UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY, CHENNAI

REGULATIONS – 2013

M.E. MANUFACTURING SYSTEMS AND MANAGEMENT

I TO IV SEMESTERS CURRICULUM AND SYLLABUS (FULL TIME)

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MS8101	Automation and Manufacturing Systems	3	0	0	3
2.	MS8102	Statistical Quality Control and Reliability Engineering	3	0	0	3
3.	MS8103	Logistics and Supply Chain Management for Manufacturing Systems	3	0	0	3
4.	MA8161	Statistical Methods for Engineers	3	1	0	4
5.	MS8151	Manufacturing Management	3	0	0	3
6.		Elective I	3	0	0	3
PRACTICAL						
7.	MS8111	Technical Seminar	0	0	2	1
		TOTAL	**18**	**1**	**2**	**20**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MS8201	Advanced Manufacturing Processes	3	0	0	3
2.	MS8202	Applied Operations Research for Manufacturing Management	3	0	0	3
3.	MS8203	Lean Manufacturing Systems and Six Sigma	3	0	0	3
4.	MS8204	Product Design for Manufacture	3	0	0	3
5.		Elective II	3	0	0	3
6.		Elective III	3	0	0	3
PRACTICAL						
7.	MS8211	Manufacturing Optimization Laboratory	0	0	3	2
		TOTAL	**18**	**0**	**3**	**20**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.		Elective IV	3	0	0	3
2.		Elective V	3	0	0	3
3.		Elective VI	3	0	0	3
PRACTICAL						
4.	MS8311	Project work Phase I	0	0	12	6

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TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	MS8411	Project work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE: 67

ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	MS8001	Experimental Design and Analysis	3	0	0	3
2.	MS8002	Financial and Management Accounting	3	0	0	3
3.	MS8003	Human Resource Management	3	0	0	3
4.	MS8004	Manufacturing Optimization	3	0	0	3
5.	MS8005	Manufacturing Planning and Control	3	0	0	3
6.	MS8006	Materials Handling System and Design	3	0	0	3
7.	MS8007	Modern Techniques of Materials Characterization	3	0	0	3
8.	MS8008	Nanostructured Materials and Technology	3	0	0	3
9.	MS8009	Processing of Composites and Polymer Materials	3	0	0	3
10.	MS8010	Safety Engineering and Industrial Hygiene	3	0	0	3
11.	CI8071	Additive Manufacturing	3	0	0	3
12.	CI8072	Computer Aided Process Planning	3	0	0	3
13.	CI8073	Industrial Robotics and Expert Systems	3	0	0	3
14.	CI8074	Manufacturing Information Systems	3	0	0	3
15.	CI8075	Mechatronics in Manufacturing	3	0	0	3
16.	CI8252	Competitive Manufacturing Systems	3	0	0	3
17.	IL8081	Project Management	3	0	0	3
18.	MS8071	Cellular Manufacturing Systems	3	0	0	3
19.	PD8071	Enterprise Resource Planning	3	0	0	3
20.	PD8072	Reverse Engineering				
21.	PD8251	Integrated Product Design and Process Development	3	1	0	4
22.	QE8071	Materials Management	3	0	0	3

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MS8101 AUTOMATION AND MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVE:

- To impart the necessary basic concepts of industrial automation, robotics, and control methods and to apply them to various manufacturing problems.

OUTCOME:

- The students should apply industrial automation, robotics, and control techniques to manufacturing systems, cellular manufacturing systems, flexible manufacturing systems.

UNIT I AUTOMATION & CONTROL TECHNOLOGIES 9

Introduction to CAD, CAM, CAD/CAM and CIM – Introduction to Manufacturing Systems – Automation in manufacturing Systems – Types of Automation – Reasons for Automation – Automation Strategies – Manufacturing Models and Metrics – Basic elements of an Automated System – Levels of Automation – Continuous versus Discrete Control – Computer Process Control.

UNIT II NUMERICAL CONTROL & INDUSTRIAL ROBOTICS 10

Elements of NC Manufacturing Systems – Computer Numerical Control – Axes and Co-ordinate Systems – Features, Advantages, Disadvantages and Limitations – Manual Part Programming – Robot Anatomy – Robot Control Systems – End Effectors – Sensors – Applications – Robot programming.

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

Components of Manufacturing Systems – Classification of Manufacturing Systems – Single Station Manufacturing cell and analysis – Manual Assembly line – Line Balancing – Automated Assembly System – Material Handling Equipment – Storage Systems.

UNIT IV MANUFACTURING SYSTEMS – CELLULAR MANUFACTURING & FLEXIBLE MANUFACTURING SYSTEMS 9

Part Families – Classification and Coding – Production Flow analysis – Cellular Manufacturing Applications of Group Technology – Flexible Manufacturing Systems – Components – Applications and benefits – FMS planning – Quantitative analysis in FMS.

UNIT V MANUFACTURING SUPPORT SYSTEMS 8

Process Planning – Computer Aided Process Planning – Production planning and Control Systems – Aggregate Planning and Master Production schedule – Material Requirement Planning – Capacity Planning – Shop Floor Control – Overview of Automatic Identification and Data capture – Bar Code Technology and Radio Frequency Identification.

TOTAL: 45 PERIODS

REFERENCES:

1. Mikell P. Groover, "**Automation, Production Systems, and Computer –Integrated Manufacturing**", 3rd Ed., PHI Learning Pvt. Ltd., New Delhi, 2009.
2. Farazdak Haideri, "**CAD / CAM and Automation**", 6th Edition, Nirali Prakashan, 2009.
3. P. N. Rao, "**CAD /CAM – Principles and Applications**", 2nd Ed., Tata McGraw Hill, 2004.
4. Mikell P. Groover and Emory W. Zimmers, Jr., "**CAD / CAM – Computer – Aided Design and Manufacturing**", Pearson Education, 2003.
5. P. Radhakrishnan, S. Subramanyan and V. Raju, "**CAD / CAM / CIM**", 2nd Edition, New Age International (Pvt.) Ltd. Publishers, 2003.
6. Chris McMahon and Jimmie Browne, "**CAD/CAM – Principles, Practice and Manufacturing Management**", 2nd Ed., Pearson Education, Asia, 2001.
7. Ibrahim Zeid and R. Sivasubramanian, "**CAD / CAM – Theory and Practice**", 2nd Ed., Tata McGraw Hill, 2010.

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MS8102 STATISTICAL QUALITY CONTROL AND RELIABILITY ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge about quality, controlling methods and reliability

OUTCOME:

- The students should apply the various quality control techniques to construct the various quality control charts for variables and attributes and also the design concepts for reliable system and its prediction.

UNIT I INTRODUCTION 9

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, Concepts in quality management, quality planning, quality measurement, trouble shooting, diagnostic techniques, System approach to quality management.

Sampling theory – Population, sample, influence of sample size – Estimation of population parameter from samples – Mean, variance, differences of means, ratios of variances.

UNIT II STATISTICAL PROCESS CONTROL 9

Variation in process – causes for variation – Cause effect diagram – Factors control charts – variables X-R, X-σ, Run Chart – Tolerance design – Establishing and interpreting control charts – Short run SPC – Process capability analysis – Six sigma concept

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 III ACCEPTANCE SAMPLING 9

Lot by lot sampling – Types – Probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk – AQL, LTPD, AOQL, Concepts – Design of sampling plans – Standard sampling plans for AQL and LTPD – Use of standard sampling plans, sequential sampling plan.

UNIT IV RELIABILITY 9

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 – Data requirements for reliability.

UNIT V RELIABILITY PREDICTION & MANAGEMENT 9

Reliability of system and models – Serial, parallel and combined configuration – Markove analysis, load sharing systems, standby systems, covarient models, static models, dynamic models – Failure rate estimates – Effect of environment and stress – RDB analysis – Standby Systems – Complex Systems – Reliability demonstration testing – Reliability growth testing – Duane curve – Risk assessment – FMEA and Fault tree analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. Amata Mitra "**Fundamentals of Quality Control and improvement**" Pearson Education, 2002.
2. Besterfield D.H., "**Quality Control**", Prentice Hall, 1993.
3. Grant, Eugene. L., "**Statistical Quality Control**", McGraw-Hill, 1996.
4. L. S. Srinath, "**Reliability Engineering**", Affiliated East West Press, 1991.
5. R.C.Gupta, "**Statistical Quality control**", Khanna Publishers, 1997.
6. Connor, P. D. T. O., "**Practical Reliability Engineering**", John Wiley, 1997.
7. Charles E. Ebling., "**An Introduction to Reliability and Maintability Engineering**",Tata-McGraw Hill, 2000

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MS8103 LOGISTICS AND SUPPLY CHAIN MANAGEMENT FOR MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart the fundamentals of logistics and supply chain management and to apply them to various manufacturing problems

OUTCOME:

- The students should apply information, demand forecasting, inventory management, transportation, warehousing & distribution, protective packaging, order processing, materials handling, purchasing & sourcing management techniques to manufacturing systems

UNIT I INTRODUCTION TO L&SCM 9

Logistics: Nature & Concepts – Evolution – Importance – Advantage – Objectives – Components – Functions – Supply Chain Management: Nature & Concepts – Value chain – Functions & Contribution – Effectiveness – Framework – Outsourcing – 3 PLs – 4 PLs – Bull whip effect – SC Relationships – Conflict resolution – Harmonious relationship – Customer Service: Nature & Concepts – Importance – Components – Cost – Gap analysis – Strategic management – Case Study.

