering drawings and prepare process plans to manufacture simple components.
- Measure the important linear dimensions, form parameters and surface finish in a given component using appropriate measuring instruments.
- Carryout measurement system analysis
- Perform time study and measure the process capability of a given process.
- Use condition based monitoring to judge the performance of a machine tool

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S- Strong (0.9); M-Medium (0.6); L-Low (0.3)
COURSE OBJECTIVES:
To get hands on experience of the various aspects involved in manufacturing systems in the following areas
1) To train the students to be fluent with their communication.
2) To make them conversant with presentation aide and tools.
3) To imbibe confidence and fine tune their gesture.
4) To structure their presentation encompassing all the salient points relevant to the topic of presentation.
5) To acumen the thrust points that will make the audience to understand better.

TECHNICAL SEMINAR
➢ To make 3 presentations in the specified topics from the domain of their post graduate program.

OUTCOMES: Upon completion of this course, the students will be able to:
1) Able to communicate assiduously without stammering.
2) To present the topic in a unstill and presumptive manner.
3) Convey their thoughts audaciously without hesitation.
4) Competent with the latest presenting aides and select the appropriate tool for effective communication.
5) Exhibit apt gesture and zeal to learn.

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MS5201 LEAN MANUFACTURING SYSTEMS AND SIX SIGMA

COURSE OBJECTIVES:
1. To explain the lean principles and the need to follow these principles in industries.
2. To give an overview of the various tools and techniques involved in lean manufacturing used in industries.
3. To provide the necessary skills needed to analyse a given situation to draw the current state map and to identify potential improvement areas and then draw the future state map.
4. To give an understanding of the various tools used in a six sigma project for quality improvement.
5. To provide an overview of the DMAIC methodology in a six sigma project.

UNIT – I EVOLUTION AND OVERVIEW OF LEAN MANUFACTURING
UNIT – II  LEAN MANUFACTURING – TOOLS AND TECHNIQUES  9
3Ms – Muda, Mura, Muri, 7 Wastes in Manufacturing, Lean Tools to eliminate Muda - 5S, Standardised work, TPM, SMED, Jidoka – Poka Yoke, JIT, Heijunka, Kanban, One piece production, Case studies.

UNIT – III  VALUE STREAM MAPPING  9
Need for Value Stream mapping; Steps involved in Value stream mapping – Choose value stream – PQ and PR analysis, Current State map, Lean Metrics, Future State Map, Kaizen plans; Lean implementation - Cultural change, Hoshin planning; Lean in the Supply chain.

UNIT – IV  SIX SIGMA – TOOLS AND TECHNIQUES  9
Integrated quality control - Off-line vs On-line inspection, Cost of Quality – Conformance and Non-Conformance cost, 7 Basic Quality Control Tools, Seven Management tools, FMEA.

UNIT – V  SIX SIGMA METHODOLOGY  9
Statistical theory, Need for Six Sigma, Six Sigma Team, DMAIC Methodology – Various quality tools used in the Define, Measure, Analyse, Improve and Control phases; Lean Six Sigma, Design for lean six sigma, Case studies.

TOTAL:45 PERIODS

OUTCOMES: Upon completion of this course, the students will be able to:

- Explain the importance and evolution of lean principles.
- Apply the various tools, techniques and methodology of lean manufacturing to improve the efficiency of an organization.
- Apply the technique of value stream mapping to improve an organization by drawing current and future state maps.
- Explain the various tools and techniques needed for a six sigma project.
- Apply six sigma methodology to improve quality in a manufacturing organisation.

REFERENCES:
2. Pascal Dennis, “Lean production Simplified: A plain language guide to the world’s most powerful Production system”, Productivity Press 2007

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S- Strong(0.9) ;     M-Medium (0.6) ;       L-Low(0.3)
OBJECTIVES:
1. To give an overview about maintenance concepts, its types and evaluation.
2. To acumen the different maintenance strategies, methodology and implementation.
3. To inculcate the ability to perceive the organization structure, maintenance and materials management
4. To provide an insight about the reliability concepts
5. To instill the knowledge of reliability systems and appraise the various reliability testing and analysis.

UNIT – I MAINTENANCE CONCEPTS
Maintenance: Definition, Systems approach, Objectives, Requirements, Levels, Maintenance policies and procedures, Maintenance principles and benefits. Types of maintenance systems, R&D in maintenance, Role of overhauling in maintenance, Expert systems in maintenance and Maintenance evaluation and its types.

UNIT – II MAINTENANCE STRATEGIES

UNIT – III MAINTENANCE MANAGEMENT

UNIT – IV RELIABILITY CONCEPTS
Definition of reliability, Performance and reliability, Reliability requirements, System life cycle, Mean time between failures, Mean time to failure, Mortality Curve, Availability, Maintainability, Bathtub curve, Time dependent failure models, Distributions, Normal, Weibull, Lognormal, Life distribution measurements, Accelerated life tests and Data requirements for reliability.

UNIT – V RELIABILITY PREDICTION & MANAGEMENT
Reliability of system and models: Serial, parallel and combined configuration. Markov analysis, load sharing systems, standby systems, covariant models, static models, dynamic models. Failure rate estimates, Effect of environment and stress, RDB analysis, Standby Systems and Complex System. Reliability demonstration testing, Reliability growth testing, Duane curve, Risk assessment, FMEA and Fault tree analysis.

