Department of Mechanical Engineering

CURRICULUM AND SYLLABI

Master of Engineering (Advanced Manufacturing and Technology)

(For the students admitted during 2015 - 2016 and onwards)

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution affiliated to Anna University and Accredited by NBA)

CONTENTS

COIMBATORE INSTITUTE OF TECHNOLOGY

(Autonomous Institution Affiliated to Anna University Chennai)

DEPARTMENT OF MECHANICAL ENGINEERING

VISION AND MISSION OF THE INSTITUTE

Vision of CIT

The Institute strives to inculcate a sound knowledge in engineering along with realised social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena.

Mission of CIT

The Mission of CIT is to impart high quality education and training to its students to make them World-class engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large.

COIMBATORE INSTITUTE OF TECHNOLOGY
(Autonomous Institution Affiliated to Anna University Chennai)
DEPARTMENT OF MECHANICAL ENGINEERING

VISION AND MISSION OF DEPARTMENT OF MECHANICAL ENGINEERING

Vision of Department of Mechanical Engineering

The department aims to become one of the top ten mechanical engineering departments in the country within the next decade

Mission of Department of Mechanical Engineering

The mission of the department of mechanical engineering is to:

- Impart sound knowledge through effective teaching-learning methods
- Prepare students to address current and impending challenges facing the country
- Create and nurture an environment for fostering innovation and research

COIMBATORE INSTITUTE OF TECHNOLOGY
(Autonomous Institution Affiliated to Anna University Chennai)
DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) OF DEPARTMENT OF MECHANICAL ENGINEERING

The following Programme Educational Objectives are designed based on the Department Mission **to prepare the students to become graduates**

1. To build advanced-level technological capabilities required for undertaking successful professional practice in specialized engineering jobs, either at entry-level or at junior-levels, in the field of manufacturing.
2. To build higher-level domain knowledge needed for the pursuit of doctoral-level research work, or for seeking a career in academics with an aptitude for life-long learning.
3. To acquire and demonstrate successfully, capabilities in applied mathematics using scientific principles and fundamental concepts of manufacturing.
4. To carry out research, design, development, testing, analysis, evaluation, and implementation of engineering solutions to problems that are often encountered in professional practice.
5. To be effective innovators, entrepreneurs and collaborators, who can lead or participate in efforts to address social, ethical, technical and business challenges.

COIMBATORE INSTITUTE OF TECHNOLOGY
(Autonomous Institution Affiliated to Anna University Chennai)
DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAMME OUTCOMES (POs) OF DEPARTMENT OF MECHANICAL ENGINEERING

1. Acquire an overall understanding of global perspective which leads to analyze, synthesize and execute various practices by integrating technologies relevant to manufacturing.
2. Enhance creativity and synthesize new methods to analyze complex engineering problems and conduct research in diverse areas pertaining to manufacturing.
3. Ability to design and solve engineering problems to meet the desired needs without compromising on public health and safety while keeping the society and environment intact.
4. Ability to use appropriate research methodologies and tools through wide literature surveys and working towards scientific development.
5. Ability to use state of the art techniques, software resources and tools necessary for effective engineering research activities.
6. Ability to integrate multi-disciplinary areas for technology development by working individually or in teams.
7. An application of engineering and management principles, as a member or as a leader in a team, or as an entrepreneur to effectively manage real-time projects.
8. An ability to communicate effectively by preparing reports and documents to satisfy appropriate standards.
9. Ability to engage in a continuous lifelong learning with enthusiasm and dedication.
10. Realization of ethical and professional responsibilities for overall societal development.
11. Ability to teach effectively the basics and recent developments in manufacturing.

M.E. ADVANCED MANUFACTURING TECHNOLOGY
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI

SEMESTER - I

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	15MMA11	Probability and statistics	FC	4	4	0	0	4
2.	15MMA12	Optimization for Engineering Applications	PC	4	4	0	0	4
3.	15MMA13	Advanced Materials Engineering	PC	3	3	0	0	3
4.	15MMA14	Mechatronics in Manufacturing Systems	PC	3	3	0	0	3
5.		Elective - I	PE	3	3	0	0	3
6.		Elective - II	PE	3	3	0	0	3
7.	15MMA17	CIM and Mechatronics Laboratories	EEC	4	0	0	4	2
			TOTAL					22

II SEMESTER

SI. No	NEW COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	15MMA21	Advanced Operations Research	PC	4	4	0	0	4
2.	15MMA22	Design for Manufacture and Assembly	PC	4	4	0	0	4
3.	15MMA23	Computer Integrated Manufacturing	PC	3	3	0	0	3
4.	15MMA24	Advanced Metal Joining Processes	PC	3	3	0	0	3
5.		Elective - III	PE	3	3	0	0	3
6.		Elective - IV	PE	3	3	0	0	3
7.	15MMA27	Simulation and Welding Laboratories	EEC	4	0	0	4	2
			TOTAL					22

III SEMESTER

SI. No	NEW COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	15MMA31	Rapid Prototyping and Manufacturing	PC	3	3	0	0	3
2.	15MMA32	Advanced Metal Forming Technology	PC	3	3	0	0	3
3.		Elective - V	PE	3	3	0	0	3
4.	15MMA41	Project Phase – I	EEC	0	0	0	12	0
			TOTAL					9

IV SEMESTER

SI. No	NEW COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	15MMA41	Project Work Phase II	EEC	0	0	0	24	18
			TOTAL	0	0	0	24	18

TOTAL NO. OF CREDITS: 71

COIMBATORE INSTITUTE OF TECHNOLOGY
(Autonomous Institution Affiliated to Anna University Chennai)
DEPARTMENT OF MECHANICAL ENGINEERING

SUBJECT OF STUDY

Name of the Degree: M.E Advanced Manufacturing Technology (Part Time)

SEMESTER - I

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	15MMA11	Probability and statistics	FC	4	4	0	0	4
2.	15MMA12	Optimization for Engineering Applications	PC	4	4	0	0	4
3.	15MMA13	Advanced Materials Engineering	PC	3	3	0	0	3
4.	15MMA17	CIM and Mechatronics Laboratories	EEC	4	0	0	4	2
			TOTAL					13

SEMESTER - II

SI. No	NEW COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	15MMA21	Advanced Operations Research	PC	4	4	0	0	4
2.	15MMA22	Design for Manufacture and Assembly	PC	4	4	0	0	4
3.	15MMA23	Computer Integrated Manufacturing	PC	3	3	0	0	3
4.	15MMA27	Simulation and Welding Laboratories	EEC	4	0	0	4	2
			TOTAL					13

SEMESTER - III

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	15MMA14	Mechatronics in Manufacturing Systems	PC	3	3	0	0	3
2.		Elective - I	PE	3	3	0	0	3
3.		Elective - II	PE	3	3	0	0	3
			TOTAL					9

SEMESTER - IV

SI. No	NEW COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	15MMA24	Advanced Metal Joining Processes	PC	3	3	0	0	3
2.		Elective - III	PE	3	3	0	0	3
3.		Elective - IV	PE	3	3	0	0	3
			TOTAL					9

SEMESTER - V

SI. No	NEW COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	15MMA31	Rapid Prototyping and Manufacturing	PC	3	3	0	0	3
2.	15MMA32	Advanced Metal Forming Technology	PC	3	3	0	0	3
3.		Elective - V	PE	3	3	0	0	3
4.	15MMA41	Project Phase – I	EEC	0	0	0	12	0
			TOTAL					9

SEMESTER - VI

SI. No	NEW COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	15MMA41	Project Phase – II	EEC	0	0	0	24	18
			TOTAL CREDIT					18

TOTAL NO. OF CREDITS: 71

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	15MMA11	Probability and statistics	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	15MMA12	Optimization for Engineering Applications	PC	4	4	0	0	4
2.	15MMA13	Advanced Materials Engineering	PC	3	3	0	0	3
3.	15MMA14	Mechatronics in Manufacturing Systems	PC	3	3	0	0	3
4.	15MMA21	Advanced Operations Research	PC	4	4	0	0	4
5.	15MMA22	Design for Manufacture and Assembly	PC	4	4	0	0	4
6.	15MMA23	Computer Integrated Manufacturing	PC	3	3	0	0	3
7.	15MMA24	Advanced Metal Joining Processes	PC	3	3	0	0	3
8.	15MMA31	Rapid Prototyping and Manufacturing	PC	3	3	0	0	3
9.	15MMA32	Advanced Metal Forming Technology	PC	3	3	0	0	3

PROFESSIONAL ELECTIVES (PE)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	15MMAE01	Design of Advanced Hydraulic and Pneumatic system	PE	3	3	0	0	3
2.	15MMAE03	Manufacturing Information systems	PE	3	3	0	0	3
3.	15MMAE05	Flexible Competitive Manufacturing system	PE	3	3	0	0	3
4.	15MMAE06	Supply chain management	PE	3	3	0	0	3
5.	15MMAE07	Advanced Metrology and Non Destructive testing	PE	3	3	0	0	3
6.	15MMAE09	Supply chain Information system	PE	3	3	0	0	3
7.	15MMAE10	Design of cellular Manufacturing system	PE	3	3	0	0	3
8.	15MMAE11	Precision Engineering	PE	3	3	0	0	3
9.	15MMAE12	Reliability and Total Productive maintenance	PE	3	3	0	0	3
10.	15MMAE13	Advances in Casting and welding	PE	3	3	0	0	3
11.	15MMAE14	Information system analysis and design	PE	3	3	0	0	3
12.	15MMAE15	Computer Aided Process Planning	PE	3	3	0	0	3
13.	15MMAE16	Corrosion and Surface engineering	PE	3	3	0	0	3
14.	15MMAE17	Advanced tool engineering and design	PE	3	3	0	0	3
15.	15MMAE18	Plastics and Composite materials	PE	3	3	0	0	3
16.	15MMAE20	Advances in foundry technology	PE	3	3	0	0	3
17.	15MMAE21	Finite element analysis in manufacturing engineering	PE	3	3	0	0	3

18.	15MMAE22	Advanced Agile and lean manufacturing systems	PE	3	3	0	0	3
19.	15MMAE23	Advanced Biomaterials	PE	3	3	0	0	3
20.	15MMAE24	Concepts and Analysis of Robot Manipulators	PE	3	3	0	0	3
21.	15MMAE25	Smart Materials and Systems	PE	3	3	0	0	3
22.	15MMAE26	Ultrasonic and Applications	PE	3	3	0	0	3
23.	15MMAE27	Vibration Analysis and Control	PE	3	3	0	0	3
24.	15MMAE28	Design of Experiments and Taguchi Methods	PE	3	3	0	0	3
25.	15MMAE29	Metal Cutting Theory and Practice	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	15MMAE02	Industrial Robotics and Machine Vision	EEC	3	3	0	0	3
2.	15MMAE04	Advances in CNC systems	EEC	3	3	0	0	3
3.	15MMAE08	Productivity management and Re engineering	EEC	3	3	0	0	3
4.	15MMAE19	Total quality system and engineering	EEC	3	3	0	0	3
5.	15MCHE23	Risk Analysis, Assessment and Management	EEC	3	3	0	0	3
6.	15MMA17	CIM and Mechatronics Laboratories	EEC	4	0	0	4	2
7.	15MMA27	Simulation and Welding Laboratories	EEC	4	0	0	4	2
8.	15MMA41	Project Work Phase I	EEC	0	0	0	12	0
9.	15MMA41	Project Work Phase II	EEC	0	0	0	24	18

Semester - I Syllabus

15MMA11 PROBABILTY AND STATISTICS

4	0	0	4

ASSESSMENT: THEORY

OBJECTIVE

- The objective is to introduce the advanced Statistical skills required for Engineering students that are imperative for effective understanding of Engineering subjects. The topics introduced will serve as basic tools for specialized studies in many Engineering fields.

EXPECTED OUTCOME

CO1: Students will have an in-depth knowledge in the recent growth of statistic and, in particular, its applications to problems of engineering.

Co2: To enable an engineer to become much more effective in all phases of work relating to research, development, or production.

CO3: To understand phenomena subjects to variation and to effectively predict or control them.

PROBABILITY AND RANDOM VARIABLES

Probability and Random variables-Moments-Moment generating function-standard distributions-functions of random variables-Two dimensional random variables-Correlation and Regression. **(14)**

MARKOV CHAIN AND RELIABILITY

Markov chain-Transition Probabilities-Chapman-Kolmogrov equations-Limiting distributions-Concepts of Reliability-Hazard function-Series and Parallel Systems-Reliability and Hazard rate for exponential distribution-Markov analysis-Mean time to failure and mean time between failure-problems (related to them)

(12)

SAMPLING DISTRIBUTIONS AND TESTING OF HYPOTHESIS

Testing of hypothesis-Sampling distributions-Test based on Normal, t-distribution, chi-square and F-distribution-Analysis of Variance-One way and two way classifications**.** **(12)**

ANALYSIS OF VARIANCE

Design of experiments-Completely Randomized Design-Randomized Block Design-Latin Square Design-2 Factorial Design. **(12)**

TIME SERIES

Time series-characteristics and Representation-Moving averages –Exponential Smoothing-Auto Regressive processes. **(10)**

Total: 60

REFERENCES

1. *Fruend John, E. and Miller Irwin, "Probability and Statistics for Engineering" 5th edition. Prentice Hall (2005).*
2. *Jay, L. Devore, " Probability and Statistics for Engineering and Sciences", Brooks/Cole Publishing Company, Monterey California (2008)*
3. *Montgomery d.C and Johnson, L.A, "Forecasting and Time Series", McGraw-Hill (2005)*
4. *Anderson, O.D., "Time Series Analysis: Theroy and Practice", I. North-Holland, Amsterdam (1982).*
5. *Gupta, S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics". Sultan Chand and Sons, New Delhi (2000).*
6. *Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications, Prentice-Hall, Inc., Englewood Cliffs, New Jercy (2003)*

15MMA12 OPTIMIZATION FOR ENGINEERING APPLICATIONS

4	0	0	4

ASSESSMENT: THEORY

OBJECTIVE:

- To understand the major capabilities and limitations of deterministic operations research modeling as applied to problems in engineering applications.
- To recognize, formulate and to use prepared computer programs to solve linear and non- linear constrained/unconstrained problems.
- To understand the reasons why the applicable algorithms work and the effects on the computed solutions of variations in the data or in the assumptions underlying the models.

EXPECTED OUTCOME:

At the end of this course, students can demonstrate his

CO1: Mastery of the knowledge, techniques, skills and modern tools used in optimization.

CO2: Ability to apply current knowledge and adapt to emerging applications in engineering and technology.

CO3: Ability to conduct, analyze and interpret experiments and apply experimental results to improve processes.

CO4: Ability to apply creativity in the design of systems, components or processes appropriate to program objectives.

CO5: Ability to identify, analyze and solve technical problems.

CO6: Respect for diversity and knowledge of contemporary professional, societal and global issues.

INTRODUCTION

Engineering applications of Optimization - Statement of an Optimization problem - Classification of Optimization - Optimization Techniques. **(05)**

CLASSICAL OPTIMIZATION TECHNIQUES

Single-Variable Optimization - Multivariable Optimization with No constraints - Multivariable Optimization with Equality constraints - Method of Lagrange multipliers - Multivariable Optimization with Inequality constraints - Kuhn-Tucker conditions. **(10)**

LINEAR PROGRAMMING

Introduction - Standard form of a linear programming problem - Geometry of linear programming problems - Solution of a system of linear simultaneous equations - Simplex algorithm - Big M method - Two phase methods - Duality in linear programming - Applications of linear programming. **(10)**

NONLINEAR PROGRAMMING

Introduction - Unimodal function - Region elimination methods - Exhaustive search method - Fibonacci method - Golden search method - Gradient search method - Direct root methods - Hooke-Jeeves' method - Powell's method - Cauchy's steepest search method. **(10)**

NON TRADITIONAL OPTIMIZATION ALGORITHMS

Non Traditional Optimization - Multi objective optimization - Genetic algorithms and Simulated Annealing - Meta heuristics search techniques - Tabu search and Ant colony optimization - Computer programming for these algorithms. (10)

Total: 60

REFERENCES:

1. Singeresu S. Rao, "Engineering Optimization - Theory and Practice", New Age Intl. Ltd. Publishers, 2010.
2. Kalyanamoy Deb, "Optimization for Engineering Algorithms and Examples, Prentice Hall of India, 2011.
3. Joshi M.C., Moudgalya K.M. "Optimization", Narosa Publishing House (P) Ltd, 2005.
4. Johnson Ray. C., "Optimization Design of Mechanical Elements", Wiley, John & Sons, 1981.
5. Goldberg D.E., "Genetic Algorithms in Search, Optimization and Machine", Baren, Addison-Wesley, New York, 2004.