UNIT II INFORMATION, DEMAND FORECASTING, INVENTORY MANAGEMENT 9

Information: Position of Information in L&SCM – Logistical Informational Systems – Operational Logistical Informational Systems – Integrated Information Technology Solution for L&SCM – Emerging L&SCM – Demand Forecasting: Nature & Components – Impact of forecast on L&SCM – Effective forecasting – Techniques – Selection – Principles – Inventory: Concepts – Types – Functions – Elements – Inventory management – ABC analysis – ABC-VED matrix – Materials Requirement Planning – Distribution Requirement Planning – Just in Time System – Prerequisites – Case study.

UNIT III TRANSPORTATION, WAREHOUSING & DISTRIBUTION 11

Transportation: Introduction – Position of transportation in L&SCM – Elements of transportation cost – Modes – Multimodal transport – Containerization – Selection of transportation modes – Transportation decision – Transportation network: routing & scheduling – Warehousing & Distribution Centers: Introduction – Concepts – Types – Functions – Strategy – Design – Operational Mechanism – Case study.

UNIT IV PROTECTIVE PACKAGING, ORDER PROCESSING, MATERIALS HANDLING, PURCHASING & SOURCING MANAGEMENT 9

Protective Packaging: Introduction – Concepts – Functions – Forms – Problems – Policy – Order Processing: Introduction – Concepts – Functions – Elements – Significance – Materials Handling: Introduction – Concept – Objective- Principles – Equipments – Considerations – Purchasing & Sourcing Management: Introduction – Nature – Scope – Importance – Trends – Contemporary sourcing & supplier management – Case study.

UNIT V L&SCM ADMINISTRATION 7

Organization: Introduction – Evolutionary trends of L&SCM – Principles – Factors. Performance Measurement: Introduction – Dimensions – Basic tools – Impediments to improve performance – Case Study.

TOTAL: 45 PERIODS

REFERENCES:

1. Agrawal, D. K., "**A Textbook of Logistics & Supply Chain Management**",MacMillan Publishers India Ltd., 2009.
2. Sunil Chopra & Peter Meindl, "**Supply Chain Management, Strategy, Planning, and Operation**", 2nd Edition, PHI, 2004.
3. David J. Bloomberg, Stephen Lemay & Joe B. Hanna, "**Logistics**", PHI, 2002.
4. Jeremy F. Shapiro, "**Modeling the Supply Chain**", Thomson Duxbury, 2002.
5. James B. Ayers, "**Handbook of Supply Chain Management**", St. Lucle Press, 2000.

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MA8161 STATISTICAL METHODS FOR ENGINEERS L T P C
3 1 0 4

OBJECTIVE:

- This course aims at providing the necessary basic concepts of a few statistical methods and to apply them to various engineering problems.

OUTCOME:

- It helps the students to have a clear perception of the power of statistical ideas and tools would be able to demonstrate the application of the statistical techniques to problems drawn from industry, management and other engineering fields.

UNIT I ESTIMATION THEORY 9+3

Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency - Maximum Likelihood Estimation – Method of Moments.

UNIT II TESTING OF HYPOTHESIS 9+3

Tests based on Normal, t, χ^2 and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

UNIT III CORRELATION & REGRESSION 9+3

Multiple and Partial Correlation – Method of Least Squares – Plane of Regression – Properties of Residuals – Coefficient of Multiple Correlation – Coefficient of Partial Correlation – Multiple Correlation with total and partial correlations – Regression and Partial correlations in terms of lower order coefficients.

UNIT IV DESIGN OF EXPERIMENTS 9+3

Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT V MULTIVARIATE ANALYSIS 9+3

Random Vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Johnson R. A. & Gupta C. B., "Miller & Freund's Probability and Statistics for Engineers", 7th Edition, Pearson Education, Asia, 2007.
2. Richard A. Johnson & Dean W. Wichern, "Applied Multivariate Statistical Analysis", 6th Edition, Pearson Education, Asia, 2007.
3. Gupta S.C. & Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 11th Edition, 2002.
4. Jay L. Devore, "Probability and statistics for Engineering and the Sciences", 5th Edition, Thomson and Duxbury, Singapore, 2002.
5. Murray R. Spiegel & Larry J. Stephens, "Schaum's Outlines – Statistics", 3rd Edition, Tata McGraw-Hill, 2000.
6. Freund, J. E., "Mathematical Statistics", 3rd Edition, Prentice Hall of India, 2001.

MS8151 **MANUFACTURING MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVE:

- To understand the fundamentals concepts of operations management in a manufacturing and service sectors.

OUTCOME:

- The students will have knowledge in layout planning, forecasting, production planning, inventory control, maintenance system and effective utilization of resources in manufacturing system.

UNIT I FACILITY, CAPACITY & LAYOUT PLANNING 9

Facility planning – Factors affecting selection of plant location, Factor rating analysis: Break – event, Load distance model, closeness ratings.

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 II DEMAND FORECASTING & PROJECT MANAGEMENT 10

Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, numerical problems, Long term forecast methodologies.

Project management – its role in functional areas of management, network representation of a project, CPM and PERT techniques, Analyzing cost-time trade-offs – Case study.

UNIT III PRODUCTION PLANNING & CONTROL 9

Steps in PPC process mapping, preparation of process mapping and feedback control for effective monitoring. Aggregate production planning, production planning strategies, Disaggregating the aggregate plan, Materials Requirement Planning (MRP), MRP-II, Supply chain management, Operation scheduling, prioritization.

UNIT IV INVENTORY PLANNING & CONTROL 8

EOQ models- with and without shortages, price breaks, effect of quantity discount – selective inventory control techniques – ABC, FSN, VED etc. Types of inventory control – Perpetual, two-bin and periodic inventory system – JIT, SMED, kanban, Zero inventory – Case study.

UNIT V MAINTENANCE SYSTEM 9

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, spares management. Maintenance records.

TOTAL: 45 PERIODS

REFERENCES:

1. S. N. Chary, "**Production and Operations Management**", 4th Edition, SIE, TMH, 2009.
2. R. Pannererselvam, "**Production and Operations Management**", 3rd Edition, PHI, 2012.
3. James. B. Dilworth, "**Operations Management – Design, Planning and Control for Manufacturing and Services**", McGraw Hill Inc. Management Series, 1992.
4. Melnyk Denzler, "**Operations Management – A Value Driven Approach**", Irwin McGraw Hill 1996.
5. Lee. J. Krajewski, L. P. Ritzman, & M. K. Malhothra, "**Operations Management – Process and Value Chains**", 8th Edition, PHI/Pearson Education, 2007.
6. R. B. Chase, N. J. Aquilano, & F. R. Jacobs, "**Operations Management – For Competitive Advantage**", 11th Edition, SIE, TMH, 2007.
7. Kanishka Bedi, "**Production and Operations Management**", 2nd Edition, Oxford Higher Education, 2007.

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MS8111 **TECHNICAL SEMINAR** **L T P C**
0 0 2 1

OBJECTIVE:

- During this course, each student is expected to prepare and present a topic on manufacturing systems & management, for duration of about 45 minutes.
- In a session of three periods per week, 2 students are expected to present the seminar.
- A faculty supervisor is to be allotted to
    - o Maintain attendance of all students for each week.
    - o Review the presentation of the students.
    - o Allot a grade / mark for each student's presentation

The students are encouraged to use power point presentation and demonstrative models.

OUTCOME:

The students would gain confidence in facing the project reviews and job placement interviews

TOTAL: 30 PERIODS

MS8201 **ADVANCED MANUFACTURING PROCESSES** **L T P C**
3 0 0 3

OBJECTIVE:

- To understand the importance of advances in manufacturing processes in manufacturing industries.

OUTCOME:

- The students should apply the advanced techniques and concepts in casting, welding, forming, unconventional machining, additive manufacturing, micro & nano machining process to the manufacturing industries.

UNIT I ADVANCES IN CASTING & WELDING PROCESS **9**

Gating and risering of castings – Nucleation and grain growth – Solidification of pure metals and alloys – Mould metal interface reactions – Weld thermal cycles and their effects, structural changes in steels, effects of pre and post heat treatments – Welding of steels, cast irons and non-ferrous alloys.

UNIT II ADVANCES IN FORMING PROCESS **9**

Severe plastic forming – Super plastic forming – Electro forming – Fine blanking – Hydro forming – Peen forming – Laser forming – Micro forming – PM forging – Isothermal forging – High speed hot forging – Near net shape forming high velocity extrusion – Incremental forming – CAD and CAM in forming.

UNIT III UNCONVENTIONAL MACHINING PROCESSES **9**

Working principles; processes parameters; applications; merits & demerits of USM – EDM – WCEDM – MEDM – ECDM – ECM – EBM – LBM – IBM – PAM – AJM – WJM.

UNIT IV ADDITIVE MANUFACTURING PROCESS **9**

Additive manufacturing – Classification, principle, advantages, limitations and applications – Working principles; methodology applications; merits & demerits of SLA – SLS – FDM – LOM – SGC – PLT – LENS – AM process evaluation

UNIT V MICRO & NANO MACHINING PROCESSES **9**

MEMS – Principle; process capabilities; types; advantages; limitations and applications of: Bulk micro machining – Surface micro machining – Tool based micro machining – Silicon Micromachining – Wafer Dicing – Nano machining processes.