OUTCOMES:
Upon completion of this course, the students will be able to:
1. Identify the maintenance requirements, policies and procedures and apply them in a given situation.
2. Attain the cognizance to appraise the various maintenance strategies
3. Plan the work force, schedule and manage the spares.
4. Explain the reliability concepts and identify the data requirements
5. Develop model, assess the effect environment and perform reliability analysis.
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S- Strong (0.9); M-Medium (0.6); L-Low (0.3)
OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Applying the fundamental concepts and principles of logistics and supply chain in manufacturing systems.
2. Applying the concept and principles of information, demand forecasting, inventory in manufacturing systems.
3. Applying the concept and principles in solving problems in transportation, warehousing & distribution in manufacturing systems.
4. Applying the concept and principles of protective packaging, order processing, materials handling, purchasing & sourcing in manufacturing systems.
5. Applying the concept and principles of logistics and supply chain administration in manufacturing systems.

UNIT I  INTRODUCTION TO L&SCM

UNIT II  INFORMATION, DEMAND FORECASTING, INVENTORY MANAGEMENT

UNIT III  TRANSPORTATION, WAREHOUSING & DISTRIBUTION

UNIT IV  PROTECTIVE PACKAGING, ORDER PROCESSING, MATERIALS HANDLING, PURCHASING & SOURCING MANAGEMENT

UNIT V  L&SCM ADMINISTRATION

TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the fundamental concepts and principles of logistics and supply chain in manufacturing systems.
2. Apply the concept and principles of information, demand forecasting, inventory in manufacturing systems.
3. Apply the concept and principles in solving problems in transportation, warehousing & distribution in manufacturing systems.
4. Apply the concept and principles of protective packaging, order processing, materials handling, purchasing & sourcing in manufacturing systems.
5. Apply the concept and principles of logistics and supply chain administration in manufacturing systems.

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S- Strong (0.9) ; M-Medium (0.6) ; L-Low (0.3)
OBJECTIVES:
The main learning objective of this course is to prepare students for:
1. Applying the principles of automation and control techniques toward new product design and development.
2. Applying the principles of numerical control and industrial robotics toward new product design and development.
3. Applying the principles of manufacturing systems; manual and automated assembly systems; and material handling systems toward new product design and development.
4. Applying the principles of cellular manufacturing systems and flexible manufacturing systems toward new product design and development.
5. Applying the principles of manufacturing support systems toward new product design and development.

UNIT – I AUTOMATION & CONTROL TECHNOLOGIES 8

UNIT – II NUMERICAL CONTROL & INDUSTRIAL ROBOTICS 10

UNIT – III MANUFACTURING SYSTEMS – MANUAL & AUTOMATED ASSEMBLY SYSTEMS – MATERIAL HANDLING SYSTEMS 9

UNIT – IV CELLULAR MANUFACTURING & FLEXIBLE MANUFACTURING SYSTEMS 8

UNIT – V MANUFACTURING SUPPORT SYSTEMS 10

TOTAL:45 PERIODS

OUTCOMES:
On successful completion of this course the students will be able:
1. Apply the principles of automation and control techniques toward new product design and development.
2. Apply the principles of numerical control and industrial robotics toward new product design and development.
3. Apply the principles of manufacturing systems; manual and automated assembly systems; and material handling systems toward new product design and development.
4. Apply the principles of cellular manufacturing systems and flexible manufacturing systems toward new product design and development.
5. Apply the principles of manufacturing support systems toward new product design and development.
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COURSE OBJECTIVES:
1. To get hands on experience in using software tools to solve problems in operations research.
2. To use statistical software tools for graphical representation of the given experimental data.
3. To use statistical software tools to solve problems lean manufacturing and six sigma.
4. To use predictive analytics to improve quality of common machining processes.
5. Explain the use of I4.0 data management software in manufacturing industries.

1. Solving Linear programming problems
2. Solving Transportation Problems
3. Network flow analysis using - PERT, CPM
4. Inventory problems
5. Graphical representation of data using statistical software
6. Drawing current state and future state maps using software tools
7. Solving problems in experimental design
   a. ANOVA
   b. Taguchi’s experimental design
   c. Response surface methodology
   d. Grey Relational Analysis
   e. TOPSIS
8. Predictive analytics for improvement of manufacturing process quality in common machining processes – turning, milling, drilling
9. Use I4.0 data management software to record and manage quality conformance data

TOTAL: 60 PERIODS
OUTCOMES: Upon completion of this course, the students will be able to:

- Use statistical software tools to solve problems in Operations Research.
- Analyse the experimental data using suitable graphical and statistical tools.
- Solve problems in experimental design using statistical software tools.
- Analyse a given multi-objective optimization problem using statistical software tools.
- Apply concepts of predictive analytics to improve manufacturing processes.

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S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

MS5212 AUTOMATION AND ROBOTICS LABORATORY

COURSE OBJECTIVES:
1. To make the student familiarize with the monitoring and measurement of physical quantities by Data Acquisition System (DAQ).
2. To offer hands-on training in the design and development of automated systems by sensors, fluid power and electrical actuators, PLC and Microcontroller.
3. To impart knowledge on modeling, analysis and actuation of robots.
4. To inculcate practical skills on Internet-of-Things (IoT).
5. To make students comprehend the application of Machine Vision and Robot Vision systems.