15MMA13 ADVANCED MATERIALS ENGINEERING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- To provide details about behavior of engineering materials and various strengthening procedures
- To gain knowledge about different modes of material fracture and procedure of failure analysis
- To know about properties, processing and applications of both latest metallic and non-metallic
- To acquire the essential knowledge about the selection of different latest materials for various applications.

EXPECTED OUTCOME

CO1: Upon completion of the course, the student will be able to get deep understanding on the principles of material selection as practiced in engineering manufacture and design and also on effective materials usage.

CO2: Can be able to identify service requirements and how to relate materials to those requirements.

INTRODUCTION

Elastic and plastic behavior –Elasticity in metals and polymers –Mechanism of plastic deformation, role of dislocation, yield stress, shear strength of perfect and real crystals –Strengthening mechanism ,work hardening, solid solution, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior -super plasticity –Deformation of non crystalline material. **(9)**

FRACTURE MECHANISM

Fracture behavior –Griffth's theory, stress intensity factor and fracture toughness-Toughening mechanisms – Ductile brittle transition in steel-High temperature fracture, creep-Larsen Miller parameter- Deformation and fracture mechanism maps-Fatigue low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law-Effect of surface and metallurgical parameters on fatigue- Fracture on non-metallic materials – Failure analysis, source of failure, procedure of failure analysis. (10**)**

MATERIAL SELECTION AND CASE STUDIES

Selection of materials –Motivation for selection, cost basis and service requirement –Selection of material properties, strength, toughness, fatigue and creep-Selection of surface durability corrosion and wear resistance – Relationship between material selection and processing –case studies in material selection with relevance to aero, auto, marine machinery and nuclear application **(9)**

MODERN METALLIC MATERIALS

Modern metallic materials-Dual phase steels , Micro alloyed, high strength low alloy (HLSA) steel, Transformation induced in plasticity (TRIP) steel, Maraging steel-Inter metallic Ni and Ti aluminides –Smart materials, shape memory alloys – Metallic glass-Quasi crystal and nano crystalline materials. (8**)**

NON METALLIC MATERIALS

Non metallic materials –polymeric materials –Formation of polymer structure –production techniques of fibre, foams, adhesives and coatings –structure, properties and application of engineering polymers – advanced structural ceramics, WC, TiC, TaC, Al_2O_3, SiC, Si_3N_4, CBN and diamond -properties, processing and application **(9)**

Total : 45

REFERENCES

1. *Thomas H. Courtney, "Mechanical behavior of materials", (2nd edition), McGraw-hill, 2000.*
2. *Charles J.A.Crane, F.A.A and Furness,J.A.G., "Selection and use of engineering materials", (3rd edition), Butterworth – Heiremann,1977.*
3. *Flinn,r.a and Trojan, P.K., "Engineering materials and their application",(6th edition),Jaico , 2000*
4. *George E.Dieter , "Mechanical metallurgy ", McGraw Hill,1988.*
5. *Metals hand book,vol.10"Failure analysis and prevention ", (10th edition),1994.*
6. *Kenneth G.Budinski., "Engineering materials: properties and selection ", 7th edition , prentice hall of India limited, New Delhi ,2005*

Web reference:

1. *www.astm.org/labs/pages/131350.htm*

15MMA13 MECHATRONICS IN MANUFACTRING SYSTEMS

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVES

- To provide basic knowledge about different types of sensors, controllers and actuators used in Mechatronics system.
- To gain knowledge in signal conditioning principles.
- To gain programming knowledge using microcontroller and PLC in manufacturing systems.

EXPECTED OUTCOME

CO1: The students should be capable to select suitable sensors, control methods and actuators for better manufacturing systems.

CO2: Capable to program using microcontroller and PLC.

CO3: Should be able to design effective Mechatronics system using advanced signal conditioning aspects

INTRODUCTION (**2)**

Mechatronics – key elements - integrated design issues in Mechatronics – design procedures for Mechatronics systems - advanced approaches in Mechatronics

SENSORS AND TRANSDUCERS **(6)**

Introduction to sensors and transducers –performance & characteristics of sensors - sensors for motion, position, force, torque, flow, temperature. Selection of sensors. – Problems – Modeling using MatLAB – simulink

SIGNAL CONDITIONING **(6)**

Signal conditioning – analog devices – op amp - inverting, non-inverting, comparator, differentiator, integrator - filtering – low, high and band pass filtering – wheat stone bridge. Quantization theory - DAC – ADC conversion. – problems - Modeling using MatLAB – Simulink

ACTUATORS **(8)**

Mechanical (self study), Hydraulics / pneumatics – actuating devices – DCVs, flow and pressure control systems – cascading circuits. Electrical – AC & DC motors – stepper motors. Selection of actuators, modeling of electromechanical systems, hydraulic – mechanical systems – problems - Modeling using MatLAB – Simulink

SIGNALS, SYSTEMS AND CONTROLS **(8)**

Modeling dynamic systems – first and second order systems – performance measures. Frequency response – sinusoidal input – root locus – bodo plots – stability – performance specifications. Controls –modes – proportional – derivative – integral – PID – digital controllers. – problems – matlab - simulink

MICROCONTROLLER **(6)**

Introduction to microcontroller: Architecture, programming, I/O, Computer interfacing, Programmable logic controller basics.

(4)

PROGRAMMABLE LOGIC CONTROLLER

PLC – basic structure – input/output processing, programming- mnemonics, timer, relay and counters, shift registers, master and jump controls data handling, analogue I/O, selection of PLC – Problems

(5)

APPLICATIONS IN MECHATRONICS

Sensors for condition monitoring, Mechatronics control for automated manufacturing, artificial intelligence in Mechatronics, fuzzy logic application in Mechatronics, micro sensors in Mechatronics - Modeling using MatLAB – simulink

Total: 45

TEXT BOOKS

1. Bolton.W Mechatronics - Electronic Control system in Mechanical and Electrical Engineering [Book]. - New Delhi : Pearson, 2012.
2. Histand Micheal B. and Alciatore David G. Introduction to Mechatronics and Measurement systems [Book]. - Singapore : Mc Graw Hill International Ed, 1999.
3. Microprocessors Principles and Applications by Gilmore. Tata McGraw hill second edition 2000

REFERENCE BOOKS

1. Isermann Rolf fundamentals, Mechatronic systems [Book]. - New Delhi : Springle International Edition, 2005.
2. Modern Control Engineering (5th Edition) by Katsuhiko Ogata.
3. Necsulescu Dan Mechatronics [Book]. - New Delhi : Pearsons, 2002.
4. Onwubolu Godfrey C Mechatronics principles and applications [Book]. - India: Elsevier, 2006.
5. Shetty Devdas and Kolk Richard A Mechatronics System Design [Book]. - New Delhi : Cengage Learning, 1997.

15MMAE21 FINITE ELEMENT ANALYSIS IN MANUFACTURING ENGINEERING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- To gain fundamental knowledge and techniques of FEM for solving boundary value problems and manufacturing process.
- To gain exposure to commercial FE analysis packages.

EXPECTED OUTCOME

On completion of the course the student will be able to

- CO1: Solve boundary value problems using classical as well as finite element methods.
- CO2: Demonstrate his/her ability in selection of appropriate elements.
- CO3: Understand various manufacturing processes with the application of finite element techniques.
- CO4: Solve simple practical problems using commercial FE analysis packages.

INTRODUCTION

Introduction –Basic of FEM – Initial value and boundary value problems – weighted residual Galerkin and Raleigh –Ritz methods – Review of variational formulation. **(6)**

1D ANALYSIS

One dimensional analysis – Steps in FEA – Discretization, interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing-one dimensional analysis in solid mechanics and heat transfer. **(10)**

2D ANALYSIS

Shape functions and higher order formulations – Global and Natural co-ordinates – Shape functions for one and two dimensional elements- three noded triangular and four noded quadrilateral element – non-linear analysis – Isoparametric elements – Jacobian matrices and transformations – basic of two dimensional axi-symmetric analysis**.** **(10)**

ANALYSIS OF PRODUCTION PROCESSES

Analysis of production processes-FEA of metal casting-Special considerations, latent heat incorporation, gap element-Time stepping procedures-Crank-Nicholson algorithm-Prediction of grain structure. Basic concepts of plasticity-Solid and flow formulation-Small incremental deformation formulation-FEA of metal cutting, chip seperation criteria, incorporation of strain rate dependency**.** **(10)**

COMPUTER IMPLEMENTATION IN FEA

Computer implementation-Preprocessing, Mesh-generation, element connecting, boundary conditions, input of material and processing characteristics-Solution and post processing-Overview of application packages such as ANSYS and Abaqus FEA. Development of code for one dimensional analysis and validation. **(9)**

Total: 45

REFERENCES:

1. Reddy, J.N. "An Introduction to Finite Element Method", McGraw-Hill, 2005.

2. Rao, S.S, "Finite Element Method in Engineering", Elsevier, 2012.

3. K. J. Bathe, "Finite Element Procedures", Cambridge, MA: Klaus-Jürgen Bathe, 2006

4. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T, "Metal forming and Finite Element Method" Oxford University Press, 1989.

5. Lewis R.W., Morgan K. Thomas, H.R. and Seetharaman K.N., "The Fintie Element Method in Heat Transfer Analysis", John Wiley, 1996.

6. Lars-Erik Lindgren., "Computational Weld Mechanics – Thermomechanical and microstructural simulations", Woodhead Publishing Ltd., Cambridge England, 2007.

7. P Seshu, "Textbook of Finite Element Analysis",PHI Learning Private Limited ,2003

WEB REFERENCES:

1. www.tbook.com

2. www.pollockeng.com

`

15MMAE06 SUPPLY CHAIN MANAGEMENT

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE:

This module is to provide a basic and a deeper understanding about supply chain management and the role of supply chain in an industry for meeting end user needs.
To provide a detailed knowledge on product and process management.
Focused to provide an insight of supply chain management from both industrial and end - user perspective.

EXPECTED OUTCOME:

CO1: Students are expected to understand the entire spectrum of activities undergone by manufacturers in meeting end-user needs.
CO2: Viewing from manufacturer's perspective, the aimed outcome of this module is to enhance innovative ideas in students, to effectively meet the end user needs.
CO3: To be able to solve industrial case studies in supply chain management.

INTRODUCTION
Supply Chain, Objectives & Stages, power of SCM – Process views of a supply chain– Strategic planning, Achieving a strategic fit in a supply chain and factors affecting the strategic fit – Value chain, supply chain flow lines - Product life cycle, Fishers classification of products – Effective and responsive supply chains (5)

SUPPLY CHAIN PROCESS
Forecasting in supply chain, characteristics, components, methods and approaches, collaborative forecasting – time series methods of forecasting- forecast error distribution order quantity and reorder point - Demand Management in MPC – MTS – ATO – MTO, customer order lead time – Postponement.
Lean – elements of lean, lean techniques, agility, leagility. Mapping business processes using lean. Supply chain process optimization. (9)

PRODUCT PROCUREMENT & INVENTORY MANAGEMENT
Procurement process – Sourcing in a supply chain – deciding factors for in-house or outsourcing – 3PL – 4 PL – Supplier selection and assessment - Inventory, economies of scale to exploit fixed costs, Economies of scale to exploit quantity discounts, Managing multi-echelon cycle inventory – Bullwhip effect
Safety inventory, Managing safety inventory practice – Product substitution. EOQ - Order Timing Decisions, safety stock, continuous distributions, probability of stocking out criterion, customer service criterion, time period correction factor. General inventory models, dynamic order quantity, deterministic and stochastic inventory models. (11)

DESIGNING A SUPPLY CHAIN
Supply chain drivers - Supply chain performance measures - SCOR Model - Network design in a supply chain, factors influencing design, Framework for network design network, models for facility location and capacity allocation - Uncertainty in network design – Discounted cash flow analysis, Decision trees in evaluating network design. Distribution, factors influencing distribution, design options for a distribution network. (10)

IT IN SUPPLY CHAIN

Dynamic supply chain design, Impact of technology on SCM, Key trends in SCM, IT in supply chain coordination, IT in supply chain design – MRP, record processing, technical issues, using MRP and system dynamics – ERP – Performance metrics – Functional Silo approach – Integrated supply chain metrics – cash to cash time – CRM – ISCM - Discussion on supply chain adopted by primary industrial sectors and case studies. (10)

Total: 45

REFERENCE BOOKS:

1. *Ayers, J., (2000), Hand Book of Supply Chain Management, The St Lencie Press/ APICS Series on Resource Management.*
2. *Burt, N.D., Dobler, W.D. and Starling, L.S. (2005), World Class Supply Chain Management, The Key to Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*
3. *Chopra, S., Meindl, P. and Kalra, D.V. (2008), Supply Chain Management, Strategy, Planning and Operation, Pearson Education, Inc.*
4. *Fredendall, D.L. and Hill, E.,(2001), Basics of Supply Chain Management, The St Lucie Press / APICS Series on Resource Management.*
5. *Monczka, R., Trent, R. and Handfield, R.(2007), Purchasing and Supply Chain Management, 3rd edition, Thompson Learning Inc.*
6. *Taha, H.A(2007), Operations research : An Introduction, Prentice Hall.*
7. *Vollmann, T.E., Berry, L.W,Whybark,D.C and Jacobs, R.F (2008), Manufacturing Planning and Control for Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*
8. *Wild, T.,(2002), Best Practice in Inventory Management, Butterworth – Heinmann, Elsevier Science Ltd.*

ADDITIONAL READING

1. *European Journal of Innovation Management*
2. *Logistics Information Management an International Journal*
3. *Supply Chain Management an International Journal*
4. *Sethi, P.S., Yan, H, and Zhang, H (2006), Inventory and Supply Chain Management with Forecast Updates, Springer International Series.*
5. *Mohantry, P.R and Deshmukh, G.S., (2005), Supply Chain Management, Theories and Practices, Published by Biztantra Innovations in Management.*
6. *Kulkarani, S and Sharma, A., (2008), Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*

15MMA17 CIM AND MECHATRONICS LABORATORIES

0	0	0	4

ASSESSMENT: PRACTICAL

CIM LAB

Computer Aided Drafting – Operating Systems – Wire Frame, Surface and Solid Modeling –Pro E Study - Helical Gear Solid Modeling using Pro-E – XL Mill CNC Milling [Projection] - Study of Profile Projector - Measurement of Thread Parameter Using Profile projector - Study of Co-ordinate Measuring Machine - XL Turn CNC Lathe [Turning, Facing, drilling and Contouring] –study of feed back milling machine(linear and circular interpoalation)- Manufacturing Simulation Using LEKIN Scheduling Software Package - Mini Project in LEKIN

EXPECTED OUTCOME

CO1: at the end of the course, the students will be able to design advanced modeling surface related techniques and apply them in a innovative complex applications.

CO2: They will be familiar with various transformations and manipulations in order to simulate and analyze for its functional performance.

CO3: They will be in a position to convert CAD models on computer into a product machined out on a CNC machine in the real time environment using the latest software.