TOTAL: 45 PERIODS

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REFERENCES:
1. Pandley P. S. & Shah. N., "**Modern Manufacturing Processes**", McGraw Hill Inc, 2007.
2. Danny Barks, "**Microengineering, MEMS and Interfacing: A Practical Guide**", CRC – Taylor and Francis Group, 2006.
3. Chua C. K., Leong K. F., and Lim C. S., "**Rapid Prototyping: Principles and Applications**", 3nd Edition, World Scientific Publishers, 2010.
4. Gibson, I., Rosen, D. W., & Stucker, B., "**Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing**", Springer, 2010.
5. Hassan Abdel-Gawad El-Hofy, "**Advance Machining Process**", McGraw Hill Inc., 2005.
6. Edward M. Mielink, "**Metal Working Science Engineering**", McGraw Hill, Inc, 2000.
7. American Society for Metals, "**Forming and Forging**", Metal Hand Book Vol.14, Metal Park, Ohio, USA, 1990.
8. Heine, R. W., Loper, C. R., & Rosenthal, P. C., "**Principles of Metal Casting**", TMH, 2012.

MS8202 APPLIED OPERATIONS RESEARCH FOR MANUFACTURING MANAGEMENT **L T P C 3 0 0 3**

OBJECTIVE:
- To impart knowledge about advanced operations research methods for manufacturing management.

OUTCOME:
- The students should apply the various operations research techniques and methods to manufacturing systems and management

UNIT I LINEAR PROGRAMMING **9**

Concepts of OR, development, applications, LP definitions, assumptions, formulation, graphical method, simplex algorithm – Big M method – Dual Simplex – Primal dual relationships – Sensitivity analysis – Transportation North-West corner solution – Least cost method – Vogel's approximation method – Modi Method – Assignment Model – Hungarian Method.

UNIT II SEQUENCING & NETWORK TECHNIQUES **9**

Sequencing problem – Processing of N jobs through 2 Machines – Processing of N jobs through 3 Machines – Processing of N jobs through M Machines – Travelling salesman problem – Network Techniques – Shortest path model – Minimum spanning tree problem – Maximal flow problem – CPM and PERT.

UNIT III REPLACEMENT **9**

Introduction, replacement of items that deteriorate when money value is not counted and counted, replacement items that fail completely i.e., group replacement.

UNIT IV INVENTORY **9**

Introduction, single item deterministic models, production is instantaneous or at a constant rate, shortages are allowed or not allowed and withdrawals from stock is continuous, purchase inventory model with one price break, shortages are not allowed, Instantaneous production demand, production or purchase cost is relevant, stochastic models, demand may be discrete or variable or instantaneous production, instantaneous demand and no setup cost.

UNIT V WAITING LINES **9**

Introduction, single channel, Poisson arrivals, exponential service, times, unrestricted queue, with infinite population and finite population models, single channel, Poisson arrivals, exponential service times with infinite population and restricted queue, multi channel, Poisson arrivals, exponential service times with infinite population and unrestricted queue.

TOTAL: 45 PERIODS

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REFERENCES:

1. Hamdy A. Taha., "**Operation Research – An Introduction**", 7th Edition, Person Education / Prentice Hall of India Edition, Asia, 2002.
2. Don T. Phillips, A.Ravindran & James Solberg, "**Operations Research: Principles and Practice**", John Wiley, India, 2006.
3. G. Srinivasan, "**Operations Research: Principles and Applications**", PHI 2008
4. R. Panneerselvam, "**Operations Research**", Prentice Hall of India Private Limited, 2005.
5. P.K. Guptha & Man-Mohan, "**Problems in Operations Research**", Sultan Chand & Sons, 1994.
6. J. K. Sharma, "**Operations Research: Theory and Applications**", Macmillan India Ltd., 1997.

MS8203 LEAN MANUFACTURING SYSTEMS AND SIX SIGMA L T P C
3 0 0 3

OBJECTIVE:

- To impart the knowledge of tools & techniques used in lean manufacturing and six sigma.

OUTCOME:

- The students should apply the various tools, techniques and methodology of lean manufacturing and six sigma concepts to the potential quality gaps in manufacturing / production industries

UNIT I EVOLUTION & OVERVIEW OF LEAN MANUFACTURING 6

Evolution of Mass production – Traditional vs. Mass production – Evolution of Toyota (Lean) Production System – Business Dynamics of Lean production – Principles of Lean production: Value, Value stream, Flow, Pull, Perfection.

UNIT II LEAN MANUFACTURING – TOOLS & TECHNIQUES 12

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.

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 – Lean in the Supply chain.

UNIT IV SIX SIGMA – TOOLS & TECHNIQUES 9

Cost of Quality – Conformance and Non-Conformance cost – 7 Basic Quality Control Tools – Seven Management tools – FMEA

UNIT V SIX SIGMA METHODOLOGY 9

Need for Six Sigma – Six Sigma Team – DMAIC Methodology: Define, Measure, Analyse, Improve and Control – Lean Six Sigma

TOTAL: 45 PERIODS

REFERENCES:

1. Pascal Dennis, "**Lean Production Simplified: A plain Language Guide to the World's Most Powerful Production System**", Productivity Press, 2007.
2. Issa Bass and Barbara Lawton, "**Lean Six Sigma using Sigma XL and Minitab**", Tata McGraw Hill, 2010.
3. Yasuhiro Monden, "**Toyota Production System: An Integrated Approach to Just-in-Time**", CRC Press, 2012.

4. Taiichi Ohno, "**Toyota Production System: Beyond Large-Scale Production**", Productivity Press, 1988.
5. Mike Rother and Rother Shook, "**Learning to See: Value-Stream Mapping to Create Value and Eliminate Muda**", The Lean Enterprise Institute, 2003.
6. James Womack, Daniel T. Jones, and Daniel Roos, "**The Machine that Changed the World**", Free Press, 1990.
7. James Womack and Daniel T. Jones, "**Lean Thinking: Banish Waste and Create Wealth in Your Organization**", Free Press, 2003.
8. Donna C. S. Summers, "**Six Sigma: Basic Tools and Techniques**", Pearson / Prentice Hall, 2007.

MS8204 PRODUCT DESIGN FOR MANUFACTURE L T P C
3 0 0 3

OBJECTIVE:

- To impart the students with knowledge of the general design principles, considerations and geometric tolerances for various manufacturing process and assembly.

OUTCOME:

- The student should apply the design principles, considerations and geometric tolerances to casting, forming, machining, welding and assembly.

UNIT I MATERIAL & PROCESS SELECTION & GEOMETRIC TOLERANCES 10

Economics of Process selection – General design principles for manufacturability – Geometric Dimensioning & Tolerance (GD&T) – Form tolerancing: straightness, flatness, circularity, cylindricity – Profile tolerancing: profile of a line, and surface – Orientation tolerancing: angularity, perpendicularity, parallelism – Location tolerancing: position, concentricity, symmetry – run out tolerancing: circular and total – Supplementary symbols.

UNIT II CAST & WELDED COMPONENTS DESIGN 11

Design considerations for: Sand cast – Die cast – Permanent mold parts. Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment.

UNIT III FORMED COMPONENTS DESIGN 8

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts.

UNIT IV MACHINED COMPONENTS DESIGN 8

Design considerations for: Turned parts – Drilled parts – Milled, planned, shaped and slotted parts – Ground parts.

UNIT V DESIGN FOR ASSEMBLY 8

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.

TOTAL: 45 PERIODS

REFERENCES:

1. James G. Bralla, "**Handbook of Product Design for Manufacture**", McGraw Hill Book Co., 2004.
2. Boothroyd, G., Dewhurst, P., & Knight, A. W., "**Product Design for Manufacture and Assembly**", 3rd Edition, CRC Press – Taylor Francis Group, 2011.
3. Harry Peck, "**Designing for Manufacture**", Sir Isaac Pitman & Sons Ltd., 1973.
4. Jenson, Helsel, & Short, "**Engineering Drawing & Design**", McGraw Hill Publications, NY, 2008.

MS8211 MANUFACTURING OPTIMIZATION LABORATORY L T P C
0 0 3 2

LIST OF EXERCISES:

1. Solving optimization problems using software packages.
2. Statistical analysis: Frequency distribution, identifying the appropriate distribution, testing for goodness of fit.
3. Simulation in manufacturing activities: scheduling & Logistics.
4. Optimization Techniques: Solving optimization problems using nontraditional optimization techniques
5. Case Studies: Solving of real time problems related to manufacturing activities using simulation software.

SOFTWARE REQUIREMENTS:

Simulation software such as: WITNESS / LINDO / LINGO / TORA / EXTEND.

TOTAL: 45 PERIODS

MS8311 PROJECT WORK PHASE I L T P C
0 0 12 6

OBJECTIVES:

- A research project topic may be selected either from published lists or from the creative ideas of the students themselves in consultation with their project supervisor.
- The objective of the research project work is to comprehensively investigate, review, redesign / modify a manufacturing and management of a system. Or propose and implement an innovative idea to a manufacturing and management of a system.
- The progress of the project is reviewed and evaluated with a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- The student must submit a project report at the end of the semester for evaluation.
- The final project work examination is evaluated jointly by external and internal examiners based on the project report and oral presentation.

OUTCOME:

- The students' would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated in their project work phase – II.

TOTAL: 180 PERIODS

MS8411 PROJECT WORK PHASE II L T P C
0 0 24 12

OBJECTIVES:

- The objective of the research project work is to produce factual results of their applied research idea in manufacturing and management of a system, from phase – I.
- The progress of the project is reviewed and evaluated with a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- The student must submit a project report at the end of the semester for evaluation
- The final project work examination is evaluated jointly by external and internal examiners based on the project report and oral presentation

OUTCOME:

- The students' would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated in their project work phase – II.

TOTAL: 360 PERIODS

MS8001 EXPERIMENTAL DESIGN AND ANALYSIS L T P C
3 0 0 3

OBJECTIVE:

- To impart the students with knowledge of the experimental design & analysis.