LIST OF EXPERIMENTS:
3. PLC Automation with Timers and Counters – Bottle filling – Sorting of Objects on Conveyor Belt.
4. Application of Stepper and Servomotors in CNC machines.
5. Modeling and Analysis of different configurations of Robot.
7. Actuation and control of Quadcopter.

OUTCOMES:
Upon completion of this course, the students will be able to:
1. Execute the measurement of physical quantities by DAQ.
2. Design and develop an apt automated system with the aid of appropriate sensors, fluid power and electrical actuators, PLC and microcontroller.
3. Implement the simulation, automation and control of quadcopter, mobile and articulated robots.
4. Develop automated and control systems by using IoT.
5. Demonstrate the machine vision and robot vision systems.
### OBJECTIVES:
1. To learn the nuances of Process Selection.
2. To study about the various Castings' restrictions and apply the same at the design stage.
3. To understand the Machining Process restrictiveness to take care at the design phase.
4. To know the intricacies of all type of Weldings and Forming Processes so as to match with Design.
5. To design a Product meeting the Assembly need.

### UNIT – I INTRODUCTION AND CASTING
Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts.

### UNIT – II FORMING
Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts.

### UNIT – III MACHINING
Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts.

### UNIT – IV WELDING

### UNIT – V ASSEMBLY

### TOTAL : 45 PERIODS

### OUTCOMES:
Upon completion of this course, the students will be able to:
- Apply economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
- Apply design consideration principles of forming in the design of extruded, stamped, and forged products.
- Apply design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- Apply design consideration principles of welding in the design of welded products.
- Apply design consideration principles of assembly in the design of assembled products.

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S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

MS5002 MECHATRONICS IN MANUFACTURING L T P C

OBJECTIVES:
1. To impart knowledge on machine vision technology.
2. To develop competency in programming ARM processor and Raspberry Pi.
3. To provide comprehensive knowledge on robotics.
4. To give exposure on Internet of Things (IoT).
5. To make students familiarize with the industrial applications of Mechatronics.

UNIT – I MACHINE VISION

UNIT – II ADVANCED MICROPROCESSOR AND MICROCONTROLLER

UNIT – III ROBOT KINEMATICS AND PROGRAMMING

UNIT – IV INTERNET OF THINGS (IoT)

UNIT – V MECHATRONICS SYSTEMS AND APPLICATIONS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply image acquisition, image processing, image segmentation, image analysis and pattern recognition techniques to implement machine vision.
2. Explain the architecture of ARM and Raspberry Pi, and also develop programs.
3. Discuss about the robot kinematics, and also execute programs.
4. Design and develop IoT based control system.
5. Suggest and formulate an apt Mechatronics system for a real-time application.

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S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)
UNIT II       CMS PLANNING & DESIGN
Problems in GT/CMS – Design of CMS – Production flow analysis – Optimization models –
Traditional approaches and heuristics – Simulated annealing – Genetic algorithms.

UNIT III      IMPLEMENTATION OF GT/CMS
Inter and intra cell layout and capacity planning – Managerial structure and groups – Batch
sequencing and sizing – Life cycle issues in GT/CMS – Linkages to JIT systems.

UNIT IV        PERFORMANCE MEASUREMENT & CONTROL
Evaluation of cellular manufacturing systems – Production control activities and scheduling
incellular manufacturing.

UNIT V        ECONOMIC OF GT/CMS
Characteristics of cell – Economic Justification of cellular manufacturing – Use of computer models
in GT/CMS – Human aspects of GT/CMS – Case studies.

OUTCOMES:
Upon the completion of the course the student will be able to
• Understand the perspectives of Cellular Manufacturing.
• Plan and Design a Cellular Manufacturing System.
• Know the factors to be considered during the implementation of Cellular Manufacturing Systems
• Measure the Performance of Cellular Manufacturing Systems and Control the Cellular
Manufacturing Systems
• The Economical aspects of Cellular Manufacturing Systems

REFERENCES:
1. Askin, R. G., &Vakharia, A.J., “GT planning and operation”, as in Cleland, D. I., &Bidanda,
PHILearning, 2010.
UNIT I \hspace{4cm} INTRODUCTION \hspace{4cm} 9

UNIT II \hspace{4cm} DESIGN FOR ADDITIVE MANUFACTURING \hspace{4cm} 9

UNIT III \hspace{4cm} VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES \hspace{4cm} 9

UNIT IV \hspace{4cm} MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES \hspace{4cm} 9

UNIT V \hspace{4cm} JETTING AND DIRECT ENERGY DEPOSITION PROCESSES \hspace{4cm} 9

COURSE OUTCOMES:
At the end of this course, the students shall be able to:
CO1: Recognize the importance in the evolution of SFM/AM, proliferation into the various fields and its effects on supply chain.
CO2: Evaluate the design for AM and its importance in the quality of fabricated parts.
CO3: Acquire knowledge on principles and applications of polymerization and sheet lamination processes with case studies.
CO4: Acquire knowledge on principles of material extrusion and powder bed fusion processes and design guidelines.
CO5: Perceive jetting and direct energy deposition processes and their applications.

TOTAL: 45 PERIODS
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MS5004 COMPETITIVE AND SUSTAINABLE MANUFACTURING SYSTEMS  L  T  P  C  

OBJECTIVES
1. Students will be able to study the basics of Flexible Manufacturing System.
2. Students will be able to study the basics and various elements of Agile Manufacturing System.
3. Students will be able to study the basics and the tools of Lean Manufacturing System.
4. Students will be able to study the basics and evolution of Reconfigurable Manufacturing System.
5. Students will be able to study the basics and applications of Sustainable Manufacturing System.