MECHATRONICS LAB

OBJECTIVE

- To study the definition and elements of mechatronics system. To learn how to acquire and process real time signals by using sensors. To simulate various mathematical functions and also electronic devices.

EXPECTED OUTCOMES:

CO1: have a firm base of knowledge in areas of mathematics, and physics relevant to mechatronics, and be able to apply and extend this knowledge;

CO2: be able to integrate mechanical engineering with electronics and intelligent computer control in designing and manufacturing machines, products and processes

CO3: be able to function effectively on problem-solving teams and to coordinate and provide leadership for teams, including multidisciplinary teams

FIRST CLYCLE

1. Study of Mechatronics system Design
2. Introduction to Labview
3. Temperature control system using Labview
4. Design of Vehicle speed indicator using Labview
5. Measurement of Pressure using Load cell and Labview
6. Bio signal measurement and Analysis using Labview

SECOND CYCLE

1. Resistor simulation
2. Capacitor simulation
3. Simple Servo simulation
4. Simple pendulum Simulation
5. Matlab Simulation for performing simple mathematical functions
6. Matlab Simulation of four bar mechanism.

Semester II - Syllabus

15MMA21 ADVANCED OPERATIONS RESEARCH

4	0	0	4

ASSESSMENT: THEORY

OBJECTIVE:

This course on advanced operations research aims to provide an in-depth knowledge on different kinds of problems and its optimizing procedures. An understanding of capabilities and limitations of deterministic modeling as applied to problems in engineering applications, be and able to formulate, develop computer programs to solve linear and nonlinear constrained / unconstrained problems

EXPECTED OUTCOME:

At the end of this course, students can demonstrate

CO1: The mastery of the knowledge, techniques, skills and modern tools used in optimization.

CO2: Ability to apply this knowledge and to emerging applications in engineering and technology.

CO3: Ability to analyze and interpret experimental results and apply them to improve processes,

CO4: Ability to apply creativity in the design of systems, components or processes appropriate to program objectives.

CO5: Respect for diversity and knowledge of contemporary professional, societal and global issues.

GEOMETRIC PROGRAMMING

Introduction - Posynomial - Unconstrained Minimization Problem - Solution of an Unconstrained Geometric Programming using Differential Calculus - Solution of an Unconstrained Geometric Programming using Arithmetic Geometric Inequality - Primal-Dual Relationship and Sufficiency Conditions in the Unconstrained Case - Constrained Minimization - Solution of a Constrained Geometric Programming Problem - Primal and Dual Programs in the Case of less-than inequalities - Geometric Programming with Mixed Inequality Constraints - Complementary Geometric Programming - Applications of Geometric Programming. **(12)**

DYNAMIC PROGRAMMING

Introduction - Multistage Decision Processes - Concept of Sub optimization and Principle of Optimality - Computational Procedure in Dynamic Programming - Example Illustrating the Calculus Method of Solution - Example Illustrating the Tabular Method of Solution - Conversion of a Final Value Problem into an Initial Value Problem - Linear Programming as a Case of Dynamic Programming - Continuous Dynamic Programming - Additional Applications of Dynamic Programming. **(10)**

INTEGER PROGRAMMING

Introduction - Graphical Representation - Gomory's Cutting Plane Method - Bala's Algorithm for Zero-One Programming Problems - Integer Polynomial Programming - Brach-and-Bound Method - Sequential Linear Discrete Programming - Generalized Penalty Function Method. **(09)**

STOCHASTIC PROGRAMMING

Introduction - Basic Concepts of Probability Theory - Stochastic Linear Programming - Stochastic Nonlinear Programming - Stochastic Geometric Programming - Stochastic Dynamic Programming. **(09)**

SELECTED ALGORITHMS

Quadratic Programming - Separable Programming - Multi Objective Optimization - Game Theory - Optimal Control Theory - CPM and PERT. **(05)**

Total: 60

REFERENCES:

1. *Hamdy Taha, "Operations Research - An Introduction" Prentice Hall of India, 9 edition (P) Ltd 2010.*
2. *Singeresu S. Rao, "Engineering Optimization - Theory and Practice", New Age Intl. Ltd. Publishers, 2010*
3. *Rao S.S. "Optimization Theory and Applications" Wiley E stem Ltd, New Delhi, 2004.*
4. *Phillips, Ravindran, Solesberg, "Operations Research Principles and Practices", Prentice Hall of India, 2005.*

15MMA22 DESIGN FOR MANUFACTURE AND ASSEMBLY

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- To aid students involved in the manufacturing of commercial products to design them to be easily made.
- To enable students to take advantage of all the inherent cost benefits available in the manufacturing process which will be used.

EXPECTED OUTCOME

CO1: In manufacturing industries, the engineers would be benefited after having learnt the concepts of how the products are manufactured with right material selection and how they are assembled.

CO2: They would be able to apply the cost reduction techniques of forming design, casting design and welding structural design and solve technical problems related to the above field.

DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY:
DFM approach, DFM guidelines, standardization, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka- Yoke principle; 6σ concept; design creativity. (7)

TOLERANCEANALYSIS:
Process capability, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law. (7)

SELECTIVE ASSEMBLY:
Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples. (7)

DATUM SYSTEMS:
Degrees of freedom, grouped datum systems-different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pair and tongue-slot pair, computation of translational of translational and rotational accuracy, geometric analysis and applications. (8)

TRUE POSITION TOLERANCING THEORY:
Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerance, functional gauges, paper layout gauging, compound assembly, examples. (8)

FORM DESIGN OF CASTINGS AND WELDMENTS:

Redesign of castings based on parting line considerations, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining, datum features- functional and manufacturing, component design-machining considerations, redesign for manufacture, examples. (8)

Total: 60

TEXT BOOK:

1. Harry PECK, `Designing for Manufacture", Pitman Publications, London, 1993.

2. Matousek R, `Engineering Design- A Systematic Approach," Blackie and Son Ltd., London, 1974.

REFERENCES:

1. Spotts MF, `Dimensioning and Tolerance for Quantity Production," Prentice Hall Inc., New Jersey, 1983.

2. Oliver R Wade, `Tolerance Control in Design and Manufacturing," Industrial Press Inc New York, 1967.

3. James G Bralla,`Hand Book of Product Design for Manufacturing," McGraw Hill Publications, 1983.

4. Trucks H E, `Design for Economic Production," Society of Manufacturing Engineers, Michigan, Second Edition, 1987.

5. Poka-Yoke, `Improving Product Quality by Preventing Defects,` Society of Manufacturing Engineers, Michigan, Second Edition, 19873

6. Creveling C M,` Tolerance Design – A Hand Book for Developing Optimal Specifications," Addison Weseley Longman Inc., USA,1997.

7. Pahi G and Beitz W, `Engineering Design-Systematic Approach," Springer Verag Pub., 1996.

8. Dennis P Hobbs, `Lean Manufacturing Implementation: A CompletE Execution Manual for any Size Manufacturing", J Rose Publishing Inc., 2003.

9. Mamboed M Farag, ` Material Selection for Engineering Design," Prentice Hall, New Jersey, 1997.

15MMA23 COMPUTER INTEGRATED MANUFACTURING

3	**0**	**0**	**3**

ASSESSMENT: THEORY

OBJECTIVE:

This course will enable the student

• To gain knowledge on total manufacturing system at various levels of planning and manufacturing.

• To understand the different types of flexible manufacturing systems and to handle the product data and software used for manufacturing

EXPECTED OUTCOME

CO1: Get a wide knowledge in the field of process planning and various new concepts like GT,CAPP, FMS

CO2: Use the different functionalities like LAN, OSA models and different protocols related to Internet and Intranet for manufacturing of engineering components

INTRODUCTION

Origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - business and financial management **(8)**

GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. - cellular manufacturing systems. Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning – Types of CAPP. **(10)**

SHOP FLOOR CONTROL AND INTRODUCTION OF FMS

Shop floor control-phases -factory data collection system -automatic identification methods-Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation -material handling and storage systems- Information flow in Shop floor control systems. (**9)**

CIM IMPLEMENTATION AND DATA COMMUNICATION

CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture- CIM implementation software. Communication fundamentals- local area networks -topology -LAN implementations – network management and installations. (10)

OPEN SYSTEM AND DATABASE FOR CIM

Open systems - open system inter connection -manufacturing automations protocol and technical office protocol (MAP /TOP) Development of databases - Architecture of database systems - data modeling and data associations - relational data bases - database operators - advantages of data base and relational database. **(8)**

Total: 45

TEXT BOOK

1. Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2008.

REFERENCES

1. Yorem koren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.

2. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 2010.

3. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc 2008.

4. Roger Hanman "Computer Intergrated Manufacturing", Addison – Wesley, 1997.

5. Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., New Delhi-1, 2003.

6. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.

7. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.

15MMA24 ADVANCED METAL JOINING PROCESSES

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE:

- To provide knowledge about the principle and applications of latest welding processes
- To acquire essential significance of thermal effects of welding and subsequent remedial measures to reduce residual stresses and distortion in weldments.
- To gain knowledge about the Weldability of different commercially available materials, their corresponding weld joints design and automation of welding processes.

EXPECTED OUTCOME:

On the completion of this course the students can have the ability

CO 1: To select suitable welding process and technique to join a given material.
CO 2: To identify and minimize the distortion and residual stresses induced in weldments.
CO 3: To evolve better design for both static and fatigue loading conditions.
CO 4: To select suitable welding automation for the production of engineering components.

SPECIAL WELDING PROCESSES

Electron beam welding, laser beam welding, ultrasonic welding, explosion welding, electro slag and electro gas welding, cold pressure welding, Friction Stir welding, diffusion bonding and adhesive bonding. **(8)**

HEAT EFFECTS OF WELDING

Metallurgical effects of heat flow in welding-TTT curve- continuous cooling transformation diagrams-development of residual stress, methods of relieving or controlling welding residual stresses, types and control of distortion, pre-heat and post welding heat treatment. (**9)**

WELDABILITY OF FERROUS AND NON-FERROUS ALLOYS

Weldability of carbon and alloy steels, stainless steels, cast irons, copper and its alloys, aluminum and its alloys, titanium and its alloys, Ni and its alloys, weldability tests. **(10)**

WELDING DESIGN

Typical joints for different welding processes, principles of welding joint design and location of joint within the member, evolving good weld design, welding symbol- Blue print reading, welding design for static and fatigue loading, fracture toughness. **(9)**

AUTOMATION IN WELDING

Welding sequence and classification of processes, manual and semi-automatic, automatic, automated welding- adaptive controls- remote welding, robotic welding- selecting welding system, gravity welding and fire cracker welding, under water welding- wet and dry. **(9)**

Total: 45

TEXT BOOKS:

1. *Parmar.R.S," Welding Processes and technology", 3rd Edition, Khanna Publishers,2013.*

REFERENCES:

1. *Roa P.N. "Manufacturing Technology ", Tata McGraw -Hill, 2005.*
2. *Avitzur , "Metal Forming Processes and Analysis ", Tata McGraw - Hill ,2005.*
3. *Dieter, "Mechanical Metallurgy ", Tata McGraw - Hill, 2005.*
4. *Harris, J.N., "Mechanical working of Metals - Theory and Practice", Pergamon Press ,1995*
5. *Altan T., "Metal forming – Fundamentals and applications" , American Society of Metals, Metals park, 2003.*
6. *ASM Hand book, Forming and Forging, Ninth edition, Vol – 14, 2003*

Web Reference:

1. *www.kkai.com/matproc.html*

15MMA27 SIMULATION AND WELDING LABORATORIES

0	0	4	2

ASSESSMENT: PRACTICAL

OBJECTIVES

- To provide software simulation knowledge for various types of manufacturing systems.
- To make use of various software's for simulating and to evaluate and validate the systems, built by simulation.
- To provide exposure to the students on various welding processes and modeling welding processes

EXPECTED COURSE OUTCOME

On completion of the course, the students will have the ability

CO1: To simulate and validate any type of manufacturing systems and flexibly use suitable software.

CO2: To select suitable welding technique for the contemporary issues in manufacturing industries.

CO3: To model and optimize welding processes

SIMULATION LAB

Introduction to simulation languages- Simulation procedure-simulation of manufacturing systems-use of simulation software's – PROMODEL, ARENA, Pre Actor, CATIA.

WELDING LAB

1. MIG Welding of T-Joints
2. TIG Welding of Aluminium (Butt Joint)
3. Pulse TIG Welding of S.S. plates
4. Pulse TIG Welding of S.S. MS plates
5. MIG SS Cladding of structural Steel
6. Stelliting by TIG Welding
7. Stelliting by Plasma transformed Arc Welding
8. Measurements of Ferrite Content in Austenitic Stainless Steel Weldments
9. Corrosion Studies of weld components
    a. AC Impedence
    b. Cycle sweep
    c. Custom sweep
    d. Rest Potential
    e. Pitting Corrosion
    f. IGC

15MMAE03 MANUFACTURING INFORMATION SYSTEMS

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- The students will learn the production planning and control system, the databases required to handle records and their maintenance, various methods of collecting data from the shop floor in order to analyze and improve the performance of the manufacturing system.
- They also understand the importance of information system along with scheduling techniques for customer requirement. They are also exposed to different case studies.

EXPECTED OUTCOME

On the completion of this course the students can have the ability

CO1: To design the database using various models and approaches.
CO2: To maintain and analyze the database in manufacturing industries.
CO3: To solve the problems of sequencing and scheduling in the real time production shop floor.

INTRODUCTION

This subject has been introduced to the students with an idea to impart to the students the knowledge on various manufacturing activities such as Materials Requirement Planning and Manufacturing Resources Planning so that they get to know about the role of information and communication in product manufacture besides understanding the importance of data, database and database management system. They also learn about the various techniques used to collect data from the shop floor in a way to analyze the performance of manufacturing system. They are also introduced to the concept of Part Based Manufacturing Information System that is widely used in modern manufacturing industries.

PRODUCTION MANAGEMENT SYSTEM

Introduction - the evolution of order policies from MRP to MRP II, the role of production organization control. **(7)**

DATABASE

Database-Terminologies-Entities & Attributes - Data Models, Schema & Subschema-Data Independence-ER Diagram - Trends in Database **(7)**

DATABASE MANAGEMENT SYSTEMS AND MODELS

Designing database-Hierarchical Model-Network Approach-Relational Data Model-Concepts, Principles, Keys, Relational Operations-Functional Dependence-Normalization, Types - Query Languages. **(10)**

MANUFACTURING SHOP FLOOR CONTROL SYSTEM

Manufacturing Consideration-Product and its structure, Inventory and Process Flow-Shop Floor Control-Data Structure and Procedure-Various Model- Order Scheduling Module, Input/Output Analysis Module, Stock Database- IOM Database. **(11)**

MANUFACTURING INFORMATION SYSTEM

Information system for manufacturing- Parts Oriented Production Information System-Concepts and structure-Computerized Production Scheduling, Online Production Control System, Computer Based Production Management System-Case Study **(10)**

Total: 45

REFERENCES:

1. Luca G. Sartori,"Manufacturing Information Systems", Addision-Wesley Publishing Company, 2003.
2. Date.C.J, "An Introduction to Database Systems", Narosa Publishing House, 2004.
3. Orlicky.G, "Material Requirements Planning", McGraw-hill Publishing & Co., 2002.
4. Kerr.R, "Knowledge Based Manufacturing Management", Addison Wesley, 2003.

Web reference:

1.www.ist.psu.edu

15MMAE 09 SUPPLY CHAIN INFORMATION SYSTEMS

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE:

- To provide visibility about the role played by information system in supply chain enhancement.
- To provide a detailed knowledge about e-business and e-commerce application in real World supply chains.
- This subject is focused to develop knowledge & role of databases in SCM, along with the knowledge on future projected SC information system.

EXPECTED OUTCOME

CO1: Students will have better understanding on the integral relationship between supply chain and information system
CO2: Students will be able to project the role played by information in triggering the material flow, and the role played by different databases and Internet in processing supply chain.