OUTCOME:

- The student should apply the principles and techniques used in experimental design in their future research projects.

UNIT I FUNDAMENTALS 9

Need for research & design of experiments – Techniques in experimental design – Application of experimental design – Test of hypothesis – Limitations – F-test – Need for ANOVA – Introduction to ANOVA – Simple design of ANOVA – Completely randomized design – Randomized complete block design – Latin square design – Duncan's multiple range test.

UNIT II FACTORIAL DESIGNS – I 9

Complete factorial experiments – 2 & 3 factor – Experiment – 2^n & 3^n – Distinction between random factor & fixed factor – Expected mean square rules – Nested Design – 2 & 3 stage – Mixed Design – Nested factor & factorial factor.

UNIT III FACTORIAL DESIGN – II 9

Confounded design – 2^2; 2^3; – Fractional factorial design – One half fraction of 2^2; 2^3; – One quarter fraction of 2^n – Split plot design – Split-split plot design – Strip-split plot design.

UNIT IV REGRESSION APPROACH, RESPONSE SURFACE METHODOLOGY, ORTHOGONAL ARRAY 9

Regression – Linear – Simple – Multiple – Matrix method – Response surface methodology – Types of design – Response surface design with blocks – Mixture experiments – Orthogonal array – Design – Column effect method – ANOVA –Interactions – Estimations – Confirmation of experiments.

UNIT V ROBUST PARAMETER DESIGN, GREY RELATIONAL ANALYSIS, MULTIVARIATE ANALYSIS OF VARIANCE 9

Robust parameter design using response surface methodology – Signal / Noise ratio – ANOVA for S/N ratio Steps in S/N ratio approach – Grey relational analysis – Multivariate analysis of variance (MANOVA) – One way MANOVA – Factorial MANOVA with 2 factors.

TOTAL: 45 PERIODS

REFERENCES:

1. Krishnaiah, K. & Shahabudeen, P., "**Applied Design of Experiments & Taguchi Methods**", PHI, 2012.
2. Panneerselvam. R, "**Design & Analysis of Experiments**", PHI, 2012.
3. Montgomery, D.C., "**Design and Analysis of Experiments**", John Wiley & Sons, 2010.
4. Dean, A. M., & Voss, D. T., "**Design and Analysis of Experiments**", Springer, 1999.
5. Mason, R. L., Gunst, R. F., & Hess, J. L., "**Design and Analysis of Experiments: with Applications to Engineering & Science**", Wiley Series on Probability & Statistics, John Wiley & Sons, 2003.
6. http://www.itl.nist.gov/div898/handbook/pri/section3/pri3.htm

MS8002 FINANCIAL AND MANAGEMENT ACCOUNTING L T P C
3 0 0 3

OBJECTIVE:

- To comprehend the financial management and accounting tools & techniques used in manufacturing industries

OUTCOME:

- The students should apply the various tools, techniques and methodology of financial and accounting concepts to the management of manufacturing / production industries.

UNIT I FINANCIAL MANAGEMENT 10

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 10

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 10

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 10

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 5

Cost of Capital – Capital structure – Dividend Policy – Leasing

TOTAL: 45 PERIODS

REFERENCES:

1. Bhattacharya, S.K. and John Deardon, "**Accounting for Management – Text and Cases**", Vikas Publishing House, New Delhi, 1996.
2. Charles, T.Horn Green – "**Introduction to Management Accounting**", Prentice Hall, New Delhi, 1996.
3. James, C.Van Horne, "**Fundamental of Financial Management**", Pearson Education, 12th Edition, 2002.
4. Pandey, I.M., "**Financial Management**", Vikas Publishing House, New Delhi, 8th Edition, 2004

MS8003 HUMAN RESOURCE MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To comprehend the important link between human resource management practices and high performance.

OUTCOME:

- The students will have thorough knowledge about the practices and analysis of HRM in terms of strategy, techniques and outcomes.

UNIT I HUMAN RESOURCE FUNCTION 5

Human Resource (HR) management – Meaning and importance- Difference between personnel and HR management – Changing environments of HRM – Strategic human resource management – Use of HRM to create competitive advantage – Trends in HRM – Organization of HR department – Role of HR Managers.

UNIT II RECRUITMENT & SELECTION 10

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 10

Orienting the employees, training process, need for training, training techniques, special purpose training, training via the internet – Training evaluation – Developing Managers: Management development – Responsive managers - On-the-job and off-the-job development techniques – Using HR to build a responsive organization – Use of CD-ROMs – Key factor for success – Performance appraisal: Tools, feedback, appraisal interviews – Performance appraisal in practice – Career planning and development – Managing promotions and transfers.

UNIT IV COMPENSATION & MANAGING QUALITY 10

Establishing pay plans: Basics of compensation – Factors determining pay rate – Current trends in compensation – Job evaluation – Pricing managerial and professional jobs – Computerized job evaluation – Pay for performance and financial incentives: Money and motivation – Incentives for operations employees and executives – Organization wide incentive plans – Practices in Indian organizations – Services benefits: Statutory benefits – Non-statutory (voluntary) benefits – Insurance benefits – Retirement benefits and other welfare measures to build employee commitment.

UNIT V LABOUR RELATIONS & EMPLOYEE SECURITY 10

Trade unions – Collective bargaining – Negotiation techniques – Discipline administration – Grievances handling – Managing dismissals and separation – Labour Welfare: Importance & Implications of labour legislations – Employee health – Auditing HR functions, Future of HRM function.

TOTAL: 45 PERIODS

REFERENCES:

1. Gary Dessler, "**Human Resource Management**", 11th Edition, PHI, 2008.
2. David A. DeCenzo & Stephen P. Robbins, "**Personnel/Human Resource Management**", 3rd Edition, PHI/Pearson, 2011.
3. Diane Arthur, "**Recruiting, Interviewing, Selecting and Orienting New Employees**", 4th Edition, PHI, 2007.
4. Biswajeet Pattanayak, "**Human Resource Management**", 3rd Edition, PHI, 2008.
5. Ian Beardwell, Len Holden, & Tim Claydon, "**HRM – A Contemporary Approach**", 4th Edition, Prentice Hall, 2004.
6. John Stredwick, "**Introduction to HRM**", Elsevier, 2nd Edition, 2005.
7. Robert L. Mathis & John H. Jackson, "**Human Resource Management**", 12th Edition, Thompson South-Western, 2006

MS8004 MANUFACTURING OPTIMIZATION L T P C
3 0 0 3

OBJECTIVE:

- To impart the knowledge of techniques used in manufacturing optimization

OUTCOME:

- The students will be able to understand and apply the various techniques and methodologies of optimization to improve manufacturing processes.

UNIT I INTRODUCTION & CLASSIFICATION 8

Need for optimization of optimization of manufacturing processes, Statement of an Optimisation problem, Classification of optimization problems; Single – variable optimization, Multi – variable optimization with No constraints, Equality constraints and Inequality constrains, Convex programming problem.

UNIT II CLASSICAL OPTIMIZATION TECHNIQUES 10

Linear Programming – Simplex method, Revised Simplex method, Duality, Karmakar's method; Non-linear programming – One-Dimensional Minimisation methods, Unconstrained and constrained optimization techniques; Geometric programming; Integer programming – Linear and Nonlinear.

UNIT III ADVANCED OPTIMIZATION TECHNIQUES 10

Genetic Algorithms, Simulated Annealing, Neural Networks, Optimisation of fuzzy systems, Tabu Search and Scatter Search, Ant System, Particle Swam Optimisation, Gray Relational Analysis.

UNIT IV OPTIMISATION OF TRADITIONAL & NON-TRADITIONAL MANUFACTURING PROCESSES 8

Modeling and optimization of traditional processes – Milling, Grinding, Turning and Drilling processes; Modeling and optimization of non-traditional processes – Ultrasonic machining, Wire Electric Discharge Machining, Electro Chemical Machining and Rapid prototyping processes.

UNIT V SYSTEMS OPTIMISATION 9

Optimisation of Supply chain networks, Process planning and scheduling, production and inventory management, process industries.

TOTAL: 45 PERIODS

REFERENCES:

1. R. Venkata Rao, "**Advanced Modeling and Optimization of Manufacturing Processes**", Springer-Verlag London Limited, 2011.
2. Singiresu S. Rao, "**Engineering Optimization: Theory and Practice**", John Wiley & Sons, 2009.
3. Ashok D. Belegundu, Tirupathi R. Chandrupatla, "**Optimization Concepts and Applications in Engineering**", Cambridge University Press, 2011.
4. Kalyanmoy Deb, "**Optimization for Engineering Design: Algorithms and Examples**", Prentice-Hall of India Private Limited, 2005.
5. Kalyanmoy Deb, "**Multi-Objective Optimization Using Evolutionary Algorithms**", Wiley, 2009.
6. Godfrey C. Onwubolu, B. V. Babu, "**New Optimization Techniques in Engineering**", Springer-Verlag, 2004.
7. Lihui Wang, Amos H. C. Ng, Kalyonmoy Deb, "**Multi-Objective Evolutionary Optimisation for Product Design and Manufacturing**", Springer-Verlag London Limited, 2011.

MS8005 MANUFACTURING PLANNING AND CONTROL L T P C
3 0 0 3

OBJECTIVE:

- To understand the fundamentals concepts of planning and control in a manufacturing sectors

OUTCOME:

- The student should apply the tools techniques and methods in planning, production control, loading, scheduling, material flow path analysis, and layout design in a manufacturing system.