UNIT-I FLEXIBLE MANUFACTURING SYSTEMS 9
System components – planning and control hierarchy – system design, system setup, scheduling and control – flow shop scheduling, job shop scheduling, Flexible inspection systems

UNIT-II AGILE MANUFACTURING SYSTEM 9
Fundamentals structure of agile manufacturing paradigm, agile manufacturing through – management driver – technology driver – strategy driver – competitive driver, Implementation of agile manufacturing in moderate and smart organizations

UNIT-III LEAN MANUFACTURING SYSTEM 9
Introduction and origin of lean production system - Lean manufacturing through waste elimination – visual management – implementation of lean manufacturing paradigm in traditional and moderate organisations, case study.

UNIT-IV RECONFIGURABLE MANUFACTURING SYSTEM (RMS) 9
Evolution of manufacturing system through Industrial revolutions and Evolution of RMS, RMS design characteristics and feasibility, RMS performance evaluation methods
UNIT-V  SUSTAINABLE MANUFACTURING SYSTEM AND APPLICATIONS  9

OUTCOMES:
On Completion of the course the student will be able to
1. Able to acquire knowledge on flexible manufacturing system.
2. Ability to implement agile manufacturing concepts.
3. Understand the concepts of Lean manufacturing system with relevant case studies.
4. Able to understand the concepts of reconfigurable manufacturing system.
5. Understand the sustainable manufacturing concepts and applications.

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S- Strong(0.9) ; M-Medium (0.6) ; L-Low(0.3)

MS5005  PROCESS PLANNING AND COST ESTIMATION   L  T  P  C

OBJECTIVES:
1. To explain the role and fundamentals of Process Planning in manufacturing industries.
2. To explain the steps involved in process planning and provide the necessary skills to prepare process plans for simple components.
3. To explain the various costs involved in a manufacturing organisation.
4. To estimate the production cost for various production operations.
5. To estimate the machining time and cost for typical machining processes.

UNIT – I  INTRODUCTION TO PROCESS PLANNING  9
Aims and Objectives, Place of process planning in Manufacturing cycle, Drawing interpretation, Dimensional tolerance vs Production processes.

UNIT – II  PROCESS PLANNING STEPS  9
Design of a process plan – Selection of production processes, tools and process parameters-Positioning and work holding devices, Selection of inspection devices and tools, Documenting the process plan, Simple Case studies.
UNIT – III  INTRODUCTION TO COST ESTIMATION 9
Importance, Types, Purpose, Components, Procedure, Classification of costs, Cost elements, Overhead expenses, Break-even analysis.

UNIT – IV  PRODUCTION COST ESTIMATION 9
Estimation of production cost for - Casting processes, Welding processes, and Forging processes.

UNIT – V  ESTIMATION OF MACHINING TIME AND COST 9
Estimation of Machining time – Lathe operations, Drilling, Milling, Shaping and Planing, and Grinding, Cost estimation for machining processes.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. To explain the role of process planning in the design / manufacturing cycle.
2. To develop process plans for a given component using the standard procedure involved in process planning.
3. To explain the various cost concepts in cost estimation of manufactured components.
4. To prepare cost estimates for simple components in casting, welding and forging processes.
5. To estimate the production time for components in various machining operations.

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S- Strong(0.9) ;  M-Medium (0.6) ;  L-Low(0.3)
OBJECTIVES

1. The aim is to import knowledge in advanced metallic materials which are required in the trust areas of mechanical engineering
2. To import knowledge on forming processes and applications of them in forming components with different type of materials
3. To import knowledge on making ceramics components by powder metallurgy route
4. To import knowledge on different nanostructured materials and their growth mechanism
5. To import knowledge on different coating materials, coating techniques and growth mechanism

UNIT I METALLIC MATERIALS WITH ENHANCED PERFORMANCE CHARACTERISTICS
Al Alloys-Al-Li Alloys- First, Second and Third Generation Al-Li alloys-Microstructure-Precipitates Characteristics-Melting and casting of Al-Li alloys-workability-weldability
Shape memory alloys- Shape memory effects- NiTi
Ti alloys- Properties and applications-workability-weldability
Steels-micro alloyed steels-TRIP steel-Microstructure-Properties

UNIT II NEAR NET SHAPE FORMING PROCESSES FOR METALS
Forming-Compressive forming- tensile forming- combined tensile and compressive forming-sheet forming-Recrystallisation and grain growth-fundamentals of plasticity- forming limit-superplasticity- superplastic forming- superplasticity of metals, ceramics and nanostructured materials

UNIT III ADVANCED CERAMIC MATERIALS AND THEIR APPLICATIONS
Introduction, properties and applications of — oxides, carbides, nitrides; Advanced ceramic products — ceramic fibers, glass ceramics,—High temperature ceramic materials-Ceramics Sintering- Solid state sintering — driving force, effect of surface curvature and boundary defects, mechanism, stages of sintering. Liquid phase sintering — stages, kinetic and thermodynamic factors, phase diagram in liquid phase sintering. Grain growth — different grain growth process, control of grain growth, grain growth and pore evolution in a porous compact, interaction between pore and grain boundary.