INTRODUCTION

World Wide Web – Web search elements – Web fundamentals – new technologies and innovations – Security protocols – Networks and numbers – Zones and domain names - Packets and protocols – OSI reference model – Intranet and its applications – Types of client server architecture – Extranet. Role of IT in network design - forecasting – planning – transportation – sourcing – coordination. **(6)**

E -BUSINESS

e – Business – Evolution of e-business – Types of e-business– Benefits of e-business - Dimensions of e-business and e-com – e-business infrastructure – ERP system – Enterprise structure modeling (Oracle application)– CRM – Selling chain management – infrastructure of selling chain – e-business servers – client connectivity - e-business case studies – e-business relationships with the stake holders – Internal & Internet based requisition development (Access / SQL) **(10)**

E -COMMERCE

The concept of e-commerce - e-commerce activities – Advantages and issues of e-com – Building blocks of electronic commerce – e-commerce business models – Value chain in e-commerce – Electronic auctions - Forward, reverse & Internet Auction – Intermediary Oriented B2B – EDI - Business to Business (B2B)– Kaplan –Sawhney B2B matrix. **(9)**

APPLICATION OF E-COMMERCE

Features and challenges of B2B exchanges – Buyer oriented B2B – Supplier oriented B2B – Business to Consumer (B2C) –Online retailing vs traditional retailing – Product suitability for online retailing – Alternative models of e-retailing: Amazon vs Webvan – elements of successful B2C strategy – Marketing on the internet – Consumer to Business (C2B) - Consumer to Consumer (C2C) – Case studies on e-commerce – m – commerce. **(10)**

ADVANCED SUPPLY CHAIN INFORMATION SYSTEMS

SC information flows – A map of SCM Systems – Drivers of new SC systems & applications – ERP systems – E-sourcing/supply & web based systems– Types of systems – Reverse auctions – Evolving E-sourcing vendors - E-sourcing and fully integrated systems – Information visibility – Benefits of information visibility – e-supply chain fusion – The continuing evolution of E-Supply chains. **(10)**

Total: 45

REFERENCE BOOKS:

1. *Agarwala, N. K., Lal, A. and Agarwala, D. (2000), Business on the Net – An Introduction to the 'Whats' and 'Hows' of e-commerce, Macmillan India Ltd.*
2. *Awad, E.M. (2007), Electronic Commerce from Vision to Fulfillment, Prentice Hall India, 3rd Edition.*
3. *Burt, N.D., Dobler, W.D. and Starling, L.S. (2005), World Class Supply Chain Management, The Key to Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*
4. *Chakrabarti, R. and Kardile, V. (2002), The Asian Managers Handbook of e -commerce, McGraw Hill Publishing Company Limited.*
5. *Chopra, S., Meindl, P. and Kalra, D.V. (2008), Supply Chain Management, Strategy, Planning and Operation, Pearson Education, Inc.*
6. *Elsenpeter, C.R and Velte, J.T. (2001), E Business: A Beginner's Guide, Tata McGraw Hill Publishing Company Limited.*
7. *Gerald, B., King, N. and Natchek, D. (2006), ORACLE E –Business Suite Manufacturing & Supply Chain Management, Oracle Press, Tata McGraw Hill Publishing Company Limited.*
8. *Kalakota, R and Robinson M (2009), e-business 2.0, Roadmap for Success, Pearson Education, Inc*
9. *Monczka, R., Trent, R. and Handfield, R. (2007), Purchasing and Supply Chain Management, 3rd edition, Thompson Learning Inc.*

Semester III - Syllabus

15MMA31 RAPID PROTOTYPING AND MANUFACTURING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE:

- This module is to provide a detailed knowledge on advanced manufacturing techniques, the Rapid Prototyping and Rapid Manufacturing Process.
- To aid in understanding the need, types, application, method of operation and the future of Rapid Prototyping system in industrial application.
- Modulation is formulated to enhance innovative thinking and solve business case studies in RP / RM techniques.

EXPECTED OUTCOME

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

CO1: Have in-depth knowledge about RP/RM technologies along with recent trends in advanced manufacturing.

CO2: Understand quick response manufacturing and developing end to end solutions in product manufacture.

CO3: Develop innovative component and product designs using RP/RM technogies.

INTRODUCTION

Process requirements for Rapid Prototyping – Product Prototyping and Product Development – Prototyping - Need for Prototyping – Issues in Prototyping – Conducting Prototyping – Design Procedure – Prototype Planning and Management – Product and Prototype Cost Estimation – Fundamentals of Cost Concepts – Prototype Cost Estimation – Cost Complexities – Prototype Design Methods – Prototype Design tools – Morphological Analysis – Functional Efficiency Technique – Paper Prototyping – Selecting a Prototype – Learning from Nature. **(7)**

VIRTUAL PROTOTYPING, MATERIALS SELECTION & PROCEDURE FOR PROTOTYPING

Using Commercial Software for Virtual Prototyping – Prototyping Materials – Material Selection Methods – Rapid Prototyping Overview –Rapid Prototyping Cycle - Rapid Prototyping Procedure – STL files – Converting STL File from Various CAD Files – Controlling Part Accuracy in STL Format – Slicing the STL File – Case Studies in Design for Assembly. **(9)**

TYPES OF RAPID PROTOTYPING PROCESS

Types of RP Process – Stereolithography –- Fused Deposition Modelling – Selective Laser Sintering – 3D Printing Process — Laminated Object Manufacturing – Electron Beam Melting Process -– History - Operation – Advantages and Disadvantages – Applications - Relation to Other RP Technologies - (applies to all the process) - Direct Laser Deposition. **(10)**

APPLICATIONS OF RAPID PROTOTYPING

Investment Casting – Sand Casting – Permanent Mould Casting – Direct RP Tooling – Silicone Rubber Tooling – Investment Cast Tooling – Powder Metallurgy Tooling – Desktop Machining - Case Studies on Current Applications of RP- Novel Application of RP Systems - Future Trends of RP Systems. **(9)**

RAPID MANUFACTURING

Rapid Manufacturing – Potential of RM on Design – Geometrical Freedom – Material Combinations – Customer Input – RM of Prototypes – Reverse Engineering – Interactive CAD Models – Role of Materials in RM – Materials for RM Process – Product Customisation and Case Studies – Future Developments Serving RM – Production Economics of RM – Cost of Manufacture – Application of RM in Medical, Automotive, Aeronautical, Space and Construction Industries. **(10)**

Total: 45

TEXT BOOKS

1. *Cooper, G.K (2001), Rapid Prototyping Technology Selection and Application, Marcel Dekker Inc, USA.*
2. *Hopkinson, N., Hague, R.J.M, and Dickens, P.M.(2006), Rapid Manufacturing, An Industrial Revolution for the Digital Age, John Wiley & Sons, Ltd, UK*
3. *Liou, W.F (2008), Rapid Prototyping and Engineering Applications, A toolbox for prototype development, CRC Press, Taylor & Francis Group LLC, USA*
4. *Kai., C.C, Lim, C.S. and Leong, F.K. (2008), Rapid Prototyping: Principles and Applications in Manufacturing, Wiley Publication.*

REFERENCE BOOKS

1. *International Journal of Advanced Manufacturing Technology*
2. *Rapid Prototyping Journal*
3. *The RPD Magazine*
4. *The tct Magazine*
5. *Wohlers Report*
6. *www.rapitech.co.in/rpdmagazine*

15MMA32 ADVANCED METAL FORMING TECHNOLOGY

3	**0**	**0**	**3**

ASSESSMENT: THEORY

OBJECTIVE

An advanced course on metal forming technology gives a in-depth knowledge on

- Understanding the behaviour of engineering material under processing conditions through selection of currently used experimental methods.
- Metal forming operations and practices such as forming, rolling, forging, powder metallurgy.
- Learn the processes, technology and equipment used in the forming industry.
- Understand the capabilities and limitations of the above manufacturing processes and the guidelines for their selection.

EXPECTED OUTCOME

On completion of the course a student will be able to demonstrate the following

CO1: An appropriate mastery of the knowledge, techniques, skills and modern forming processes.
CO2: To apply current knowledge and adapt to emerging applications, engineering and technology.
CO3: To conduct, analyze and interpret experiments and apply experimental results to improve processes/
CO4: To apply the technologies of engineering materials, manufacturing processes, automation, production operations.

INTRODUCTION

Stress and strain - Three dimensional stress pattern - True stress and true strain - Principal stresses - Yield criteria - Von Mises criterian - Tresca's criterian - Von Mises Yield for plane strain problems - Coloumb function and sticking friction. **(8)**

FORGING

Forging - Forging in plane strain - Forging of circular disc - Effect of friction - Forging equipment - defects in forged products - Causes & Remedies. **(7)**

ROLLING AND EXTRUSION

Rolling and extrusion - Rolling of sheet and strip in plane strain conditions - Effect of friction - maximum draft , rolling load , torque and H.P - roll deflection - defect in rolled products - causes and remedies - forward and backward extrusion - Approximate extrusion loads - tube extrusion . (**10)**

DRAWING

Drawing - Rod and Wire drawing - Equilibrium equation - Strip drawing - tube drawing with mandrel - Effect of friction and cone angle - Defects in drawn parts. (**10)**

UNCONVENTIONAL FORMING METHODS

Unconventional forming - High energy rate forming - Explosive forming - Magnetic Pulse forming - Electro hydraulic forming - Super plasticity - Powder metallurgy - Techniques - Applications.

(10)

Total: 45

References:

1. *Roa P.N. "Manufacturing Technology ", Tata McGraw -Hill, 4th Edition, 2013..*
2. *Avitzur , "Metal Forming Processes and Analysis ", Tata McGraw - Hill ,2005.*
3. *Dieter, "Mechanical Metallurgy ", Tata McGraw - Hill, 2005.*
4. *Harris, J.N., "Mechanical working of Metals - Theory and Practice", Pergamon Press ,1995*
5. *Taylour Altan , Soo-IK-Oh and Harold L.Gegel ,"American Society for Metals " ,1983.*

Web Reference:

1. *www.kkai.com/matproc.html*

Elective - Syllabus

15MMAE01 DESIGN OF ADVANCED HYDRAULIC AND PNEUMATIC SYSTEMS | **3** | **0** | **0** | **3** |

ASSESSMENT: THEORY

OBJECTIVE:

- To gain knowledge on various hydraulics and pneumatics systems.
- To understand hydraulic and pneumatic circuits used in industries.
- To study the various actuators, control systems and its selection methods.

EXPECTED OUTCOME

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

CO1: develop simple and complex hydraulic and pneumatic systems for required applications.
CO2: select appropriate control systems for particular applications.
CO3: apply the concepts of pneumatic systems for any industrial projects.
CO4: demonstrate the robotic applications with the help of microprocessors and PLC's.

INTRODUCTION

Fluid Power - Hydraulic fluids - properties and selection. Pneumatic fluid – properties and selection. Advantages and Applications of Fluid Power. Fluid Power Industry. **(3)**

HYDRAULIC MOTORS AND PUMPS

Oil hydraulic systems-Hydraulic Power Generators-Selection and specification of pumps, pump characteristics. **(5)**

ACTUATORS AND CONTROL UNITS

Hydraulic actuators-Linear and Rotary Actuators- selection, specification and characteristics.
Control and regulation elements-Pressure, direction and flow control valves-relief valves, non return and safety valves-actuation systems. **(10)**

HYDRAULIC CIRCUITS

Hydraulic circuits-Reciprocation, quick return, sequencing, synchronizing circuits- accumulator circuits-industrial circuits- press circuits- hydraulic milling machine- grinding, planning, copying, forklift, earth mover circuits- design and selection of components- safety and emergency mandrels. **(9)**

PNEUMATICS – BASICS AND CIRCUITS

Pneumatic systems and circuits – Pneumatic fundamentals – control elements position and pressure sensing – logic circuits – switching circuits- fringe condition modules and these integration – sequential circuits – cascade methods – mapping methods – step counter method- compound circuit design – combination circuit design. **(9)**

COMBINED CIRCUITS

Installation, maintenance and special circuits – Pneumatic equipments – selection of components – design calculations- application – fault finding – hydro pneumatic circuits – use of microprocessors for sequencing – PLC, Low cost automation – Robotic circuits. **(9)**

Total: 45

References :

1. *Antony Espossito, "Fluid power with Applications", Prentice Hall,7th Edition, 2008.*
2. *Dudleyt, A.Pease and John J.Pippenger, "Basic Fluid Power ",Prentice Hall, 1987.*
3. *Andrew Parr, "Hydraulic and pneumatics" ,(HB), Jaico publishing House, 1999.*
4. *Bolton.W. "Pneumatic and Hydraulic Systems", Butterworth – Heinemann, 1997.*

Web References:

1. www.pneumatics.com
2. www.fluidpower.com.tw

15MMAE02 INDUSTRIAL ROBOTICS AND MACHINE VISION

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- To provide the advanced features of robots, its components and industrial applications of robotics.
- To give details about automation and machine vision.

EXPECTED OUTCOME

CO1: This module will potentially widen the understanding of students in robotics application, utilization of robotics in industry and escalates to the design of robotics system.
CO2: The knowledge obtained following this module will give a direct impact in e – manufacturing applications.
CO3: Improves the understanding of students in manufacturing automation and design optimization.

ROBOTICS AND ITS COMPONENTS

Robotics – Introduction–Basic Structure– Classification of robot and Robotic systems –laws of robotics – robot motions – work space, precision of movement. Drives and control systems: Hydraulic systems, power supply – servo valve – sump – hydraulic motor – DC servo motors – stepper motors – operation. Mechanical Components of Robots: Power transmission systems: Gear transmission. Belt drives, cables, Roller Chains, Link – Road Systems, Rotary to linear motion conversion, Ract and pinion drives, ball bearing screws, speed reducers, Harmonic drives. **(9)**

KINEMATICS OF ROBOT

Introduction, Matrix Representation, Homogeneous transformation, forward and inverse Kinematics, Inverse Kinematics Programming, Degeneracy, dexterity, velocity and static forces, velocity transformation force control systems, Basics of Trajectory planning. **(9)**

ROBOT END EFFECTORS

Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of Grippers – Vacuum cups – Magnetic Grippers – Adhesive Grippers–Robot end effector interface.
Sensors: Position sensors – Potentiometers, encoders – LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors, RCC, VOICE recognition and synthesizers. **(9)**

MACHINE VISION

Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization –Image definition, levels of Computation. Image processing Techniques: Data reduction – Windowing, digital conversion. Segmentation – Thresholding, Connectivity, Noise Reduction, Edge detection, Segmentation, Region growing and Region Splitting, Binary Morphology and grey morphology operations. **(9)**

FEATURE EXTRACTION

Geometry of curves – Curve approximation, Texture and texture analysis, Image resolution – Depth and volume, Color processing, Object recognition by features, Depth measurement, specialized lighting techniques. Segmentation using motion – Tracking. Image Data Compression, Real time Image processing, Application of Vision systems. (**9)**

Total:45

TEXT BOOKS

1. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)

2. Rafael C. Gonzalez, Richard E. Woods 'Digital Image Processing' Addition- Wesley Publishing Company, 2001.

REFERENCES

1. *M.P. Groover, Industrial Robotics – Technology, Programming and Applications, McGraw-Hill, USA, 2004.*

2. Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991.

3. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1997.

4. P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 2001.

15MMAE03 MANUFACTURING INFORMATION SYSTEMS

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- The students will learn the production planning and control system, the databases required to handle records and their maintenance, various methods of collecting data from the shop floor in order to analyze and improve the performance of the manufacturing system.
- They also understand the importance of information system along with scheduling techniques for customer requirement. They are also exposed to different case studies.

EXPECTED OUTCOME

On the completion of this course the students can have the ability

CO1: To design the database using various models and approaches.
CO2: To maintain and analyze the database in manufacturing industries.
CO3: To solve the problems of sequencing and scheduling in the real time production shop floor.