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

UNIT I INTRODUCTION TO MANUFACTURING SYSTEMS ENGINEERING 10

Process Planning – Logical design of process planning – Shortcomings of traditional process planning – Computer aided process planning – Computerization of files management – Variant (Retrieval) approach – Generative approach – Semi generative approach – General remarks on CAPP developments and trends.

UNIT II PRODUCTION CONTROL 10

Overview of manufacturing control – Approaches in manufacturing planning and control – Manufacturing planning and control performance – Manufacturing planning parameters and variables – Forecasting – Master production schedule – Materials requirements planning – Order release – Shop floor control – Cellular manufacturing – JIT and MRP II – Computer generated time standards.

UNIT III LOADING & SCHEDULING 7

Information retrieval for loading and scheduling – Master scheduling – Perceptual loading – Despatching – Progress chasing – Expediting – Order scheduling devices

UNIT IV MATERIAL FLOW PATH ANALYSIS IN MANUFACTURING 9

Material handling function – Types of equipment used – Conveyor systems – Automated guided vehicle systems – Guiding and routing – Traffic control and safety – Interfacing handling and storage with manufacturing-design factors in material handling systems.

UNIT V LAYOUT OF MANUFACTURING SYSTEMS 9

Plant layout – Definition – Objectives – Principles – Factors influencing layout – Types of layout – Cellular layout – Tools and tooling system for cellular manufacturing

TOTAL: 45 PERIODS

REFERENCES:

1. S. K. Mukhopadhyay, "**Production Planning and Control: Text and Cases**", PHI, 2007.
2. G. Halevi & R. D. Weill, "**Principles of Process Planning**", Chapman & Hall, Madras, 1995.
3. M. P. Groover, "**Automatic Production System and Computer Integrated Manufacturing**", Prentice Hall, 1990.
4. Bary Hawkes, "**CAD/CAM Processes**", 1990.
5. Evert E. Adams Jr., & Donold J. Ebert, "**Production and Operation Management**", Prentice Hall of India, 1994.
6. S. N. Chary, "**Production and Operations Management**", 3rd Edition, Tata McGraw Hill, New Delhi,1991.
7. Patrik Jonsson & Stig-Arne Mattsson, "**Manufacturing Planning and Control**", Tata McGraw Hill, 2011.

MS8006 MATERIALS HANDLING SYSTEMS AND DESIGN L T P C
3 0 0 3

OBJECTIVE:

- To understand the importance of material handling system and its design in manufacturing systems & management

OUTCOME:

- The students should apply the concepts of material handling systems and design functions in different manufacturing industries.

UNIT I MATERIALS HANDLING EQUIPMENT 10

The material handling function, principles – Types of material handling systems – Material handling equipment – Basic types – Storage systems – Unitizing equipment system – Tracking and identification system – Analysis of material handling system – Material characteristics – Plant and equipment – Production schedule – Layout – Handling condition – Cost consideration – Selection and applications of material handling system – Types of material handling equipment – Characteristics – Analysis and material transfer system – Economic analysis of material handling

equipments: Breakeven analysis – Equipment operating cost per unit distance – Work volume analysis – Illustrative problems – Productivity/Indicator ratios.

UNIT II HOISTS & HOISTING GEAR 12

Standard hoisting elements: Welded and roller chains – Hemp and wire ropes – Use of ropes, pulleys, pulley systems, sprockets and drums – Load handling attachments – Use of forged hooks and eye hooks – Crane grabs – Lifting magnets – Grabbing attachments – Purpose of arresting gear – Brakes: shoe, band and cone types – 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 7

Types – Description – Applications of belt conveyors, apron conveyors, escalators, pneumatic conveyors, screw conveyors and vibratory conveyors – AGV Systems, AS/RS Systems, Carousel Storage Systems & WIP Storage Systems – Simple analysis of storage systems.

UNIT IV ELEVATORS 7

Bucket elevators: Types – Loading and bucket arrangements – Cage elevators – Shaft way, guide, counter weights, hoisting machine, safety devices – Use of lift trucks.

UNIT V MECHANIZED ASSEMBLY 9

Principles and operating characteristics of part feeders such as: Vibratory bowl feeder, Reciprocating tube hopper, Centrifugal hopper feeder and Center board hopper feeder – Orientation of parts – In-bowl and Out-of-bowl tooling – Different types of escapements transfer systems and indexing mechanisms.

TOTAL: 45 PERIODS

REFERENCES:

1. Rudenko, N., "**Materials Handling Equipment**", ELnvee Publishers, 1970.
2. John R. Immer, "**Material Handling**", McGraw Hill Book Co., 1953.
3. Sharma S. C., "**Materials Management & Materials Handling**", Khanna Publishers, New Delhi, 2000.
4. Spivakovsy, A.O., & Dyachkov, V.K., "**Conveying Machines**", Volumes I and II, MIR Publishers, 1985.
5. Alexandrov, M., "**Materials Handling Equipments**", MIR Publishers, 1981.
6. Kulwiec, "**Material Handling Hand Book**". 2nd edition. John Wiley Sons Inc., 1985.
7. Charles Reese, "**Material Handling Systems: Designing for Safety and Health**", CRC Press, 2000.

MS8007 MODERN TECHNIQUES OF MATERIALS CHARACTERIZATION L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge about various characterization techniques used in materials research.

OUTCOME:

- The students should apply the concepts of imaging techniques, X-ray diffraction analysis, spectroscopic and thermal methods of characterization to materials characterization.

UNIT I METALLOGRAPHIC TECHNIQUES 9

Macroexamination – 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 9

X-ray generation, absorption edges, characteristic spectrum, Crystallography basics, Bragg's law, Diffraction methods – Laue, rotating crystal and powder methods. Stereographic projection. Intensity of diffracted beams – structure factor calculations and other factors – Counters - proportional, Scintillating, Geiger and semiconductor counters.

UNIT III ANALYSIS OF X-RAY DIFFRACTION 9

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 9

Basic principles and applications of Transmission electron microscope – Selected Area Electron Diffraction and image formation, specimen preparation techniques. Construction, modes of operation and application of Scanning electron microscope, Electron Backscattered Diffraction (EBSD) -EDS, Electron probe micro analysis (EPMA), Introduction to Scanning Tunnelling Microscope (STM) and Atomic Force Microscope (AFM).

UNIT V CHEMICAL AND THERMAL ANALYSIS 9

Basic principles and applications of Auger spectroscopy, X- ray photoelectron spectroscopy (XPS). U-V, Visible, IR, FTIR and Raman spectroscopy – fluorescence and phosphorescence methods – flame photometry – atomic absorption – Inductively Coupled Plasma -Atomic Emission Spectrometry (ICP- AES). Basic principles and applications of Differential thermal analysis (DTA), differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA)

TOTAL: 45 PERIODS

REFERENCES:

1. Yang Leng, "**Materials Characterization: Introduction to Microscopic and Spectroscopic Methods**", John Wiley & Sons, 2008.
2. Cullity, B. D., "**Elements of X-ray Diffraction**", Addison-Wesley Company Inc., New York, 3rd Edition, 2000.
3. D. A. Skoog, F. James Leary and T. A. Nieman, "**Principles of Instrumental Analysis**", 5th Edition, Saunders Publishing Co., 1998.
4. Thomas G., "**Transmission Electron Microscopy of Metals**", John Wiley, 1996.
5. Weinberg, F., "**Tools and Techniques in Physical Metallurgy**", Volume I & II, Marcel and Decker, 1970.
6. Sam Zhang, Lin Li, & Ashok Kumar, "**Materials Characterization Techniques**", CRC Press, 2009.

MS8008 NANO STRUCTURED MATERIALS AND TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To impart the knowledge of the nanomaterials and mechanism of nanostructure formation and its characterization

OUTCOME:

- The student should apply the different types processing technique that can produce zero, one two and bulk nanostructured materials.

UNIT I INTRODUCTION TO NANOMATERIALS 7

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 10

Nano Particles – Properties – Processing – Liquid state processing - Sol-gel process, wet chemical synthesis – Vapour state processing – PVD, CVD, Aerosol processing, solid state processing – mechanical, mechanochemical synthesis – Application of nanoparticle.

Quantum Dots – Quantum confinement – Pauli Exclusion Principle – Processing – Optical lithography – MOCVD – Droplet epitaxy – Applications.

UNIT III ONE DIMENSIONAL NANOMATERIALS 10

Carbon nanotubes – Old and new forms of carbon – Structure of CNT and classification – Processing – Solid carbon based production techniques – Gaseous carbon based production technique – Growth mechanisms – Applications.

Nanowire – Processing – Vapour – Liquid – Solid growth (VLS technique) – Laser ablation – Oxide assisted growth – Vapour – Solid growth (VS growth) – Carbo thermal reactions – Thermal evaporation – Temperature based synthesis – Electro spinning – Applications.

UNIT IV SUPER HARD COATINGS & BULK NANOSTRUCTURE FORMATION 9

Superhard coating – Types – Characteristics – Thermal stability – Case studies (nc-TiN/a-Si_3N_4 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 9

Nano indentation – Types of nanoindenter – Atomic force microscope (AFM) – Electrostatic force mode (EFM) – Magnetic force mode (MFM) – Scanning Tunneling microscope (STM) – Scanning electron microscope (SEM) – Transmission electron microscope (TEM).