UNIT IV NANOSTRUCTURED MATERIALS

UNIT V COATING MATERIALS AND TECHNOLOGY

TOTAL:45 PERIODS
OUTCOMES
On successful completion of the course, the students can able
1. To Select and use advanced metallic materials in the trust areas of mechanical engineering
2. To select suitable forming techniques, design the forming process for the industrial component production.
3. To identify and use appropriate ceramics for different applications
4. To produce different nanostructured materials
5. To select suitable coating materials and process to develop coating for industrial components.

REFERENCES
1 Kurt Lange, HANDBOOK OF METAL FORMING, Society of Manufacturing Engineers, USA

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MS5007 HUMAN RESOURCE MANAGEMENT L T P C
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Objectives
1. Students will be able to study the functions of Human Resource management.
2. Students will be able to study the recruitment and selection methods in Human Resource management.
3. Students will be able to study the training methods in Human Resource management.
4. Students will be able to study the compensation concepts and ensuring quality in Human Resource management.
5. Students will be able to study the concepts in labour relations and employee security in Human Resource management.

UNIT-I HUMAN RESOURCE FUNCTION 9

UNIT-II RECRUITMENT & SELECTION 9
Job analysis: Methods – Job specification and description – HR and the responsive organization – IT and computerized skill inventory – Computer based job analysis : HR planning and forecasting – Building employee commitment – Recruitment and selection process – Promotion from within – Developing and using application forms – IT and recruiting on the internet – Employee testing & selection: Selection process, basic testing concepts, types of test and
validation – Work samples & simulation, selection techniques, interview, common interviewing mistakes – Designing & conducting the effective interview, competency mapping, computer aided interview – Evaluation of selection process.

UNIT-III TRAINING & DEVELOPMENT

UNIT-IV COMPENSATION & MANAGING QUALITY

UNIT-V LABOUR RELATIONS & EMPLOYEE SECURITY

TOTAL (L: 45 )=45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. Able to acquire knowledge on Human Resource management functions.
2. Ability to learn the various methods involved in recruitment and selection process.
3. Understand the concepts of training methods and development techniques.
4. Able to understand the concepts of compensation and benefits.
5. Understand the various employee relations and security.

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S- Strong(0.9) ;   M-Medium (0.6) ;   L-Low(0.3)
OBJECTIVES:
- To impart knowledge about the various steps involved in Metallography.
- To expose the students to various techniques involved in X-ray Diffraction.
- To make the students capable of interpretation and analysis of the results obtained from X-ray diffraction.
- To inculcate the students the concepts Electron Microscopy and some Chemical Thermal Analysis.
- To imbibe knowledge on the various thermal and Chemical analysis involved in materials characterisation.

UNIT I METALLOGRAPHIC TECHNIQUES
Macro examination – Applications, metallurgical microscope - principle, construction and working, metallographic specimen preparation, optic properties - magnification, numerical aperture, resolving power, depth of focus, depth of field, different light sources, lenses aberrations and their remedial measures, various illumination techniques - bright field, dark field, phase-contrast, polarized light illuminations, interference microscopy, high temperature microscopy; quantitative metallography – Image analysis- Confocal laser scanning microscopy.

UNIT II X-RAY DIFFRACTION TECHNIQUES

UNIT III ANALYSIS OF X-RAY DIFFRACTION
Line broadening, particle size, crystallite size, Precise parameter measurement, Phase identification, phase quantification, Phase diagram determination, X-ray diffraction application in the determination of crystal structure, lattice parameter, residual stress – quantitative phase estimation. X-ray Fluorescence: Energy Dispersive Spectroscopy (EDS) and Wave Dispersive X-ray Spectrometry (WDS).

UNIT IV ELECTRON MICROSCOPY

UNIT V CHEMICAL AND THERMAL ANALYSIS

OUTCOMES:
The students will be able:
- To explain the various steps involved in Metallography and exposed to the operations and construction of Metallurgical Microscopes.
- To compare the different techniques involved in X-ray diffraction and estimate the phases present.
- To interpret and infer the results obtained in X-ray diffraction and perform structure factor calculations, phase identification and determine the crystal structure, lattice parameter, residual stress – quantitative phase estimation.
To apply the concepts of Scanning Electron Microscopy and Transmission Electron Microscopy for materials characterization.

To classify the various thermal and Chemical analysis involved in materials characterisation.

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S- Strong (0.9) ; M-Medium (0.6) ; L-Low (0.3)

OBJECTIVES:
1. To import knowledge on design of nanostructure and discuss the effects due to properties change
2. To provide adequate knowledge to develop zero dimensional nanostructure using different processes
3. To provide adequate knowledge to develop CNT and nanowire using different processes and understanding the mechanism of growth
4. To provide adequate knowledge to develop superhard coatings and bulk nanostructured materials.
5. To import knowledge on characterisation techniques used for characterizing nanostructures.

UNIT-I INTRODUCTION TO NANOMATERIALS

Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials - Gleiter’s Classification of Nanostructured materials – properly changes due to size effects, inverse Hall - Petch effects - polymeric nanostructures
UNIT - II  ZERO DIMENSIONAL NANOMATERIALS  


UNIT - III  ONE DIMENSIONAL NANOMATERIALS  


UNIT - IV  SUPER HARD COATINGS AND BULK NANOSTRUCTURE FORMATION  
Superhard coating – types – characteristics – thermal stability – case studies (nc-TiN/a-Si3N4 coating) – Applications.