INTRODUCTION

This subject has been introduced to the students with an idea to impart to the students the knowledge on various manufacturing activities such as Materials Requirement Planning and Manufacturing Resources Planning so that they get to know about the role of information and communication in product manufacture besides understanding the importance of data, database and database management system. They also learn about the various techniques used to collect data from the shop floor in a way to analyze the performance of manufacturing system. They are also introduced to the concept of Part Based Manufacturing Information System that is widely used in modern manufacturing industries.

PRODUCTION MANAGEMENT SYSTEM

Introduction - the evolution of order policies from MRP to MRP II, the role of production organization control. **(7)**

DATABASE

Database-Terminologies-Entities & Attributes - Data Models, Schema & Subschema-Data Independence-ER Diagram - Trends in Database **(7)**

DATABASE MANAGEMENT SYSTEMS AND MODELS

Designing database-Hierarchical Model-Network Approach-Relational Data Model-Concepts, Principles, Keys, Relational Operations-Functional Dependence-Normalization, Types - Query Languages. **(10)**

MANUFACTURING SHOP FLOOR CONTROL SYSTEM

Manufacturing Consideration-Product and its structure, Inventory and Process Flow-Shop Floor Control-Data Structure and Procedure-Various Model- Order Scheduling Module, Input/Output Analysis Module, Stock Database- IOM Database. **(11)**

MANUFACTURING INFORMATION SYSTEM

Information system for manufacturing- Parts Oriented Production Information System-Concepts and structure-Computerized Production Scheduling, Online Production Control System, Computer Based Production Management System-Case Study **(10)**

Total: 45

REFERENCES:

1. Luca G. Sartori,"Manufacturing Information Systems", Addision-Wesley Publishing Company, 2003.
2. Date.C.J, "An Introduction to Database Systems", Narosa Publishing House, 2004.
3. Orlicky.G, "Material Requirements Planning", McGraw-hill Publishing & Co., 2002.
4. Kerr.R, "Knowledge Based Manufacturing Management", Addison Wesley, 2003.

Web reference:

1.www.ist.psu.edu

15MMAE04 ADVANCES IN CNC SYSTEMS

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE:

This Course will enable the student

- To learn the elements involved in CNC Machines and Mechanism for converting program of instructions to machine tool action
- To generate program using various techniques and study of special type CNC machines

EXPECTED OUTCOMES:

- The students would have understood the CNC and PLC programming techniques, the working of CNC machines and various commands used for 3D model building.
- They will be able to write programs for product manufacture on CNC machines.

INTRODUCTION

Classification – Construction details of CNC machines – machine structure, guideways, feed drives – spindle, measuring systems –Drivers and controls – Spindle drives, feed drives, D.C.drives - A.C.drives **(8)**

CNC SYSTEM

Introduction – Configuration of CNC system –interfacing – Monitoring – Diagnostics- Machine data – Compensations for machine accuracies – PLC programming – Adaptive control CNC systems. **(10)**

PROGRAMMING OF CNC MACHINES

Various programming techniques – APT – Programming for various machines in ISO and FANUC – CAM packages for CNC Machines such as Uni graphics, LDEAS, Pro-Engineer, CATIA, ESPIRIT, MASTERCAM, etc., (**12)**

TOOLING FOR CNC MACHINES

Interchangeable tooling system – present and qualified tools – coolant fed tooling system – Modular fixture – quick change system – Automatic head changers – tooling requirements for turning and machining centres – Tool assemblies – tool magazines –ATC mechanisms – tool management. (**8)**

SPECIAL TYPES OF CNC MACHINES

CNC grinding machines, EDM, Wire cut EDM, CNC Gear Hobbing machine – Installation, Maintenance-Testing and performance, Evaluation of CNC Machines (**7)**

Total: 45

REFERENCES:

1. *Radhakrishnan,P "Computer Numerical Control Machines", New Academic sciences limited, 2nd Revised Edition, 2014*
2. *Sehrawat,M.S and NarangJ.S "CNC Mchines", Dhanpat Rai and Co., 2008*
3. *"Mechatronics", HMT Ltd, TATA McGraw Hill, Publishing Company Ltd., 1998*
4. *Thyer,G.E "Computer Numerical Control of Machine Tools", B.H.Newberg,1991*
5. *Krar.S "CNC Technology and programming", McGraw Hill, 1990*
6. *Peter Smid, "CNC Programming Hand Book", Industries Press Inc, 2000*

15MMAE05 FLEXIBLE COMPETITIVE MANUFACTURING SYSTEM | **3** | **0** | **0** | **3** |

ASSESSMENT: THEORY

OBJECTIVE

This Course will enable the student

- To gather the information about Flexible manufacturing system concept in detail.
- To understand modern manufacturing methodology
- To learn the recent trends in Scheduling and Simulation

EXPECTED OUTCOME

CO1: The graduates will be able to implement the concepts of group technology, know the techniques of part family generation and improve the performance of manufacturing system.

CO2: Students will apply newer techniques in real time manufacturing environment methodologies in order to reduce total manufacturing lead time and down time in the production shop floor.

INTRODUCTION

Manufacturing in a competitive environment - Automation of manufacturing process – types of automation - material handling and movement - industrial robots - Sensor technology - flexible, fixturing - Design for assembly, disassembly and services. **(9)**

GROUP TECHNOLOGY AND CELL DESIGN

Group technology - Part families generation - classification and coding - Production flow analysis - Machine cell design – Benefits **(9)**

FLEXIBLE MANUFACTURING SYSTEM AND APPLICATIONS

Flexible Manufacturing System - Introduction - Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling – Knowledge based scheduling – Agile manufacturing. **(9)**

SOFTWARE INTEGRATION WITH FMS

Computer software, simulation and database of FMS - System issues - Types of software - specification and selection Trends - Application of simulation software - Manufacturing data system - data flow - CAD/CAM considerations - Planning FMS database. **(9)**

LEAN MANUFACTURING

Just in time - Characteristics of JIT – batch size concepts - work station loads - close supplier ties - flexible work force - line flow strategy. Total productive maintenance - Kanban system - strategic implications - implementation issues - MRD JIT - Lean manufacturing. **(9)**

Total : 45

References:

1. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice-Hall of India Pvt Ltd., New Delhi, 2010

2. Jha, N.K."Handbook of Flexible Manufacturing Systems",Academic Press Inc., 1991.

3. Kalpakjain, "Manufacturing Engineering and Technology", Addision-Wesley Publishing Co.1995.

4 Talichi Ohno, Toyoto, "Production System Beyond Large-Scale production", Productivity Press (India) Pvt Ltd.,1992.

15MMAE06 SUPPLY CHAIN MANAGEMENT

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE:

This module is to provide a basic and a deeper understanding about supply chain management and the role of supply chain in an industry for meeting end user needs.
To provide a detailed knowledge on product and process management.
Focused to provide an insight of supply chain management from both industrial and end - user perspective.

EXPECTED OUTCOME:

CO1: Students are expected to understand the entire spectrum of activities undergone by manufacturers in meeting end-user needs.
CO2: Viewing from manufacturer's perspective, the aimed outcome of this module is to enhance innovative ideas in students, to effectively meet the end user needs.
CO3: To be able to solve industrial case studies in supply chain management.

INTRODUCTION

Supply Chain, Objectives & Stages, power of SCM – Process views of a supply chain– Strategic planning, Achieving a strategic fit in a supply chain and factors affecting the strategic fit – Value chain, supply chain flow lines - Product life cycle, Fishers classification of products – Effective and responsive supply chains (5)

SUPPLY CHAIN PROCESS

Forecasting in supply chain, characteristics, components, methods and approaches, collaborative forecasting – time series methods of forecasting- forecast error distribution order quantity and reorder point - Demand Management in MPC – MTS – ATO – MTO, customer order lead time – Postponement.
Lean – elements of lean, lean techniques, agility, leagility. Mapping business processes using lean. Supply chain process optimization. (9)

PRODUCT PROCUREMENT & INVENTORY MANAGEMENT

Procurement process – Sourcing in a supply chain – deciding factors for in-house or outsourcing – 3PL – 4 PL – Supplier selection and assessment - Inventory, economies of scale to exploit fixed costs, Economies of scale to exploit quantity discounts, Managing multi-echelon cycle inventory – Bullwhip effect
Safety inventory, Managing safety inventory practice – Product substitution. EOQ - Order Timing Decisions, safety stock, continuous distributions, probability of stocking out criterion, customer service criterion, time period correction factor. General inventory models, dynamic order quantity, deterministic and stochastic inventory models. (11)

DESIGNING A SUPPLY CHAIN

Supply chain drivers - Supply chain performance measures - SCOR Model - Network design in a supply chain, factors influencing design, Framework for network design network, models for facility location and capacity allocation - Uncertainty in network design – Discounted cash flow analysis, Decision trees in evaluating network design. Distribution, factors influencing distribution, design options for a distribution network. (10)

IT IN SUPPLY CHAIN

Dynamic supply chain design, Impact of technology on SCM, Key trends in SCM, IT in supply chain coordination, IT in supply chain design – MRP, record processing, technical issues, using MRP and system dynamics – ERP – Performance metrics – Functional Silo approach – Integrated supply chain metrics – cash to cash time – CRM – ISCM - Discussion on supply chain adopted by primary industrial sectors and case studies. (10)

Total: 45

REFERENCE BOOKS:

9. *Ayers, J., (2000), Hand Book of Supply Chain Management, The St Lencie Press/ APICS Series on Resource Management.*
10. *Burt, N.D., Dobler, W.D. and Starling, L.S. (2005), World Class Supply Chain Management, The Key to Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*
11. *Chopra, S., Meindl, P. and Kalra, D.V. (2008), Supply Chain Management, Strategy, Planning and Operation, Pearson Education, Inc.*
12. *Fredendall, D.L. and Hill, E.,(2001), Basics of Supply Chain Management, The St Lucie Press / APICS Series on Resource Management.*
13. *Monczka, R., Trent, R. and Handfield, R.(2007), Purchasing and Supply Chain Management, 3rd edition, Thompson Learning Inc.*
14. *Taha, H.A(2007), Operations research : An Introduction, Prentice Hall.*
15. *Vollmann, T.E., Berry, L.W,Whybark,D.C and Jacobs, R.F (2008), Manufacturing Planning and Control for Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*
16. *Wild, T.,(2002), Best Practice in Inventory Management, Butterworth – Heinmann, Elsevier Science Ltd.*

ADDITIONAL READING

7. *European Journal of Innovation Management*
8. *Logistics Information Management an International Journal*
9. *Supply Chain Management an International Journal*
10. *Sethi, P.S., Yan, H, and Zhang, H (2006), Inventory and Supply Chain Management with Forecast Updates, Springer International Series.*
11. *Mohantry, P.R and Deshmukh, G.S., (2005), Supply Chain Management, Theories and Practices, Published by Biztantra Innovations in Management.*
12. *Kulkarani, S and Sharma, A., (2008), Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*

15MMAE07 ADVANCED METROLOGY AND NON DESTRUCTIVE TESTING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- To provide an insight for the need of quantifying the physical parameters and their techniques in evaluating them.
- To provide an insight to principles of latest metrological systems used in industries.
- To provide fundamental knowledge on non destructive testing methods.

EXPECTED OUTCOME

Upon successful completion of this course, students will be able to:
CO1: Demonstrate techniques used to quantify and comparison of products to required standards.
CO2: Conversant with the newer technologies used in metrology.
CO3: Design procedures which will incorporate quality in the product as per the customer's needs.
CO4: Demonstrate his or her knowledge in developing control mechanism to check variation in attributes and variables.
CO5: Select suitable ND testing method for the contemporary issues.

INTRODUCTION

Measuring Machines - Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Images shearing microscope- Use of computers- Machine vision technology - Microprocessors in metrology. **(9)**

STATISTIAL QUALITY CONTROL

Statistical Quality Control - Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - reliability and life testing. **(9)**

BASIC NDT TESTS

Liquid penetrants and magnetic particle tests - characteristics of liquid penetrants - different washable systems - Developers - applications - method of production of magnetic fields - Principles of operation of magnetic particle test - applications -Advantages and limitations. **(9)**

RADIOGRAPY

Radiography - Sources of ray - x- ray production - properties of d and x rays - film characteristics – exposure charts-contrasts-operational characteristics of x ray equipment - applications. **(9)**

ULTRASONIC TESTING METHODS

Ultrasonic and acoustic emission techniques - Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method -A, B, C scans -Principles of acoustics emission technique - Advantage and limitations - Instrumentation - applications. **(9)**

Total: 45

References:

1.Jain,R.K."Engineering Metrology ", Khanna Publishers, 2009.
2.Barry Hull and Vernon John ," Non Destructive Testing ", Mac Millan, 2009
3.American Society for Metals ,"Metals Hand Book ", Vol II ,1976.
4.Progress in Acoustics Emission, " Proceedings of 10th International Acoustics Emission Symposium ", Japanese Society for NDI,1990.

Web References:

1.www.metrologytooling.com
2.www.sisndt.com
3.www.iuk'tu-harburg.de

15MMAE08 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- To provide an understanding of production management and re-engineering concepts, their applications to manufacturing system. To deal with managerial, strategic and technological dimensions of productivity management and re-engineering. To understand the improvement tools and techniques, so as to deal with business challenges from a leadership and management perspective globally.

EXPECTED OUTCOME

CO1: Understand the approach and obligations of the professional systems analyst and the analogies between software and other branches of engineering.
CO2: Knowing the need for quality assurance, students apply in the industry with engineering standards like ISO 9000-2000
CO3: Use a variety of analysis and design techniques to document existing systems, to propose alternative new systems, and to specify required information systems
CO4: Able to produce the key deliverable's of the product life cycle.
CO5: Able to apply the project management tools.

INTRODUCTION

Introduction - Productivity concepts - Macro and Micro factors of productivity, Productivity benefit model, productivity cycle. (**5)**

PRODUCTIVITY MEASURES

Productivity Models - Productivity measurement at International, National and Organizational level, Total Productivity models. Productivity management in manufacturing and service sector. Productivity evaluation models, Productivity improvement models and techniques. (**12)**

ORGANIZATIONAL TRANSFORMATION AND REENGINEERING

Organizational Transformation - Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, DSMCQ and PMP model. (**8)**

PROCESS IMPROVEMENT

Re-engineering - Process Improvement Models, PMI models, Edosomwan model, Moen and Nolan strategy for process improvement, LMICIP model, NPRDC model. (**10)**

TOOLS AND TECHNIQUES

Re-engineering Tools and implementation - Analytical and process tools and techniques - Information and communication technology - Enabling role of IT, RE opportunities, process redesign - cases. Software methods in BPR - specification of BP, case study - Order, processing, user interfaces, maintainability and reusability. (**10)**

Total: 45

References:

1. Edosomwan, J.A., "Organisational transformation and process re-engineering", British Library cataloging in pub. data, 2005.
2. Sumanth, D.J., "Productivity engineering and management", Tata McGraw Hill, New Delhi, 1984.
3. Rastogi, P.N. "Re-engineering and Re-inventing the enterprise", Wheeler pub. New Delhi, 2006.
4. Premvrat, Sardana, G.D. and Shahay, B.S., "Productivity Management - A systems approach", Narosa Pub. New Delhi, 2007.
5. Lawrence Leemis. , "Reliability : Probabilistic models and Statistical methods", Prentice hall , 1995.

15MMAE 09 SUPPLY CHAIN INFORMATION SYSTEMS

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE:

- To provide visibility about the role played by information system in supply chain enhancement.
- To provide a detailed knowledge about e-business and e-commerce application in real World supply chains.
- This subject is focused to develop knowledge & role of databases in SCM, along with the knowledge on future projected SC information system.

EXPECTED OUTCOME

CO1: Students will have better understanding on the integral relationship between supply chain and information system

CO2: Students will be able to project the role played by information in triggering the material flow, and the role played by different databases and Internet in processing supply chain.