TOTAL: 45 PERIODS

REFERENCES:

1. Mark Ratner and Daniel Ratner, "**Nano Technology**", Pearson Education, New Delhi, 2003.
2. G. Wilde, "**Nanostructured Materials**", Elsevier, 2008.
3. Bamberg, D., Grundman, M. and Ledentsov, N. N., "**Quantum Dot Heterostructures**", Wiley, 1999.
4. N John Dinardo, "**Nanoscale characterisation of surfaces & interfaces**", Weinheim Cambridge: Wiley-VCH, 2nd Edision, 2000.
5. G Timp (Ed.), "**Nanotechnology**", AIP Press/Springer, 1999.
6. Bhusan, Bharat (Ed.), "**Springer Handbook of Nanotechnology**", 2nd Edition, 2007.
7. Charles P. Poole Jr. and Frank J. Ownes, "**Introduction to Nanotechnology**", Wiley Interscience, 2003.

MS8009 PROCESSING OF COMPOSITES AND POLYMER MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- The aim is impart the students with knowledge of the polymers and advanced materials and its manufacturing

OUTCOME:

- The student should apply different types of polymers, ceramics and advanced composites manufacturing methods engineering industrial application.

UNIT I POLYMERS & COMPOSITES 9

Polymers-Thermosetting and Thermoplastic polymers – Polymerisation – Different Polymers – Fundamentals of composites – Need for composites –- classification of composites – Matrix Materials – Reinforcement Materials – Applications of various types of composites – Fiber production techniques for glass, carbon and ceramic fiber.

UNIT II POLYMER MATRIX COMPOSITES 9

Polymer resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Rovings – woven fabrics – Non woven random mats – Various types of fibres – PMC processes – Hand layup processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding – Resin transfer moulding – Pultrusion – Filament winding – Injection moulding – Fibre reinforced plastics (FRP), glass fibre reinforced plastics (GRP). Laminates – Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates – Applications of PMC in aerospace, automotive industries.

UNIT III METAL MATRIX COMPOSITES 10

Characteristics of MMC, advantages of MMC, limitations of MMC, rule of mixtures – Processing of MMC – Powder metallurgy process – Diffusion bonding – Stir casting – Squeeze casting. In-situ reactions – Interface – measurement of interface properties – Applications of MMC in aerospace, automotive industries.

UNIT IV CERAMIC MATRIX COMPOSITE & SPECIAL COMPOSITES 10

Need for CMC –Toughening Mechanism – Processing- Sintering - Hot pressing – Cold Isostatic Pressing (CIPing) – Hot Isostatic Pressing (HIPing) – Applications of CMC in aerospace, automotive industries – Carbon / carbon composites – Advantages of carbon matrix – Limitations of carbon matrix carbon fiber – Chemical vapour deposition of carbon on carbon fiber perform – Sol-gel technique

UNIT V INTERFACE & FAILURE ANALYSIS 7

Interface – Interphase – Mechanisms of Bonding – Measurements of interface bonding strength – Yielding – Particle/fiber fracture – Interface decohesion / debonding.

TOTAL: 45 PERIODS

REFERENCES:

1. Kishan K. Chawla, "**Composite Material: Science and Engineering**", 2nd Edition, Springer, 1998.
2. T. W. Clyne & P. J. Withers, "**An Introduction to Metal Matrix Composites**", Cambridge University Press, 1993.
3. B. T. Astrom, "**Manufacturing of Polymer Composites**", Chapman & Hall, 1997.
4. S. C. Sharma, "**Composite Materials**", Narosa Publishing House, 2000.
5. Berins, "**Design with Plastics and Plastic Engineering**", Wiley & Sons Inc., ISBN: 0442010699, 1995
6. D. Huda, M. A. El Baradie and M. S. J. Hashmi, "**Metal-Matrix Composites: Materials Aspects – Part II**", Journal of Materials Processing Technology, 37, (1993), 521 – 541.
7. D. Huda, M. A. El Baradie and M. S. J. Hashmi, "**Metal-Matrix Composites: Manufacturing Aspects – Part I**", Journal of Materials Processing Technology, 37, (1993), 513 – 528.

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

MS8010 SAFETY ENGINEERING AND INDUSTRIAL HYGIENE L T P C
3 0 0 3

OBJECTIVE:

- To acquire the knowledge about the safety engineering and industrial hygiene for various manufacturing industry

OUTCOME:

- The students should apply the safety rules and principles for different manufacturing environment like machine erection, welding, gas cutting and forming field with the emphasize on Industrial hygiene.

UNIT I SAFETY IN METAL WORKING MACHINES 5

General safety Consideration, Need for safety, Organization and planning-requirement for successful planning, principles, maintenance, Implementation of safety concepts in of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, wood working machine, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes (saws, types) – IS standards.

UNIT II PRINCIPLES OF MACHINE GUARDING 10

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: Typical guarding system for turning, drilling, boring, milling, grinding, shaping, sawing and shearing – Presses – Forge hammer – Flywheels – Shafts – Couplings – Gears – Sprockets wheels and chains – Pulleys and belts – Authorized entry to hazardous installations – Benefits of good guarding systems.

UNIT III SAFETY IN WELDING & GAS CUTTING 10

Personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – Safety in generation, distribution and handling of industrial gases – Colour coding – Safety inspection – Flashback arrestor – Leak detection-pipe line safety-storage and handling of gas cylinders.

UNIT IV SAFETY IN COLD WORKING & HOT WORKING OF METALS 10

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot – Operated presses, power press electric controls, power press set up and die removal, inspection and maintenance – Metal sheers – Press brakes.

Safety in forging, hot rolling mill operation, guards in hot rolling mills – hot bending of pipes, hazards and control measures.

Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes – safety in heat treatment – electro plating – painting – sand blasting – short blasting.

UNIT V INDUSTRIAL HYGIENE & SAFETY TESTING 10

Importance of industrial hygiene, Safety in radiography – personal monitoring devices – radiation hazards, Visual and respiratory hazards – occupational hazards – health and welfare measures in engineering industry – pollution control – industrial waste disposal – Indian boiler regulation-Pollution norms – safety in testing – dynamic balancing – hydro testing – walls and boilers headers and pressure vessels – leak testing – air and steam.

TOTAL: 45 PERIODS

REFERENCES:

1. Frank E. McElroyn (Ed.), "**Accident Prevention Manual for Industrial Operations: Engineering and Technology**", 8th Edition, National Safety Council, USA, 1980.
2. Occupational Health Services, "**Occupational Safety Manual**", BHEL, Trichy, 1988.

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

3. John V. Grimaldi & Rollin H. Simonds, "**Safety Management**", All India Travelers Book Seller, New Delhi, 1989.
4. N. V. Krishnan, "**Safety in Industry**", Jaico Publisher House, 1996.
5. Department of Labour, "**Indian Boilers Act 1923**", Commercial Law Publishers (INDIA) Pvt. Ltd, Allahabad.
6. Department of Employment, "**Safety in the Use of Woodworking Machines**", HMSO, London, UK, 1992.
7. Welding Institute, UK, "**Health and Safety in Welding and Allied Processes**", High Tech. Publishing Ltd., London, 1989.
8. R. P. Blake, "**Industrial Safety**", Prentice Hall, 1963.
9. Roy E. Sanders, "**Chemical Process Safety – Learning from Case Histories**", Elsevier Butterworth-Heineman, USA, 2005.
10. J. M. Stellman (Ed.), "**Encyclopedia of Occupational Health and Safety**" Vol. I & II, 4th Edition, International Labour Organisation, Geneva, 1998.

CI8071 ADDITIVE MANUFACTURING L T P C
3 0 0 3

OBJECTIVE:

- To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology and the associated Aerospace, Architecture, Art, Medical and industrial applications.

OUTCOME:

- On completion of this course, they will learn about a variety of Additive Manufacturing (AM) technologies, their potential to support design and manufacturing, case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools

UNIT I INTRODUCTION: 8

Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits-Applications.

UNIT II REVERSE ENGINEERING AND CAD MODELING: 10

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 10

Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications.
Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 10

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

UNIT V OTHER ADDITIVE MANUFACTURING SYSTEMS: 7

Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

TOTAL: 45 PERIODS

REFERENCES:

1. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.
3. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.
4. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2011.
5. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
6. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

CI8072 COMPUTER AIDED PROCESS PLANNING L T P C

3 0 0 3

OBJECTIVE:

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

OUTCOME:

At the end of this course the students are expected to use

1. Application of computers in the documentation
2. Creating database for the future use.
3. Use of commercially available CAPP system in Industries

UNIT I INTRODUCTION 8

Production Planning and Process Planning – The role of Process Planning in the Manufacturing cycle – Experience based planning – Need for computer aided process planning – Process Planning and Concurrent Engineering, Group Technology.

UNIT II PART DESIGN REPRESENTATION 10

Basic part representation methods: CAD models – Feature based design – Design interface: Syntactic pattern recognition – State transition diagram – Decomposition approach – Logic approach – Graph based approach.

UNIT III KNOWLEDGE REPRESENTATION 7

Process knowledge – Dimensions and tolerances – Surface properties – Process constraints – Process economics – Process capability

UNIT IV SYSTEM FORMULATION 10

Logical Design of Process Planning – System structure – Planning strategy – Declarative knowledge of part – Procedure knowledge of planning – Other issues: process parameter selection, tool selection, machine selection, plan optimization , Implementation considerations – Decision table and Decision trees.