Buck nanostructure formation – Equal Channel angular pressing (ECAP) – High pressure torsion (HPT), Accumulative roll bending – Reciprocating extrusion compression, cyclic close die forging – Repetitive corrugation and straightening – Grain refinement mechanisms.

UNIT - V  CHARACTERIZATION OF NANOMATERIALS  

OUTCOMES
On completion of this course, the students can able to
1. design of nanostructures considering the effects due to properties change
2. process zero dimensional nanostructures using different processes
3. Fabricate CNT and nanowire using different processes
4. Develop Superhard coatings and bulk nanostructured materials.
5. Use different characterisation techniques for characterizing nanostructures.

REFERENCES
MS5010 SUSTAINABLE AND GREEN MANUFACTURING L T P C

OBJECTIVES:
1. To introduce the need for sustainability in manufacturing and the various dimensions of sustainability.
2. To give an overview of the principles of green design and EOL treatment.
3. To explain the principles of green manufacturing.
4. To give an understanding of the concept and importance of sustainable machining.
5. To provide an overview of the concepts of energy efficiency and the regulations governing manufacturing industries.

UNIT – I INTRODUCTION TO SUSTAINABLE MANUFACTURING 9
Introduction, Design for sustainability, design methods and tools, Industrial ecology and sustainability, Economics of sustainable engineering, Analytical techniques for sustainability analysis.

UNIT – II GREEN DESIGN AND EOL TREATMENT 9
Principles of green design, Ecofriendly materials, End of life treatment and Environmental impact scenario, Design for Environment, Reclamation and recycling of waste, Remanufacturing.

UNIT – III ENVIRONMENTALLY BENIGN MANUFACTURING 9

UNIT – IV SUSTAINABLE MACHINING 9
Energy consumption in machining, Cutting tool sustainability – tool wear maps, Nanofluids, Minimum Quantity Lubrication in machining – drilling, grinding and milling.

UNIT – V ENERGY EFFICIENCY AND REGULATIONS 9

TOTAL:45 PERIODS

OUTCOMES:
At the end of the course, the students would be able to
- Explain the need for sustainability in product design and manufacturing.
- Evaluate the end of life assessment of products and evaluate the possibilities for recycle and reuse.
- Explain the metrics, principles and techniques of green manufacturing.
- Explain the methods available for sustainable machining.
- Explain the environmental regulations governing manufacturing industries and estimate the energy efficiency of manufacturing processes.
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MS5011 INTEGRATED PRODUCT DESIGN AND PROCESS DEVELOPMENT L T P C

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<th>INTRODUCTION TO PRODUCT DESIGN AND IDENTIFICATION OF CUSTOMER NEED</th>
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<td>Need for IPPD - Strategic importance of Product development – Duration and Cost of Product Development – Challenges in Product Development - Product Development Processes and Organizations – Activities in Identifying Customer Needs</td>
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UNIT – II PRODUCT SPECIFICATIONS, CONCEPT GENERATION, SELECTION AND TESTING
Plan and establish Target and Final product specifications – Activities of Concept Generation - Task - Concept Selection methodology – Concept Screening and Scoring - Concept Testing Methodologies.

UNIT – III PRODUCT ARCHITECTURE, INDUSTRIAL DESIGN AND DESIGN FOR MANUFACTURE
Product Architecture – Implications and establishing the architecture – Delayed Differentiation – Platform Planning- Need and impact of industrial design - Industrial design process - management of the industrial design process - assessing the quality of industrial design – DFM Definition - Estimation of Manufacturing cost- Reducing the component costs, costs of supporting function and assembly costs – Impact of DFM decision on other factors.

UNIT – IV PROTOTYPING, ROBUST DESIGN AND INTELLECTUAL PROPERTY
Prototype basics - Principles of prototyping - Planning for prototypes - Robust design – Seven step process of Robust Design through Design of Experiments- Need and Importance of Intellectual Property – Seven step process of preparing a patent document.

UNIT – V PRODUCT DEVELOPMENT ECONOMICS AND MANAGING PROJECTS
Economic Analysis – Elements of Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project - project execution – postmortem project evaluation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; product planning; customer need analysis for new product design and development.
2. Set product specifications and generate, select, screen, test concepts for new product design and development.
3. Apply the principles of product architecture, industrial design and design for manufacturing principles in new product development.
4. Apply the adopt Prototyping techniques and Design of Experiment principles to develop a robust design and document a new product for patent.
5. Apply of the concepts of economics principles; project management practices in accelerating the new product development activity.

REFERENCES:

0.3- Low 0.6- Medium 0.9- High

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OBJECTIVES
1. Students will be able to identify the needs of Enterprise resource planning.
2. Students will be able to understand the various technologies of ERP.
3. Students will be able to distinguish the various ERP packages.
4. Students will be able to understand the various architecture of ERP.
5. Students will be able to identify the issues in ERP procurement.

UNIT-I ENTERPRISE RESOURCE PLANNING AND VALUE CHAIN MANAGEMENT

UNIT-II TECHNOLOGY AND ARCHITECTURE

UNIT-III ERP SYSTEM PACKAGES
SAP, People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organizational and social issues.

UNIT-IV ERP ARCHITECTURE
Overview – Architecture – AIM – applications – Oracle SCM. SAP: Overview – Architecture – applications - Before and after Y2k – Critical issues – Training on various modules of IBCS ERP Package - Oracle ERP and MAXIMO, including ERP on the NET.