INTRODUCTION

World Wide Web – Web search elements – Web fundamentals – new technologies and innovations – Security protocols – Networks and numbers – Zones and domain names - Packets and protocols – OSI reference model – Intranet and its applications – Types of client server architecture – Extranet Role of IT in network design - forecasting – planning – transportation – sourcing – coordination. **(6)**

E -BUSINESS

e – Business – Evolution of e-business – Types of e-business– Benefits of e-business - Dimensions of e-business and e-com – e-business infrastructure – ERP system – Enterprise structure modeling (Oracle application)– CRM – Selling chain management – infrastructure of selling chain – e-business servers – client connectivity - e-business case studies – e-business relationships with the stake holders – Internal & Internet based requisition development (Access / SQL) **(10)**

E -COMMERCE

The concept of e-commerce - e-commerce activities – Advantages and issues of e-com – Building blocks of electronic commerce – e-commerce business models – Value chain in e-commerce – Electronic auctions - Forward, reverse & Internet Auction – Intermediary Oriented B2B – EDI - Business to Business (B2B)– Kaplan –Sawhney B2B matrix. **(9)**

APPLICATION OF E-COMMERCE

Features and challenges of B2B exchanges – Buyer oriented B2B – Supplier oriented B2B – Business to Consumer (B2C) –Online retailing vs traditional retailing – Product suitability for online retailing – Alternative models of e-retailing: Amazon vs Webvan – elements of successful B2C strategy – Marketing on the internet – Consumer to Business (C2B) - Consumer to Consumer (C2C) – Case studies on e-commerce – m – commerce. **(10)**

ADVANCED SUPPLY CHAIN INFORMATION SYSTEMS

SC information flows – A map of SCM Systems – Drivers of new SC systems & applications – ERP systems – E-sourcing/supply & web based systems– Types of systems – Reverse auctions – Evolving E-sourcing vendors - E-sourcing and fully integrated systems – Information visibility – Benefits of information visibility – e-supply chain fusion – The continuing evolution of E-Supply chains. **(10)**

Total: 45

REFERENCE BOOKS:

10. *Agarwala, N. K., Lal, A. and Agarwala, D. (2000), Business on the Net – An Introduction to the 'Whats' and 'Hows' of e-commerce, Macmillan India Ltd.*
11. *Awad, E.M. (2007), Electronic Commerce from Vision to Fulfillment, Prentice Hall India, 3rd Edition.*
12. *Burt, N.D., Dobler, W.D. and Starling, L.S. (2005), World Class Supply Chain Management, The Key to Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*
13. *Chakrabarti, R. and Kardile, V. (2002), The Asian Managers Handbook of e -commerce, McGraw Hill Publishing Company Limited.*
14. *Chopra, S., Meindl, P. and Kalra, D.V. (2008), Supply Chain Management, Strategy, Planning and Operation, Pearson Education, Inc.*
15. *Elsenpeter, C.R and Velte, J.T. (2001), E Business: A Beginner's Guide, Tata McGraw Hill Publishing Company Limited.*
16. *Gerald, B., King, N. and Natchek, D. (2006), ORACLE E –Business Suite Manufacturing & Supply Chain Management, Oracle Press, Tata McGraw Hill Publishing Company Limited.*
17. *Kalakota, R and Robinson M (2009), e-business 2.0, Roadmap for Success, Pearson Education, Inc*
18. *Monczka, R., Trent, R. and Handfield, R. (2007), Purchasing and Supply Chain Management, 3rd edition, Thompson Learning Inc.*

15MMAE10 DESIGN OF CELLULAR MANUFACTURING SYSTEM | **3** | **0** | **0** | **3** |

ASSESSMENT: THEORY

OBJECTIVE

This Course will enable the student

1. To learn various approaches involved in Cellular Manufacturing system.
2. To understand the design aspects of CMS
3. To Study about Machine Cell Layout and its performance in detail.

EXPECTED OUTCOME

CO1: The graduates would be able to identify the role of advanced manufacturing technology in improving the productivity, design a cellular manufacturing system and the suitable layout in a manufacturing organization whether big or small

CO2: They will be able to optimize various parameters using non-traditional techniques thereby reducing the total production cost.

INTRODUCTION

Introduction-Introduction of Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT. (**5)**

CELLULAR MANUFACTURING SYSTEM DESIGN AND APPROACH

CMS planning and design - Problems in GT/CMS - Design of CMS - Models , traditional approaches and non-traditional approaches - Genetic Algorithms, Simulated Annealing, Neural networks. (**12)**

MACHINE CELL LAYOUT

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

(**10)**

PERFORMANCE MEASUREMENT

Performance Measurement and Control - Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework. (**10)**

COMPARITIVE STUDIES

Economics of GT/CMS - Conventional Vs group use of computer models in GT/CMS, Human aspects of GT/CMS -cases. (**8)**

Total: 45

REFERENCES:

1. Burbidge, J.L., "Group Technology in Engineering Industry", Mechanical Engineering pub. London, 1979.

2. Askin, R.G. and Vakharia, A.J., "G.T - Planning and Operation in the automated factory" Hand Book: Technology and Management", Cleland, D.I. AND Bidananda, B(Eds), TAB Books, NY, 1991.

3. Irani, S.A,. "Cellular Manufacturing Systems Hand Book".

4. Kamrani, A.K. Parsaei, H.R. and Liles, D.H.(Eds), "planning, design and analysis of cellular manufacturing systems ", Elsevier, 1995.

15MMAE11 PRECISION ENGINEERING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- To understand the concepts of Nano technology and its applications.
- To study about the various machining techniques used in industries and to give first level introduction to micro machining techniques.

EXPECTED OUTCOME

CO1: On completion of course, the students will have perspective knowledge on latest trends in Nano field.
CO2: Able to apply various precision concepts of modern manufacturing systems for real life application.

INTRODUCTION

Concepts of accuracy-Introduction- Concepts of accuracy of machine tools –spindle and displacements accuracies –Accuracy of numerical control systems –Errors due to numerical interpolation – displacement measurement system and velocity lags **(9)**

DIMENSIONING AND TOLERRANCING

Geometric dimensioning and tolerancing –Tolerance zone conversions –Surfaces, features of size, datum features –datum, oddly configured and curved surfaces as datum features ,equalizing datum –datum features of size representation-form controls, orientation controls –logical approach to tolerance (**9)**

NANOTECHNOLOGY – AN INTRODUCTION

Fundamentals of nanotechnology and measuring–Processing system of nanometer accuracies–mechanism of metal processing–nano physical processing of atomic-bit-units nano chemical and electrochemical atomic-bit processing. IN processing in-situ measurement position of processing point –post process and on-machine measurement of dimensional feature and surface – Mechanical and optional measuring system. **(9)**

POSITIONING SYSTEMS

Nano-positioning systems of nanometer accuracy and repeatability –Guide systems for moving elements –Servo control systems for tool positioning –Computer aided digital and ultra precision position control **(9)**

MANUFACTURING METHODS

Application and future trends in nano technology –nano-Grating systems –Nano lithography, photolithography, and electron beam lithography –machining of soft materials, diamond turning , mirror grinding of ceramics – development of intelligent products –Nano processing of materials for super high density ICs-Nano-mechanical parts and micro nano machines. **(9)**

Total: 45

References:

1. *Murthy,R.L.," Precision Engineering in manufacturing ", Tata Mcgraw Hill (P) limited publishers ,2007.*
2. *James D.Meadows, "Geometric dimensioning and tolerancing ", Marcel Dekker Inc., 1995.*
3. *Norio Tanigichi,"Nano Technology", oxford university press, 2003.*

15MMAE12 RELIABILITY AND TOTAL PRODUCTIVE MAINTENANCE | **3** | **0** | **0** | **3** |

ASSESSMENT: THEORY

OBJECTIVE

- To study the reliability concepts, failure data analysis, reliability prediction and management and the concepts of total productive maintenance.
- To enable the students to understand the concepts of reliability and total productive maintenance and to make them apply these in the industries.

EXPECTED OUTCOME

CO1: Achieve a good understanding of the basic technologies as related to reliability and maintenance engineering, their scope and limitations.
CO2: Student should able to use the theories and methods that form the basis for these areas.

INTRODUCTION

Introduction - Reliability function - MTBF - MTTF - morality curve -availability - Maintainability. **(05)**

DISTRIBUTIVE FUNCTIONS

Failure Data Analysis - Repair time distributions - exponential, normal, log normal, gamma, and Weibull - reliability data requirements - Graphical evaluation. **(10)**

RELIABILITY PREDICTION

Reliability Prediction - Failure rate estimates - Effect of environment and stress - Series and Parallel systems - RDB analysis - Standby Systems - Complex Systems. **(10)**

RELIABILITY MANAGEMENT

Reliability Management - Reliability demonstration tests - Reliability growth testing - Duane curve - Risk assessment - FMEA, Fault tree - Reliability Improvement - Analysis of downtime - Repair time distribution - System repair time - Maintainability prediction - Measures of maintainability.

(**10)**

TOTAL PRODUCTIVE MAINTENANCE

Total Productive Maintenance - Causes of Machine Failures - Downtime - Maintenance policies - TPM pillars - Autonomous maintenance - Restorability predictions - Replacement models - Spares provisioning - Maintenance management - Cleanliness and House Keeping - TPM implementation. (**10)**

Total : 45

REFERENCES:

1. Paul Kales, "Reliability for technology, Engineering and Management", Prentice Hall, New Jersey, 2000.
2. Modarres, " Reliability and Risk analysis ", Meral Dekker Inc., 2005.
3. O'CONNOR, P.D.T', "Practical Reliability Engineering ", John Wiley-1994.
4. NAKAJIMA.S...,"Introduction to TPM - Total Productive Maintenance", Productivity Press-1995.
5. Gopalakrishnan.P, and Banerji A.K., "Maintenance and Spare Parts Management ", Prentice Hall of India, New Delhi, 2005.
6. Dhillon B.S., " Engineering maintainability: How to design for reliability and easy maintenance ", Prentice Hall of India, New Delhi, 2005.
7. Ebeling, " An Introduction to reliability and maintainability Engineering ", Waveland Pr Limited, 2nd Edition, 2009.

15MMAE13 ADVANCES IN CASTING AND WELDING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVES:

1. To provide knowledge about solidification of metals and corresponding design principles of casting.
2. To import principles and applications of latest casting processes
3. To gain knowledge about thermal effects of welding, Weldability of ferrous and non-ferrous metals, residual stresses in weldments, good weld joint design principles and latest welding processes.
4. To acquire latest knowledge about automation in casting and welding.

EXPECTED OUTCOME

CO1: The students will demonstrate the ability to analysis &design economical procedure of product development, incorporate environmental and social issue.
CO2: Acquire skills required to work in a multi-disciplinary environment.
CO3: Understand knowledge on emerging science of manufacturing principles& engage in lifelong learning process.

CASTING METALLURGY AND DESIGN
Casting metallurgy and design-Heat transfer between metal and mould-Solidification of pure metals and alloys-Shrinkage in cast metals-Progressive and directional solidification-Principles of gating and riser-Degasification of the melt-Design considerations in casting- Casting defects, Designing for directional solidification and minimum defects. (**9)**

SPECIAL CASTING PROCESS
Special casting process-Shell Moulding, precision investment casting, CO2, Moulding, centrifugal casting, Die casting and continuous casting. (**9)**

WELDING METALLURGY AND DESIGN
Welding metallurgy and design-Heat affected zone and its characteristics-Weldability of steels, Stainless steel, aluminium and Titanium alloys-Hydrogen embitterment-Lamellar tearing-Residual stress-Heat transfer and solidification-Analysis of stresses in welded structures-pre and post welding heat treatments-Weld joint design-Welding defects-testing of weldment. **(9)**

UNCONVENTIONAL AND SPECIAL WELDING PROCESSES
Unconventional and special welding processes-Friction welding-Explosive welding-Diffusion bonding-High frequency Induction welding-Ultrasonic welding-Electron beam welding-Laser beam welding.
(**9)**

RECENT ADVANCES IN CASTING AND WELDING
Recent advances in casting and welding-Layout of mechanized foundry-sand reclamation-Material handling in foundry-Pollution control in Foundry-Recent trends in casting-Computer Aided design of Castings, Low pressure die casting, Squeeze casting, full mould casting process. Automation in welding-Welding robots-Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.
(**9)**

Total: 45

Text Books

1. *Lal.M. and Khanna.O.P."A Text Books of foundry technology", DhanpatRai& Sons, 2012.*
2. *R S Parmer, "Welding Engineering Technology", Khanna publishers, 2nd Edition, 2008.*

References:

1. Jain p L, "Principles of Foundry Technology", Tata McGraw Hill, 2009.

2. "ASM metals Hand book on Casting"-Revised Edn, 1995.

5. Titoun.D. &Stepanov.Yu.A.,"Foundry Practice", MIR Publishers,Moscow, 2005.

6. Heine Loper& Rosenthal, "Principles of Metal Casting", Tata McGraw Hill, 2005.

7. Mukherjee,P.C., "Fundamentals of Metal casting Oxford"- IBH, 1979.

8.Iotrowski-"Robotic welding- a guide to selection and application"-Society of Mechanical Engineers. 1987.

9. Schwariz.M.M., "Source book on Innovative Welding Processes"-American society for metals(Ohio), 1981.

10. Cornu.J.,"Advanced Welding Systems"-Volumes I,II, and III, JAICO Publishers,1994.

11. Lancaster.J.F., "Metallurgy of welding"-George Allen & Unwind Publishers, 1980.

12. "Welding Handbook".(Section I) American Welding Society, 1986.

13. Kazakov.n.f.,"Diffusion bonding of materials", MIR Publishers, Moscow,1985.

15MMAE14 INFORMATION SYSTEMS ANALYSIS AND DESIGN | 3 | 0 | 0 | 3 |

ASSESSMENT: THEORY

OBJECTIVE

1. To study the computer based information system, management information systems, system development, quality, Knowledge based system and decision support system.
2. To enable the students to understand the concepts of information systems focuses on best practices, tools and models to implement an effective management system
3. The course emphasizes management skills such as planning, project management, quality and efficiency management in IS projects.

EXPECTED OUTCOME

CO1: The course would expose the students to acquire knowledge and understanding of various techniques in computerized information systemsin relation to management level decision making

CO2: Students can efficiently design and contribution to the management and development of new systems in an organization.

CO3: Students are expected to gain the knowledge of different types of Expert systems and their industrial applications in acquiring and predicting information related to manufacturing system

CO4: Students are able to understand the concept of quality, total quality management

COMPUTER BASED INFORMATION SYSTEM

Computer Based Information System - Concept of Information and system – system classification – the challenge of information system – computers and information processing – managing data resource – organizing data in a traditional file environment – a modern database environment – designing database

(7)

MANAGEMENT INFORMATION

Management information system – concepts – Design and implementation of MIS – Information system for decision making, types levels of decision making – MIS as a technique for making a programmed decisions – Decision – Assisting information systems – Conceptual Systems Design – Detailed System design

(10)

SYSTEM ANALYSIS AND DESIGN

Overview of system Development – System Analysis – System Design-completing the system development process - the traditional system life cycle – stages and limitations of life cycle approach – case study

(**10)**

QUALITY

Quality , Success and Services-traditional tool and methodologies for quality assurances- new approaches to quality – information system failure causes- the concept of implementation – controlling risk factor**.**

(10)

KNOWLEDGE BASED SYSTEMS

Knowledge – based systems- decision support systems- group DSS- ESS- artificial intelligence- expert system- other intelligent technique –neural network, genetic algorithm, fuzzy logic**.** **(8)**

Total: 45

REFERENCES:

1. *Kenneth C. Laudon and Jane P.Laudon,"Managemant Information systems", Prentice Hall of India Pvt., Ltd., 2007.*
2. *Robert G. Mudrick, Joel E.Ross and James R. Clagget, "Informetion system for modern Management", Prentice Hall of India, 2006*
3. *Davis . G.B., MIS, "Conceptual Foundation, Structure and Development" Mcgraw Hill Publishing, 2005*
4. *Chung.P.W.H and Lovegrove G., "Industrial Engineering Application of AI and expert systems", Gardon Breach Science publication,2006.*

WEB REFERENCES:

1. *www.dis.uniromal.it*

15MMAE15 COMPUTER AIDED PROCESS PLANNING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- To study the Process Planning concepts, Part Design Representation, Process engineering and planning and Computer Aided Process Planning Systems, Integrated Process Planning Systems, part family generation.
- To make them apply these in the industries, process planning sheet preparations.