Attested

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UNIT V COMPUTER AIDED PROCESS PLANNING SYSTEMS 10

Computer aided Process Planning – Variant process planning – Generative process planning– Forward and Backward planning, input format – Totally Integrated process planning systems – Expert process planning-Commercial systems: CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP

TOTAL: 45 PERIODS

REFERENCES:

1. Halevi, G. & Weill, R.D., "**Principles of Process Planning**", A logical approach – Springer, 2003.
2. Chang, T.C. & Wysk, R.A., "**An Introduction to Automated Process Planning Systems**", Prentice Hall, 1985.
3. Chang, T.C., "**An Expert Process Planning System**", Prentice Hall, 1985.
4. Singh, N., "**Systems Approach to Computer Integrated Design and Manufacturing**", John Wiley & Sons, 1996.
5. Rao, "**Computer Aided Manufacturing**", Tata McGraw Hill Publishing Co. 2002.
6. Vollmann, T. E. & Bery, W.E., "**Manufacturing Planning and Control Systems**, 5th Edition, Galgotia Publications, 2004.

WEB REFERENCES:

1. http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm
2. http://Estraj.ute.sk/journal/englo/027/027.htm

CI8073 INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To teach students the basics of robotics, construction features, sensor applications, robot cell design, robot programming and application of artificial intelligence and expert systems in robotics.

OUTCOME:

- The student will be able to design robots and robotic work cells and write program for controlling the robots. The student will be able to apply artificial intelligence and expert systems in robotics.

UNIT I INTRODUCTION AND ROBOT KINEMATICS 10

Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors.

Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT II ROBOT DRIVES AND CONTROL 9

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT III ROBOT SENSORS 9

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation – Image Grabbing – Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing – Image segmentation – Pattern recognition – Training of vision system.

UNIT IV ROBOT CELL DESIGN & APPLICATION 9

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis – Industrial application of robots.

UNIT V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS 8

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques – Application of AI and KBES in Robots.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. K. S. Fu, R. C. Gonzalez & C. S. G. Lee, "**Robotics Control, Sensing, Vision and Intelligence**", McGraw Hill, 1987.

REFERENCES:

1. Yoram Koren, "**Robotics for Engineers**", McGraw-Hill, 1987.
2. Kozyrey, Yu. "**Industrial Robots**", MIR Publishers Moscow, 1985.
3. Richard D. Klafter, Thomas A. Chmielewski, & Michael Negin, "**Robotics Engineering – An Integrated Approach**", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S. R., "**Robotics Technology and Flexible Automation**", Tata McGraw-Hill, 1994.
5. Mikell P. Groover, Mitchell Weis, Roger N. Nagel, & Nicholas G. Odrey, "**Industrial Robotics Technology, Programming and Applications**", McGraw-Hill Int., 1986.
6. Timothy Jordanides et al., "**Expert Systems and Robotics**", Springer –Verlag, New York, May 1991.

CI8074 MANUFACTURING INFORMATION SYSTEMS L T P C
3 0 0 3

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

OUTCOME:

- On completion of this course, the students are expected to create simple to moderately complex manufacturing information system for manufacturing industry.

UNIT I INTRODUCTION: 7

The Evolution of order policies, from mrp to MRP II to ERP – Agile Manufacturing Information Systems, Manufacturing Database Integration.

UNIT II DATABASE: 9

Terminologies – Entities and attributes – Data models, schema and subschema - Data Independence – ER Diagram – UML notation for describing the enterprise–wide data objects-Trends in database.

UNIT III DESIGNING DATABASE: 9

Hierarchical model – Network approach- Relational Database concepts, principles, keys,– functional dependency – Normalization types – relational operations- Query Languages-Case studies.

UNIT IV MANUFACTURING CONSIDERATION: 10

The product and its structure, inventory and process flow – Shop floor control Data structure and procedure – various models – the order scheduling module, Input/output analysis module, and stock status database – the complete IOM database.

UNIT V INFORMATION SYSTEM FOR MANUFACTURING: 10

Parts oriented production information system – concepts and structure – Computerized production scheduling, online production control systems, Computer based production management system, computerized manufacturing information system -RFID-Telecommunication– case study.

TOTAL: 45 PERIODS

REFERENCES:

1. Sartori, L.G., "Manufacturing Information Systems", Addison-Wesley Publishing Company, 1988.
2. Date, C.J., "An Introduction to Database Systems" Addison Wesley", 8th Edn,. 2003
3. Orlicky, G., "Material Requirements Planning", McGraw-Hill, 1994.
4. Kerr, R., "Knowledge based Manufacturing Management", Addison-Wesley, 1991.
5. Oliver, G. and Wolfhard, K., "RFID in Manufacturing", Kubach.vwe.,2008
6. Franjo, C., "Manufacturing Information & Data Systems Analysis, Design & Practice", Butterworth-Heinemann, 2002.
7. Weiming S, "Information Technology for Balanced Manufacturing Systems", Springer, 2006.

WEB REFERENCES:

1. www.ist.psu.edu
2. www.cse.wustl.edu(UML Notation Guide)

CI8075 MECHATRONICS IN MANUFACTURING L T P C
3 0 0 3

OBJECTIVE:

- To provide the student with the knowledge of sensors, transducers, various types of actuators used in mechatronics systems and also the use of PLCs and mechatronics design.

OUTCOME:

- At the end of this course the student should be able to apply Mechatronics in design and practical requirements.

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 10

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 10

Steps in mechatronics design - 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 PERIODS

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. Shetty, D. and Kolk, O. A., “Mechatronics systems design”, PWS Publishing company, 2007.
4. Onwubolu, G.C., "Mechatronics Principles and Applications", Elsevier, 2006.
5. Mahalik,N.P., “Mechatronics Principles, Concepts and applicatlions” Tata McGraw-Hill Publishing Company Limited, 2003.
6. Histand, M.B. and Alciatore,D.G., “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 1999.
7. Bradley, D.A., Dawson. D., Buru, N.C. and Loader, A.J., “Mechatronics” Nelson Thornes Ltd, Eswar press, Indian print, 2004.
8. Sinclair, I., “Sensors and Transducers”, Elsevier, Newnes, Reprint 2012.

CI8252 COMPETITIVE MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVE:

- To emphasize the knowledge on the quality improvement, automation, and advanced manufacturing techniques to create the highest-caliber products quickly, efficiently, inexpensively, and in synchronization with the marketing, sales, and customer service of the company.

OUTCOME:

- At the end of this course the student will be able to apply the knowledge to implement and work in competitive manufacturing systems. Student will be able to practice the principles of flexible manufacturing, Kaizen, 5S, Jidoka, Poka Yoke and Lean manufacturing.

UNIT I MANUFACTURING IN A COMPETITIVE ENVIRONMENT 9

Five areas of competitive manufacturing: cost, quality, delivery, safety/environment, and morale. Automation of manufacturing process - Numerical control - Adaptive control - material handling and movement - Industrial robots - Sensor technology - flexible fixtures - Design for assembly, disassembly and service – PLM.

UNIT II GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS 9

Part families - classification and coding - Production flow analysis - Machine cell design - Benefits. Components of FMS - Computer control and functions - Planning, scheduling and control of FMS - Knowledge based scheduling.

UNIT III COMPUTER SOFTWARE, SIMULATION AND DATABASE OF FMS 9

System issues - Types of software - specification and selection - Trends - Simulation and Applications - Simulation software - Manufacturing data systems - data flow - CAD/CAM considerations - Planning FMS database.

UNIT IV LEAN MANUFACTURING 9

Origin of lean production system – Customer focus – Muda (waste) – Standards – 5S system – Total Productive Maintenance – standardized work –Man power reduction – Overall efficiency - Kaizen – Common layouts - Jidoka concept – Poka-Yoke (mistake proofing) - Worker Involvement– Quality circle activity - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Lean culture – APQP – SOP – PPAP – Factories of the future.

Attested

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UNIT V JUST IN TIME **9**

Characteristics of JIT - Pull method - quality -small lot sizes - work station loads - close supplier ties – flexible work force - line flow strategy - preventive maintenance for JIT – VSM - Kanban system - strategic implications - implementation issues.

TOTAL: 45 PERIODS

REFERECES:

1. Jha, N.K., “Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.
2. Bhat, S. K., “Total Quality Management", Himalaya Publishing House Pvt. Ltd., 2011.
3. Groover, M.P., “Automation, Production Systems and Computer Integrated Manufacturing ", Third Edition, Prentice-Hall, 2007.
4. Kalpakjian, “Manufacturing Engineering and Technology ", Addison-Wesley Publishing Co., 1995.
5. Ohno, T.T., “Production System Beyond Large-Scale production", Productivity Press (India) Pvt. Ltd. 1992.
6. Dennis, P., “Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System”, (Second edition), Productivity Press, New York, 2007.

IL8081 PROJECT MANAGEMENT **L T P C**

3 0 0 3

UNIT I STRATEGIC MANAGEMENT AND PROJECT SELECTION **9**

Project selection models, Project portfolio process, Analysis under uncertainty, Project organization, Matrix organization

UNIT II PROJECT PLANNING **9**

Work Breakdown Structure, Systems integration, Interface coordination, Project life cycle, Conflict and negotiation.

UNIT III PROJECT IMPLEMENTATION **12**

Estimating Project Budgets, Process of cost estimation, Scheduling: Network Techniques PERT and CPM, Risk analysis using simulation, CPM- crashing a project, Resource loading, leveling, and allocation.

UNIT IV MONITORING AND INFORMATION SYSTEMS **9**

Information needs and the reporting process, computerized PMIS, Earned value analysis, Planning-Monitoring-Controlling cycle**,** Project control**:** types of control processes, design of control systems, control of change and scope.

UNIT V PROJECT AUDITING **6**

Construction and use of audit report, Project audit life cycle, Essentials of audit and evaluation, Varieties of project termination, the termination process, The Final Report – A project history.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.Panneer selvam,P. Senthil Kumar, Project Management, PHI, 2010.
2. Arun Kanada, Project Management A life cycle approach, PHI, 2011.