UNIT-V ERP PROCUREMENT ISSUES

OUTCOMES:
On Completion of the course the student will be able to
1. Able to acquire integrated view of the various facets of business, including planning, manufacturing, sales, finance and marketing.
2. Able to understand the development of software to integrate business activities such as inventory management and control, order tracking, customer service, finance and human resources.
3. Awareness on the software applications and tools that are available to business to use to drive out costs and improve efficiency.
4. Understand the architecture of various ERP packages available in the market.
5. Ability to learn the outsourcing concepts of ERP and its economics.

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MS5013 ROBOTICS AND EXPERT SYSTEM  L  T  P  C  3 0 0 3

UNIT I  FUNDAMENTALS OF ROBOT  9

UNIT II  ROBOT DRIVE SYSTEMS AND END EFFECTORS  9
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III  SENSORS AND MACHINE VISION  9

UNIT IV  ROBOT KINEMATICS AND ROBOT PROGRAMMING  9
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Expert system, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V  IMPLEMENTATION AND ROBOT ECONOMICS  9
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1 Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors.
CO2 Illustrate the different types of robot drive systems as well as robot end effectors.
CO3  Apply the different sensors and image processing techniques in robotics to improve the
ability of robots.
CO4  Develop robotic programs for different tasks and familiarize with the kinematics motions of
robot.
CO5  Examine the implementation of robots in various industrial sectors and interpolate the
economic analysis of robots.

REFERENCES:
   2012.

MS5014  FINANCIAL MANAGEMENT AND ACCOUNTING

OBJECTIVES:
The main learning objective of this course is to prepare students for:
- Applying the fundamental concepts and principles financial management in manufacturing
  systems.
- Applying the concepts and principles of financial accounting in manufacturing systems.
- Applying the concepts and principles of cost accounting in manufacturing systems.
- Applying the concepts and principles of budgeting in manufacturing systems.
- Applying the concepts and principles of financial decision making in manufacturing systems.

UNIT I  FINANCIAL MANAGEMENT
Investment decisions – Capital Investment process, types of investment proposals, investment
appraisal techniques – payback period method, Accounting rate of return, net present value
method, internal rate of return and profitability index method.

UNIT II  FINANCIAL ACCOUNTING
Salient features of Balance sheet and Profit & Loss Statement, Cash Flow and Fund Flow
Analysis, Working Capital management, Inventory valuation, Financial Ratio analysis –
Depreciation.

UNIT III  COST ACCOUNTING
Cost accounting systems: Job costing, Process costing, Allocation of overheads, Activity based
costing, differential cost and incremental cost, Variance analysis, Software costing.

UNIT IV  BUDGETING
Requirements for a sound budget, fixed budget-preparation of sales and production budget,
flexible budgets, zero base budgeting and budgetary control.

UNIT V  FINANCIAL DECISIONS
Cost of Capital – Capital structure – Dividend Policy – Leasing

TOTAL: 45 PERIODS

48
OUTCOMES:
Upon completion of this course, the students will be able to:

- Apply the fundamental concepts and principles of financial management in manufacturing systems.
- Apply the concepts and principles of financial accounting in manufacturing systems.
- Apply the concepts and principles of cost accounting in manufacturing systems.
- Apply the concepts and principles of budgeting in manufacturing systems.
- Apply the concepts and principles of financial decision making in manufacturing systems.

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ED5079 MATERIAL HANDLING SYSTEMS AND DESIGN
(Use of Approved Data Book Is Permitted)

COURSE OBJECTIVES:
1. Fundamental concepts related to material handling.
2. Design of various hoisting gears for different material handling applications.
3. Development of conveyer systems for material flow in different industrial production systems.
4. Design of elevators for various manufacturing and service applications.
5. Integrated mechanical system design for machine tools, power transmission and engine parts.

UNIT – I INTRODUCTIONS AND DESIGN OF HOISTS

UNIT – II DRIVES OF HOISTING GEAR
Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

UNIT – III CONVEYORS
Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.
UNIT – IV   ELEVATORS  
Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

UNIT – V   INTEGRATED DESIGN  
Integrated Design of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Bale lifter, Cam Testing Machine, Power Screws, Gear Box Design more than six speed.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Design hoists and brakes used in any handling applications.
2. Design drive mechanisms and hoisting gear for different handling applications.
3. Design different conveyor systems for material handling applications.
4. Design bucket, cage and fork lift elevators for to and fro transportation of materials in vertical direction.
5. Design of integrated mechanical system for machine tools, power transmission and engine parts

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OBJECTIVES:

- Impart knowledge on basic concepts of aggregate planning, manufacturing planning and enterprise resource planning.
- Pivot foundation in material planning concepts.
- Articulate knowledge on inventory management models.
- Educate the purchasing techniques and concepts.
- Exposure on warehouse management activities.

UNIT I  INTRODUCTION  9
Operating environment-aggregate planning-role, need, strategies, costs techniques, approaches master scheduling-manufacturing planning and control system-manufacturing resource planning enterprise resource planning-making the production plan.

UNIT II  MATERIALS PLANNING  9

UNIT III  INVENTORY MANAGEMENT  9
Policy Decisions–objectives-control-Retail Discounting Model, Newsvendor Model; EOQ and EBQ models for uniform and variable demand With and without shortages -Quantity discount models. Probabilistic inventory models.