EXPECTED OUTCOME

CO1: The graduates will adopt the process planning procedure after generating part families.
CO2: To adopt these techniques to improve the production efficiency.
CO3: They would be able to make use of certain CAPP related software packages in order to construct operation instruction sheet.
CO4: They also know the shortest way of executing machining techniques.

INTRODUCTION

Introduction - The Role of Process Planning in the manufacturing cycle - Process Planning and Production Planning - Process Planning and Concurrent Engineering, CAPP, Group Technology **(5)**

GROUP TECHNOLOGY

Part Design Representation - Design Drafting - Dimensioning - Conventional tolerancing - Geometric tolerancing - CAD - input/output devices - topology - Geometric transformation - Perspective transformation - Data Structure - Geometric modeling for process planning - GT coding - The OPITZ system - The MICLASS system- CODE system. **(10)**

PROCESS PLANNING

Process engineering and process planning - Experience based planning - Process capability analysis - Process Planning - Forward and Backward planning & scheduling, software for studying, Input format, AI. **(10)**

COMPUTER AIDED PROCESS PLANNING

Computer Aided Process Planning Systems - Logical Design of a Process Planning - Implementation considerations - manufacturing system components, production volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP. – Process planning Softwares. **(10)**

PROCESS PLAN SYSTEMS

An Integrated Process Planning Systems - Totally integrated process plans systems - An overview - Modulus structure - Data Structure, operation - Report generation, Expert Process Planning. **(10)**

Total: 45

TEXT BOOKS:

1. Gideon Halevi and Roland D.Weill," Principles of Process planning, A logical approach", Chapman Hall, 1995.
2. Tien - Chien Chang, Richard A.Wysk," An introduction to automated process planning systems ",Prentice Hall,1985
3. Chang, T.C.,"An Expert process planning system", Prentice Hall, 1985
4. Nanua singh, "Systems approach to Computer Integrated Design and Manufacturing", John Wiley & Sons,1996
5. Rao, " Computer Aided Manufacturing",Tata McGraw Hill Publising CO.,2000

WEB REFERENCE:

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

15MMAE16 CORROSION AND SURFACE ENGINEERING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVES

- To provide detailed knowledge about different types of corrosion mechanism, corrosion behavior of ferrous and non-ferrous materials and the factors that influence it.
- To gain knowledge about the standard corrosion testing procedure and corrosion prevention methods.
- To acquire properties and applications of various surface coating techniques

EXPECTED OUTCOME

CO1: The student is able to identify the possible type of corrosion that the selected material could be subjected to and the corresponding corrosion prevention measures to be adopted.
CO2: Knowing the corrosion and wear behavior of materials one could select suitable surface coating methods and effectively control the properties of coatings.

INTRODUCTION
Mechanisms and types of corrosion - Principles of direct and Electro chemical corrosion, Hydrogen evolution and oxygen absorption mechanisms – Galvanic corrosion, Galvanic series - specific types of corrosion such as, Uniform, Pitting, Inter granular, Cavitations, Crevice, Fretting, Erosion and Stress corrosion - Factors influencing Corrosion. **(10)**

TESTING METHODS
Testing and prevention of corrosion - Corrosion testing techniques and procedures - Prevention of corrosion - Design against corrosion - Modification of corrosive environment - Inhibitors - Cathodic protection - Protective surface coatings **(8)**

CORROSION OF MATERIALS
Corrosion Behavior of Materials - Corrosion of Steels, Stainless steels, Aluminium alloys, Copper alloys, Nickel alloys and Titanium alloys - Corrosion of polymers, Ceramics and composite materials **(8)**

SURFACE ENGINEERING
Surface engineering for wear and corrosion resistance - Diffusion coatings – Electro and Electroless plating - Hot dip coating - Hard facing - Metal spraying, Flame and Arc processes - Conversion coatings - Selection of coating for wear and corrosion resistance **(10)**

THIN LAYER ENGINEERING PROCESSES
Thin Layer Engineering Processes - Laser and Electron Beam hardening - Effect of process variables such as power and scan speed - Physical vapour deposition, thermal evaporation, Arc vapourisation, Sputtering, ion plating - Chemical vapour deposition - Coating of tools, TiC, TiN, Al2O3 and Diamond Coating properties and applications of thin coatings. **(9)**

Total: 45

TEXT BOOKS:

1. Fontana, G., " Corrosion Engineering ", McGraw-Hill, 1985.
2. Schweitzer P.A., " Corrosion Engineering Hand Book ", 3rd Edition. Marcel Decker, 1996.
3. Winston Revie, R,Uhlig's " Corrosion, Hand Book ", 2nd Edition, JohnWiley, 2000.
4. Kammeth G.Budinski, "Surface Engineering for Wear resistance ", Prentice Hall, 1988.
5. "Metals Handbook, Vol.5- Surface Engineering ", ASM International, 1996.

WEB REFERENCE:

1. www.hw.ac.uk/mecwww/research/an/coserg-2.htm

15MMAE17 ADVANCED TOOL ENGINEERING AND DESIGN

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE

- To enable the students to understand the analysis, planning, design, construction and application of tools, methods and procedures necessary to increase manufacturing productivity.
- To provide an exposure to the recent trends in the field of tool engineering.

EXPECTED OUTCOME

CO1: The students will be able to work on thermal related software's and its applications.
CO2: Students will be having in-depth knowledge on designing the machine tools.
CO3: Able to select proper tools for appropriate applications considering type of process.

MECHANISM OF CHIP FORMATION AND TYPES OF CHIPS

Mechanism of chip formation, Types of chip, techniques for the study of chip form formation, chip tool interface, built- up edge, chip breakers etc - problems. **(4)**

FORCES IN METAL CUTTING

Stress on the shear plane, Shear angle relationship in thin plane analysis. Minimum energy theory - stresses on the tool. Measurement of tool Forces - virtual tool dynamometers – evaluation of cutting forces, tool failures, work piece failure etc. with various real time problems **(5)**

THERMAL ASPECTS OF METAL CUTTING

Heat in metal cutting, Flow of heat, Methods of tool temperature measurement, significance of cutting tool temperature. Cutting fluids - Types and selection – evaluation of heat flow in both the tool and work piece. **(4)**

CUTTING TOOL MATERIAL AND TOOL WEAR

Cutting tool materials - classification, application, heat treatment. Mechanisms of tool wear, Tool failure, Methods of tool wear Measurement. Tool life, Machinability index, Tool life equations, Universal machinability index, Economics of turning. **(9)**

THERMAL ANALYSIS WITH CFD SOFTWARE

Introduction to CFD - various tools and techniques in CFD – various features of CFD – Applications of CFD – Comparisons of CFD with ANSYS and NISA – CFD in thermal analysis of metal cutting. **(5)**

JIGS & FIXTURES

Fundamental ideas and principles of Jigs and Fixtures. Design of drill jigs and fixtures for turning, drilling, milling, broaching and grinding operations. Locating and clamping devices of jigs and fixtures. Indexing devices and types. Different types of jigs & fixtures. Design of a jig and fixtures for the given component by using Computer Aided Design (CAD). **(9)**

PRESS TOOLS & ECONOMIC ASPECTS OF TOOLING

Dies, punches, types of presses, clearances, types of dies, strip layout, calculation of press capacity, center of pressure. Design consideration for die elements. Economics of tooling – Tool selection and tool replacement with respect to small tools. **(9)**

Total: 45

TEXT BOOKS:

1. Ranganath.Bj., "Tool Engineering Design:, Vikas publishing house pvt.ltd ,New delhi, , 2nd Edition, 2005.

2. ASTME "Fundamentals of Tool design:.prentice hall of India pvt. ltd., New delhi.5 edition, 1985.

3. Sharma. p.c.,"A Text Book of Production Engineerig" s.chand& co. ltd., New delhi,2005

4. Rodin .p., "Design and Production of cutting tools:, MIR publishers,1968.

5. Donaldson, "Tool Design Handbook", Mcgraw hill, new work,1976.

REFERENCES:

1. Amerego.E.J and Brown.R.H., "The Machining of Metals".Prentice hall, 1969.

2. ELBS "Principles of jig and Tool design: Published by English Universities Michigan,1969.

3. "P.S.G Design Data Book", PSG college of Technology, DPV printers, coimbatore, 2005.

4. Production Tooling Equipment - S.A.J.Parsons, published by Macmillan, 1966.

15MMAE18 PLASTICS AND COMPOSITE MATERIALS

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVES

- To import knowledge about different types of plastics and composites and their fabrication methods.
- To acquire details about the effects machining and joining parameters on its quality
- To gain knowledge about the different types of reinforcements and its corresponding fabrication methods of composites.

EXPECTED OUTCOME

CO1: The students can select suitable plastics and composite materials for the required applications and its corresponding fabrication method.
CO2: Can be able to identify service requirements and how to relate materials to those requirements.
CO3: The students will be able to identify the various properties of composites and plastics.

INTRODUCTION

Introduction – Chemistry and classification of Polymers – Properties of Thermo plastics Properties of Thermosetting plastics – Applications – Merits and Demerits. (**5)**

PLASTICS PROCESS

Processing of plastics – Extrusion – Injection Moulding -Blow Moulding – Compression And transfer Moulding – casting – Thermo Forming. Machining and joining of plastics – General Machining Properties of Plastics – Machining Parameters and their effect – joining of Plastics- Mechanical Fasteners – Thermal bonding – Press Fitting. (**17)**

COMPOSITE MATERIALS

Introduction to Composite Materials – Fibers – Glass, Boron , Carbon , Organic , Ceramic and Metallic Fibers – Matrix Materials – Polymers, Metals and Ceramics. **(5)**

POLYMER MATRIX COMPOSITES

Processing of Polymer Matrix Composites – Open Mould Processes, Bag Moulding, Compression Moulding With BMS and SMS - Filament winding – Pultrusion - Centrifugal Casting – Injection Moulding – Application of PMC`s **(9)**

METAL MATRIX COMPOSITES

Processing of metal matrix composites – Solid State Fabrication Techniques – Diffusion Bonding – Powder Metallurgy Techniques – Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fiber – Liquid State Fabrication Method – Infiltration – Squeeze Casting – Rheo Casting – Compocasting – Application of MMC`s. **(9)**

Total: 45

REFERENCE:

1. *Harold Belofsky, "Plastics: Product Design and Process Engineering", Hanser Publishers, 1995.*
2. *Bera, E and Moet, A, "High Performance Polymers", Hanser Publisners ,1991*
3. *Hensen.F, "Plastics Extrusion Technology", Hanser Publishers, 1988.*
4. *Johnnaber F, "Injection Moulding Machines", Hanser Publishesr, 1983.*
5. *Rauwendaal, C, "Polymer Extrusion", Hanser Publishers, 1990.*
6. *Rosatao,D.V., "Blow Moulding Handbook", Hanser Publishers, 1989.*
7. *A.K.B hargava, "Engineering Materials: Polymers, Ceramics and Composites", Prentice-Hall of India Limited, New Delhi, 2005.*

15MMAE19 TOTAL QUALITY SYSTEM AND ENGINEERING

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVE:

- This course aims at providing the concepts of TQM, SQC and Acceptance sampling.

EXPECTED OUTCOME

The students will be able to

CO1: Design a better system in manufacturing and implement the appropriate processes.
CO2: Apply the basic concepts of sampling problems in real world applications.
CO3: Demonstrate his ability in solving industrial problems using SQC methods.

PRINCIPLES OF TQM

Introduction - Principles of Quality Management - Pioneers of TQM - Quality costs - Quality system Customer Orientation - Benchmarking - Re-engineering - concurrent engineering. (9)

LEADERSHIP AND QUALITY AUDITING

Practices of TQM - leadership - organizational structure - Team building - Information systems and documentation - Quality Auditing - ISO 9000 - QS 9000. **(9)**

TQM TECHNIQUES

Techniques of TQM - Single vendor concept - JIT- Quality Function Deployment - Quality circles - KAIZEN - SGA - POKA - YOKE - Taguchi Methods. **(9)**

STATISTICAL QUALITY CONTROL

Statistical Quality control - Methods and Philosophy of Statistical process control - Control Charts for variables and Attributes - Cumulative sum and exponentially weighted moving average control charts - Other SPC Techniques - Process Capability Analysis - Six Sigma accuracy. **(9)**

SAMPLING

Acceptance sampling - Acceptance sampling problem - Single sampling Plans for attributes - double, multiple and sequential sampling, Military standards - The Dodge & Romig sampling plans. **(9)**

Total: 45

TEXT BOOKS:

1. Suresh Dalela and Saurabh, "ISO 9000 - A Manual for total Quality Management", S.Chand and company Ltd., 1997
2. John Bank, “The Essence of Total Quality Management", Prentice Hall of India Pvt. Ltd., 2nd Edition, 2001.

REFERENCES:

1. Mohamed Zairi, "Total Quality Management for Engineers", Woodhead Publising Limited 1991.
2.Harvid noori and russel, "Production and operations management - Total Quality and Responsiveness", McGraw-Hill Inc, 1995
3. Douglus C Montgomery,"Introduction to Statistical Quality Control", McGraw Hill, 1984
4. Grant E.L and Leavensworth, "Statistical Quality control", McGraw hill, 1984
5. Suganthi. L and Anand A Samuel, "Total Quality Management", Prentice - Hall of India, New Delhi, 2005.
6. Howard Gitlow, Alan Oppenheim and Proa Oppenheim, "Quality Management", McGraw-Hill Inc, 2005.
7. Dale H. Besterfield, and Etc, "Total Quality Management ", 3rd Edition, Pearson Education - Prentice Hall, 2007.

WEB REFERENCES:

1. www.ahepr.gov/research/feboo/0200ra15.htm.
2. www.mcb.co.uk/tam.htm

15MMAE20 ADVANCES IN FOUNDRY TECHNOLOGY

3	0	0	3

ASSESSMENT: THEORY

OBJECTIVES

- To know about the casting metallurgy and design aspects of moulding, gating and riser.
- To learn about the special casting processes and foundry mechanization.
- To understand about the computer applications in foundry technology.

EXPECTED OUTCOME

The students could be able to

CO1: Perform casting design with the acquired knowledge on runner, riser, gates materials and components for the desired product.

CO2: The students will be able to apply computer design for the casting and select suitable foundry technique for the desired product.

CO3: To design a better foundry layout in order to increase the productivity by implementing mechanization techniques and computers.

INTRODUCTION

Basics of casting techniques – Various aspects of advances inn foundry technology – Scope of the study **(1)**

CASTING METALLURGY AND DESIGN

Casting metallurgy & design - Solidification of pure metals and alloys - Fluidity- Shrinkage in cast metals - Absorption of gases - Degassing methods - Progressive solidification - Directional solidification - Hot spot & Junction - Design for moulding-Design for core support. (**9)**

PRINCIPLE OF GATING AND RISER

Principle of gating and riser - Improvement of yield efficiency - Simple problems in gating and risening for steels and cast irons **(9)**

SPECIAL CASTING PROCESSES

Special casting processes - Shell moulding, investment casting, Carbon - Dioxide moulding, Centrifugal casting, Die casting, Continous casting, Squeeze casting, Vaccum casting, Full mould processes, Semi-Solid metal casting,Thixocasting and Rheocasting process, Compo casting. **(11)**

FOUNDRY MECHANIZATION

Foundry mechanization – Layout of mechanized foundry – Sand reclamation – Material handling in foundry – Pollution control in foundry – Casting defects – Identification, Analysis and Remedies. **(9)**

COMPUTER AIDED DESIGN AND CASTINGS

Computer aided design and castings – Computer aided pattern making and use of rapid prototyping technology in foundry, Feeder design and solidification analysis, Gating design and mould filling analysis, Rapid tooling fabrication, Implementing rapid casting development technologies, Case study from industry. **(6)**

Total: 45

TEXT BOOKS:

1.Heine R W., Loper, C.R.Rosenthal, P.C.,"Principles of Metal Casting",Tata-McGraw Hill Publishing Co Ltd, New Delhi, 1995.