REFERENCES:

1. Jack R. Meredith, and Samuel J. Mantel Jr., Project Management – A Managerial Approach, John Wiley and Sons, 2006.
2. Harold Kerzner, Project Management – A Systems Approach to Planning, Scheduling and Controlling, John Wiley and Sons, 2006.

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MS8071 CELLULAR MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on planning, design, implementation, and control of group technology and cellular manufacturing.

OUTCOME:

- The students should apply the various tools, techniques and methodology used in planning, design, implementation, and control of group technology and cellular manufacturing.

UNIT I INTRODUCTION 8

Group Technology – Limitations of traditional manufacturing systems – Group machining concept – Principle of cellular manufacturing – Terminology associated with cellular manufacturing – Characteristics and perspectives of cellular manufacturing – Areas of applications of cellular manufacturing – Benefits and limitations of cellular manufacturing

UNIT II CMS PLANNING & DESIGN 10

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 10

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 9

Evaluation of cellular manufacturing systems – Production control activities and scheduling in cellular manufacturing.

UNIT V ECONOMIC OF GT/CMS 8

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

TOTAL: 45 PERIODS

REFERENCES:

1. Nagendra Parashar, B. S., "**Cellular Manufacturing Systems: An Integrated Approach**" PHI Learning, 2010.
2. Askin, R. G., & Vakharia, A.J., "**GT planning and operation**", as in Cleland, D. I., & Bidanda, B., (Editors), "The Automated Factory – Hand Book: Technology and Management", TAB Professional & Reference Books, NY, 1990.
3. Shahrukh A. Irani, "**Handbook of Cellular Manufacturing Systems**", John Wiley & Sons, 1999.

PD8071 ENTERPRISE RESOURCE PLANNING L T P C
3 0 0 3

OBJECTIVE:

- To impart to students the basic concepts of Enterprise Resource Planning and itsrole in improving the business dynamics

OUTCOME:

Upon completion of the course, the students will be able

- To provide an integrated view of the various facets of business, including planning, manufacturing, sales, finance and marketing.
- To understand the development of software to integrate business activities such as inventory management and control, order tracking, customer service, finance and human resources.
- To become aware of the software applications and tools that are available to business to use to drive out costs and improve efficiency.

UNIT I ENTERPRISE RESOURCE PLANNING 10

Principle – ERP framework – BusinessBlue Print – Business Engineeringvs Business process Re-Engineering – Tools – Languages – Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models –Process Models

UNIT II TECHNOLOGY AND ARCHITECTURE 10

Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework.

UNIT III ERP SYSTEM PACKAGES 10

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 – Organisational and social issues.

UNIT IV ERP ARCHITECTURE 7

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 8

Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies.

TOTAL: 45 PERIODS

REFERENCES:

2. Sadagopan.S , ERP-A Managerial Perspective, Tata Mcgraw Hill, 1999.
3. Jose Antonio Fernandez , The SAP R/3 Handbook, Tata Mcgraw Hill, 1998.
4. Vinod Kumar Crag and N.K.Venkitakrishnan ,Enterprise Resource Planning –Concepts and Practice, Prentice Hall of India, 1998.
5. ERPWARE , ERP Implementation Framework, Garg & Venkitakrishnan, Prentice Hall, 1999.
6. Thomas E Vollmann and BeryWhybark , Manufacturing and Control Systems, Galgothia Publications, 1998.

PD8072 REVERSE ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge to the students abut the need for and the various tools required for reverse engineering with exposure to the software needed for implementing reverse engineering.

OUTCOMES:

Upon completion of the course, the students will be able to

- Understand the basic principles of reverse engineering
- Select the suitable tools and methodology for reverse engineering any product

UNIT I INTRODUCTION 5

Scope and tasks of RE - Domain analysis- process of duplicating

UNIT II TOOLS FOR RE 8

Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material- characteristics evaluation -software and application-prototyping - verification

UNIT III CONCEPTS 12

History of Reverse Engineering – Preserving and preparation for the four stage process – Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation

UNIT IV DATA MANAGEMENT 10

Data reverse engineering – Three data Reverse engineering strategies – Definition – organization data issues - Software application – Finding reusable software components – Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces – Reverse Engineering of assembly programs: A model based approach and its logical basics

UNIT V INTEGRATION 10

Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering -–coordinate measurement – feature capturing – surface and solid members

TOTAL: 45 PERIODS

REFERENCES

1. T. J. Biggerstaff, "**Design Recovery for Maintenance and Reuse**", IEEE Corp., July 1991.
2. S. Rugaban, "**White Paper on RE**", Technical Report, Georgia Inst. of Technology, 1994.
3. Katheryn, A. Ingle, "**Reverse Engineering**", McGraw-Hill, 1994.
4. Peter Aiken, "**Data Reverse Engineering**", McGraw-Hill, 1996.
5. Linda Wills, "**Reverse Engineering**", Kluwer Academic Publishers, 1996.
6. Donald R. Honsa, "**Co-ordinate Measurement and Reverse Engineering**", American Gear Manufacturers Association, ISBN 1555897.

PD8251 INTEGRATED PRODUCT DESIGN AND PROCESS DEVELOPMENT** **L T P C**
3 1 0 4

OBJECTIVE

- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

OUTCOME:

On completion of the course the student will be able to

- Understand the integration of customer requirements in product design
- Apply structural approach to concept generation, selection and testing
- Understand various aspects of design such as industrial design , design for manufacture , economic analysis and product architecture

UNIT I INTRODUCTION 8

Need for IPPD-Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement

UNIT II CONCEPT GENERATION, SELECTION AND TESTING 10

Plan and establish product specifications. Task - Structured approaches - clarification - search-externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change - variety - component standardization - product performance - manufacturability – Concept Testing Methodologies.

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UNIT III PRODUCT ARCHITECTURE 8

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

UNIT IV INDUSTRIAL DESIGN 8

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically - Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process - technology driven products - user - driven products - assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 11

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project-project execution.

T=15, TOTAL: 60 PERIODS

TEXT BOOK

1. Karl T.Ulrich and Steven D.Eppinger, "**Product Design and Development**", McGraw –Hill International Edns,1999.

REFERENCES:

1. Kenneth Crow, "**Concurrent Engineering / Integrated Product Development**", DRM Associates, 6/3,Via Olivera, Palos Verdes, CA, USA, 90274.
2. Stephen Rosenthal, "**Effective Product Design and Development: How to Cut Lead Time and Increase Customer Satisfaction**", Business One Irwin/APICS Library of Integrated Resource Management, Homewood, CA, USA, 1992, ISBN, 1-55623-603-4
3. Stuart Pugh, "**Tool Design – Integrated Methods for successful Product Engineering**", Addison Wesley Publishing, New York, NY, 1991, ISBN 0-202-41639-5.

QE8071 MATERIALS MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To understand the importance of materials management system and its concepts

OUTCOME:

- To introduce the concepts of materials management with the emphasis on the various material planning, purchasing policies, purchasing system and the concepts of materials management.

UNIT I INTRODUCTION 9

Introduction to materials management and productivity, functions, organization structures and role of material management. Materials and profitability and Profit center concept, Contribution to profits, policy manual, internal interface, External Environment, Centralized Purchasing, Decentralization, Delegations of powers.

UNIT II MATERIAL PLANNING 9

Material Planning, definition, influencing factors, use of standard deviation, Importance of materials Research, Advantages of MIS, Techniques of Materials Intelligence, Environment Conditions, Source of information, Materials requirement planning (MRP) and Manufacturing resource Planning (MRPII) ,Evolution to ERP and Distribution Requirements Planning (DRP), Pull systems.

UNIT III PURCHASING 9

Importance and objectives of good purchasing system, Prime and organizational functions, purchasing policy and procedures, responsibility and limitations, purchasing decisions, purchasing role in new product development, role of purchasing in cost reduction, negotiations and purchase, purchasing research: identification of right sources of supply, Vendor relation and selection, vendor rating and standardization, vendor certification plans, supply reliability, developing new source of supply.

UNIT IV COST REDUCTION 9

Cost control vs Cost reduction, price analysis, material cost reduction techniques, variety reduction, cost reduction and value improvement, material holding cost, Acquisition cost, Settlement of Bills, Accounting, Audit in Materials Management, Internal Audit, Operational Audit, techniques of cost control, cost effectiveness, cost analysis for material management, material flow cost control.

UNIT V INVENTORY MANAGEMENT 9

Inventory vs Stores, Functions and types of inventory, Types of inventory control, Handling Uncertainties and safety stock, inventory build-up, EOQ for various inventory models, inventory models with quantity discount, exchange curve concept, coverage analysis, optimal stocking policies, inventory management of perishable commodities, ABC-VED analysis, design of inventory distribution systems, spare parts inventory management, information systems for inventory management, cases studies.

TOTAL: 45 PERIODS

REFERENCES:

1. P. Gopalakrishnan, "**Purchasing and Materials Management**", 23rd Edition, Tata McGraw Hill, 2008.
2. J. R. Tony Arnold, Stephen N. Chapman, & Lloyd M. Clive, "**Introduction to Materials Management**", 7th Edition, Prentice Hall, 2011.
3. W. R. Stelzer, "**Materials Management**", PHI, 1979.
4. K. K. Ahuja, "**Materials Management**", CBS Publishers & Distributors, 2008.
5. Donald Waters, "**Inventory Control and Management**", John Wiley & Sons; 2nd Edition, 2003.
6. Ed C. Mercado, "**Hands-on Inventory Management (Series on Resource Management)**", Auerbach Publications, 2008.