UNIT IV  PURCHASING MANAGEMENT  9
Establishing specifications-selecting suppliers-price determination-forward buying-mixed buying strategy-price forecasting-buying seasonal commodities-purchasing under uncertainty-demand -price forecasting-purchasing under uncertainty-purchasing of capital equipment, international purchasing

UNIT V  WAREHOUSE MANAGEMENT  9
Warehousing functions – types - Stores management-stores systems and procedures-incoming materials control-stores accounting and stock verification-Obsolete, surplus and scrap-value analysis-material handling-transportation and traffic management -operational efficiency productivity-cost effectiveness-performance measurement

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1 : Understand the basic concepts of aggregate planning, manufacturing planning and enterprise resource planning
CO2 : Effectively gain knowledge of materials planning concepts
CO3 : Design and analyze inventory management models
CO4 : Effectively understand the purchasing techniques and concepts
CO5 : Gain knowledge on warehouse management activities

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DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
REFERENCE BOOKS:

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS

COURSE OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.
UNIT III  MODELING UNCERTAINTY AND STATISTICAL INFERENCE

Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV  ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK

Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V  OTHER DATA ANALYTICAL FRAMEWORKS
Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
• Use open source frameworks for modeling and storing data.
• Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:
UNIT V  PERIODIC AND PREVENTIVE MAINTENANCE  9
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

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OE5093  OPERATIONS RESEARCH  L T P C
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COURSE OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I  LINEAR PROGRAMMING  9
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II  ADVANCES IN LINEAR PROGRAMMING  9
Solutions to LPP using simplex algorithm - Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III  NETWORK ANALYSIS – I  9
Transportation problems -Northwest corner rule, least cost method, Voges’s approximation method - Assignment problem - Hungarian algorithm
UNIT IV NETWORK ANALYSIS – II 9
Shortest path problem: Dijkstra’s algorithms, Floyd’s algorithm, systematic method - CPM/PERT

UNIT V NETWORK ANALYSIS – III 9
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

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UNIT III  PROJECT EXECUTION AND COSTING CONCEPTS  9
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV  COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL  9
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V  QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT  9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control Techniques
CO5 - Become familiar with quantitative techniques in cost management

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REFERENCES:
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988

COURSE OBJECTIVES:
• Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
• Identify the various reinforcements used in composite materials.
• Compare the manufacturing process of metal matrix composites.
• Understand the manufacturing processes of polymer matrix composites.
• Analyze the strength of composite materials.
UNIT I

INTRODUCTION

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II

REINFORCEMENTS

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III

MANUFACTURING OF METAL MATRIX COMPOSITES


UNIT IV

MANUFACTURING OF POLYMER MATRIX COMPOSITES


UNIT V

STRENGTH

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

COURSE OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

REFERENCES:

OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

UNIT IV BIOMASS COMBUSTION 9
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY 9
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

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AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C 2 0 0 0

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

UNIT III TITLE WRITING SKILLS 6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

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COURSE OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I  INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II  REPERCUSSIONS OF DISASTERS AND HAZARDS

UNIT III  DISASTER PRONE AREAS IN INDIA
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV  DISASTER PREPAREDNESS AND MANAGEMENT
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V  RISK ASSESSMENT
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

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AX5093  SANSKRIT FOR TECHNICAL KNOWLEDGE                  L T P C  2 0 0 0

COURSE OBJECTIVES
• Illustrate the basic sanskrit language.
• Recognize sanskrit, the scientific language in the world.
• Appraise learning of sanskrit to improve brain functioning.
• Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
• Extract huge knowledge from ancient literature.

UNIT I  ALPHABETS  6
Alphabets in Sanskrit

UNIT II  TENSES AND SENTENCES  6
Past/Present/Future Tense - Simple Sentences

UNIT III  ORDER AND ROOTS  6
Order - Introduction of roots

UNIT IV  SANSKRIT LITERATURE  6
Technical information about Sanskrit Literature

UNIT V  TECHNICAL CONCEPTS OF ENGINEERING  6
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

COURSE OUTCOMES
• CO1 - Understanding basic Sanskrit language.
• CO2 - Write sentences.
• CO3 - Know the order and roots of Sanskrit.
• CO4 - Know about technical information about Sanskrit literature.
• CO5 - Understand the technical concepts of Engineering.

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REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
AX5094 VALUE EDUCATION

COURSE OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING

AX5095 CONSTITUTION OF INDIA

COURSE OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevist Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.
UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

UNIT IV ORGANS OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

UNIT VI ELECTION COMMISSION:
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

COURSE OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

TOTAL: 30 PERIODS

SUGGESTED READING
1. The Constitution of India, 1950 (Bare Act), Government Publication.
COURSE OBJECTIVES
Students will be able to:

- Review existing evidence on the view topic to inform programme design and policy
- Making under taken 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 - Overview of methodology and Searching.

UNIT II INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT III THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT IV 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 V PROFESSIONAL DEVELOPMENT
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 VI RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

AX5097  STRESS MANAGEMENT BY YOGA          L  T  P  C
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COURSE OBJECTIVES
• To achieve overall health of body and mind
• To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-TYPES of pranayam

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to:
• Develop healthy mind in a healthy body thus improving social health also
• Improve efficiency

SUGGESTED READING
1. “Yogic Asanas for Group Tarining-Part-I”Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098  PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS          L  T  P  C
                    2 0 0 0
COURSE OBJECTIVES
• To learn to achieve the highest goal happily
• To become a person with stable mind, pleasing personality and determination
• To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)
UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar- vairagya, New Delhi,2010