2.Jain P.L,"Principles of Foundry Technology", Tata McGraw Hill Publishing Co Ltd, New Delhi, 1995.

REFERENCES:

1. Jain "Principles of Foundry Technology", Tata Mc Graw Hill 3rd edition 2005.
2. "ASM Metals Hand book on Casting", Revised edition 1995.
3. Heine.R.W.Loper and Rosenthal "Principles of Metal Casting" Tata Mc Graw Hill, 1997.
4. Peter Beelay "Foundry Technology" Butterworth, Second edition, 2001.
5. Ravi.B "Metal Casting Computer aided Design and Analysis" Prentice Hall, 2005.
6. Srinivasan.N.K "Foundry Engineering" Khanna Tech pub co, New Delhi, 2000.

15MMAE21 FINITE ELEMENT ANALYSIS IN MANUFACTURING ENGINEERING | 3 | 2 | 0 | 4 |

ASSESSMENT: THEORY

OBJECTIVE

- To gain fundamental knowledge and techniques of FEM for solving boundary value problems and manufacturing process.
- To gain exposure to commercial FE analysis packages.

EXPECTED OUTCOME

CO1: On completion of the course the student will be able to,

CO2: Solve boundary value problems using classical as well as finite element methods.
CO3: Demonstrate his/her ability in selection of appropriate elements.
CO4: Understand various manufacturing processes with the application of finite element techniques.
CO5: Solve simple practical problems using commercial FE analysis packages.

INTRODUCTION

Introduction –Basic of FEM – Initial value and boundary value problems – weighted residual Galerkin and Raleigh –Ritz methods – Review of variational formulation. **(6)**

1D ANALYSIS

One dimensional analysis – Steps in FEA – Discretization, interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing-one dimensional analysis in solid mechanics and heat transfer. **(10)**

2D ANALYSIS

Shape functions and higher order formulations – Global and Natural co-ordinates – Shape functions for one and two dimensional elements- three noded triangular and four noded quadrilateral element – non-linear analysis – Isoparametric elements – Jacobian matrices and transformations – basic of two dimensional axi-symmetric analysis**.** **(10)**

ANALYSIS OF PRODUCTION PROCESSES

Analysis of production processes-FEA of metal casting-Special considerations, latent heat incorporation, gap element-Time stepping procedures-Crank-Nicholson algorithm-Prediction of grain structure. Basic concepts of plasticity-Solid and flow formulation-Small incremental deformation formulation-FEA of metal cutting, chip seperation criteria, incorporation of strain rate dependency**.** **(10)**

COMPUTER IMPLEMENTATION IN FEA

Computer implementation-Preprocessing, Mesh-generation, element connecting, boundary conditions, input of material and processing characteristics-Solution and post processing-Overview of application packages such as ANSYS and Abaqus FEA. Development of code for one dimensional analysis and validation. **(9)**

Total: 45

REFERENCES:

1. Reddy, J.N. "An Introduction to Finite Element Method", McGraw-Hill, 2005.

2. Rao, S.S, "Finite Element Method in Engineering", Elsevier, 2012.

3. K. J. Bathe, "Finite Element Procedures", Cambridge, MA: Klaus-Jürgen Bathe, 2006

4. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T, "Metal forming and Finite Element Method" Oxford University Press, 1989.

5. Lewis R.W., Morgan K. Thomas, H.R. and Seetharaman K.N., "The Fintie Element Method in Heat Transfer Analysis", John Wiley, 1996.

6. Lars-Erik Lindgren., "Computational Weld Mechanics – Thermomechanical and microstructural simulations", Woodhead Publishing Ltd., Cambridge England, 2007.

7. P Seshu, "Textbook of Finite Element Analysis",PHI Learning Private Limited ,2003

WEB REFERENCES:

1. www.tbook.com

2. www.pollockeng.com

15MMAE22 ADVANCED AGILE AND LEAN MANUFACTURING SYSTEM | 3 | 0 | 0 | 3 |

ASSESSMENT: THEORY

OBJECTIVE:

- This course is intended to teach the students about E manufacturing concepts i.e., use of IT in the manufacturing sector and advanced manufacturing systems like Lean manufacturing, Agile manufacturing etc.

EXPECTED OUTCOME

On completion of the course the student will be able to,

CO1: implement the concepts of E-manufacturing in the manufacturing industries.
CO2: decide the fundamental principle in transforming conventional manufacturing organisation into E-manufacturing systems.
CO3: apply the knowledge of various e-manufacturing technologies and their possible implementation.
CO4: identify the considerations and paradigms needed when selecting, evaluating, and adopting the E-manufacturing concept in the manufacturing industries.

INTRODUCTION

Introduction – Manufacturing operations – Manufacturing Industries and products – Manufacturing Support systems – E- manufacturing concept. **(5)**

MANUFACTURING STRATEGY

Manufacturing strategy and supply chain – Forecasting systems – Dimensions of manufacturing strategy – Supply chain management concepts – Aggregate planning – Single stage inventory control. **(12)**

LEAN MANUFACTURING

Lean Manufacturing – Principles of lean manufacturing – Lean flow- Two paths of implementing lean manufacturing – methodologies for change- environment for change – Pitfalls in implementing lean manufacturing. **(8)**

AGILE MANUFACTURING

Agile manufacturing – Meaning and definition of Agility – Force pulling towards Agility – Three consequences converging physical products, information and services – Empowerment -Enterprise Integration – Concurrent operations – Planning internal alignment of company – Role of strategic planning departments. **(10)**

E-MANUFACTURING

E-Manufacturing – Concepts of E-Manufacturing – Use of internet in manufacturing industries – E-business technology in manufacturing industry – Scope of applications - Implementation Methodology – Benefits of E-Manufacturing. **(10)**

Total: 45

References:

1. Mikell P. Groover., "Automation , Production systems and Computer – Integrated Manufacturing ", Pearson – Prentice Hall, 2007.

2. Ronald G.Askin, " Design and Analysis of Lean Production System ", John Wiley and sons, 2002 .

3. Bedwprth D D, " Integrated Production control systems Management,Analysis, Design ", John Wiley and sons, Newyork , 2002

4. Vollman T E ," Manufacturing Planning and control Systems", Galgotia publication , New Delhi ,1998.

5. Paul Kenneth wright , " 21st Century manufacturing" , Prentice hall , 2001

15MMAE24-Concepts and analysis on robot manipulators

3	0	0	3

Module 1: Introduction

Introduction -- brief history, basic of robot structure, types, classification and usage, science and technology of robots, degrees of freedom, Grubler's criterion, loop mobility criterion.

Module 2: Kinematics of serial robots

Position and orientation of a rigid body, types of transformations, transformation matrix, homogeneous transformations, and representation of joints, links representation- D-H parameters – Examples.

Direct and inverse kinematics problems - serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator. (9)

Module 3: Kinematics of parallel robots

Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-form and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform, screw theory. (9)

Module 4: Velocity and statics of robot manipulators

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough Stewart platform, Singularity analysis and statics. (9)

Module 5: Dynamics of serial and parallel robots

Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, Simulations using Matlab or ADAMS. (9)

Module 6: Motion planning and control

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators. (9)

Module 7: Advanced topics in robotics

Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's). (9)

References:

1 Robotics: Fundamental Concepts and Analysis, Oxford University Press Second reprint, May 2008
2 Foundations of Robotics- T. Yoshikawa, PHI
3 Parallel Robots- J. P. Merlet, 2nd ed. 2006, Springer
4 Introduction to Robotics-S. K. Saha, Tata McGraw Hill.
5. Robot Analysis: The Mechanics of Serial and Parallel Manipulators, Lung-Wen -Tsai, Wiley.

15MMAE25 SMART MATERIALS & SYSTEMS

3	0	0	3

COURSE OBJECTIVES: To gain fundamental knowledge on different types of smart materials and systems and to understand the applications of smart materials in various domains.

COURSE OUTCOMES: At the end of this course, the students will be able to
CO1: Demonstrate and analyze the various types of smart materials and systems.
CO2: Evaluate the characteristics of smart material with different domains.
CO3: Analyze and select a piezoelectric composite material according to the requirement.
CO4: Determine the characteristics of shape memory alloys.
CO5: Apply smart materials and systems to various real-world problems.

INTRODUCTION AND HISTORICAL PERSPECTIVE

Classes of materials and their usage – Intelligent /Smart materials – Evaluation of materials Science – Structural material – Functional materials – Polyfunctional materials – Generation of smart materials – Diverse areas of intelligent materials – Primitive functions of intelligent materials – Intelligent inherent in materials – Examples of intelligent materials, structural materials, Electrical materials, biocompatible materials etc. – Intelligent biological materials – Biomimetics – Wolff's law – Technological applications of Intelligent materials. (9)

SMART MATERIALS AND STRUCTURAL SYSTEMS

The principal ingredients of smart materials – Thermal materials – Sensing technologies – Micro sensors – Intelligent systems – Hybrid smart materials – An algorithm for synthesizing a smart material – Passive sensory smart structures– Reactive actuator based smart structures – Active sensing and reactive smart structures – Smart skins – Aero elastic tailoring of airfoils – Synthesis of future smart systems. (9)

ELECTRO-RHEOLOGICAL (FLUIDS) SMART MATERIALS

Suspensions and electro-rheological fluids – Bingham-body model – Newtonian viscosity and non-Newtonian viscosity – Principal characteristics of electro rheological fluids – The electrorheological phenomenon – Charge migration mechanism for the dispersed phase – Electrorheological fluid domain – Electrorheological fluid actuators – Electro-rheological fluid design parameter – Applications of Electrorheolgoical fluids. (9)

PIEZOELECTRIC SMART MATERIALS

Background – Electrostriction – Pyroelectricity – Piezoelectricity – Industrial piezoelectric materials – PZT – PVDF – PVDF film – Properties of commercial piezoelectric materials – Properties of piezoelectric film (explanation) – Smart materials featuring piezoelectric elements – smart composite laminate with embedded piezoelectric actuators – SAW filters. (9)

SHAPE – MEMORY (ALLOYS) SMART MATERIALS

Background on shape – memory alloys (SMA) Nickel – Titanium alloy (Nitinol) – Materials characteristics of Nitinol – Martensitic transformations – Austenitic transformations – Thermoelastic martensitic transformations – Cu based SMA, chiral materials – Applications of SMA – Continuum applications of SMA fastners – SMA fibers – reaction vessels, nuclear reactors, chemical plants, etc. – Micro robot actuated by SMA – SMA memorisation process (Satellite antenna applications) SMA blood clot filter – Impediments to applications of SMA – SMA plastics – primary molding – secondary molding – Potential applications of SMA plastics. (9)

REFERENCES:

1. M.V.Gandhi and B.S. Thompson, Smart Materials and Structures Chapman and Hall, London, First Edition, 1992
2. T.W. Deurig, K.N.Melton, D.Stockel and C.M.Wayman, Engineering aspects of Shape Memory alloys, Butterworth –Heinemann, 1990
3. C.A.Rogers, Smart Materials, Structures and Mathematical issues, Technomic Publising Co., USA, 1989.

15MMAE26 ULTRASONICS AND APPLICATIONS

3	0	0	3

COURSE OBJECTIVES:

To gain fundamental knowledge on ultrasonic transducers and determine the velocity of propagation and absorption in different mediums and to use this principle to solve various real life problems.

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO1: Demonstrate and analyze the various types of transducers and its components.
CO2: Evaluate the absorption of ultrasonic radiation in different domains.
CO3: Compute the propagation of ultrasonic waves in different medium.
CO4: Determine the velocity of propagation of ultrasound.
CO5: Apply ultrasonic principle to various real-world problems.

ULTRASONIC TRANSDUCERS

Piezoelectric and Magnetostrictive transducers - equivalent circuits – Efficiency - Transducer mounting Mechanical and Electronics, linear and sector transducers - variable frequency systems. (9)

ABSORPTION OF ULTRASONIC RADIATION

Classical absorption due to viscosity - Absorption due to thermal conductivity - Relaxation process - Evaluation of dispersion and absorption curves - structural relaxation - relation between collision frequency and relaxation time -
Ultrasonic attenuation in solids. (9)

ULTRASONIC PROPAGATION IN SOLIDS AND LIQUIDS

Propagation of Ultrasonic waves in solids - Plane wave propagation – Relation between velocity of sound and elastic properties - Adiabatic and Isothermal elastic constants - Ultrasonic propagation in liquids - Internal pressure and free volume calculations. (9)

DETERMINATION OF VELOCITY OF PROPAGATION OF ULTRASOUND

Transit time method - Pulse Echo methods - Acoustic Interferometry - Measurements at high pressure and high temperature - Transducer coupling materials. (9)

APPLICATION OF ULTRASONICS

Industrial applications - Medical Applications - Acoustic microscope - Acoustic hologram - ultrasonic transaxial tomography. (9)

REFERENCES:

1. G.L.Gooberman, Ultrasonics - Theory and Applications, - The English Universities Press Ltd., London, 1968.
2. Schreiber, Anderson and Soga, Elastic Constants and Their Measurement, Mc Graw Hill Book Co., New Delhi, 1973.
3. R.A.Lerski (Editor), Practical Ultrasound, IRL Press, Oxford,1988. 4. Robert T.Beyer and Stephen V. Letcher, Physical Ultrasonics, Academic Press, London, 1969.

15MMAE27 VIBRATION ANALYSIS AND CONTROL

3	0	0	3

COURSE OBJECTIVES:

To gain fundamental knowledge on vibration analysis for both single and multi-degreeof-freedom systems and to understand various vibration control methods.

COURSE OUTCOMES: At the end of this course, the students will be able to

CO1: Analyze a given physical problem and develop a simple mathematical model.
CO2: Simplify non-linear vibratory systems in order to analyze as linear problems.
CO3: Compute multi-degree freedom system and continuous system with different methods.
CO4: Determine overall response of a vibratory system based on initial conditions.
CO5: Apply vibration control mechanisms in real-world problems.

FUNDAMENTALS OF VIBRATION

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration- Review of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers -.Response To Arbitrary and non- harmonic Excitations – Transient Vibration – Impulse loads-Critical Speed of Shaft-Rotor systems. (9)

TWO DEGREE FREEDOM SYSTEM

Introduction-Free Vibration of Undamped and Damped- Forced Vibration with Harmonic Excitation System – Coordinate Couplings and Principal Coordinates (9)

MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method - Geared Systems-Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams (9)

VIBRATION CONTROL

Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active Vibration Control (9)

EXPERIMENTAL METHODS IN VIBRATION ANALYSIS

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. –Vibration Exciters-Mechanical, Hydraulic, Electromagnetic and Electrodynamics –Frequency Measuring Instruments-. System Identification from Frequency Response - Testing for resonance and mode shapes (9)

TEXT BOOK:

1. Rao, S.S.," Mechanical Vibrations," Addison Wesley Longman, 1995.
2. Thomson, W.T. – "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990

REFERENCES:

1. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.
2. S. Graham Kelly & Shashidar K. Kudari, "Mechanical Vibrations", Tata McGraw –Hill Publishing Com. Ltd New Delhi,2007