Syed Ammal Engineering College, Ramanathapuram

An Autonomous Institution & Affiliated to Anna University Chennai

Regulation 2024

Choice based Credit System

M.E. Manufacturing Engineering

Vision	Mission
To be an eminent center of excellence to produce engineers who could evolve as technocrats to serve the society	To accomplish the welfare of society through excellence in teaching, research and skills that exploits the rapidly changing technical diversity of mechanical engineering with a collaborative environment that stimulates staff and students to reach their highest potential through life-long learning.

S.No	Subject Area	Credits per Semester				Total Credits
		I	II	III	IV	
1	**FC**	4				4
2	**PCC**	14	18			32
3	**PEC**		6	9		15
4	**RMC**	2				2
6	**OEC**			3		3
7	**EEC**		1	6	12	19
	Non Credit Audit Course	1	1			0
	Total Credits	**21**	**23**	**19**	**12**	**75**

- FC - Foundation Courses
- PCC – Professional Course Core (Branch Compulsory Courses)
- PEC – Professional Elective Course (Branch Elective Course)
- RMC - Research Methodology and IPR Courses
- OEC – Open Elective Course (Elective Courses offered by other branches)
- EEC – Employability Enhancement Course (Communication lab, Project, Internship, Seminar, Case studies, Industrial training, Professional Practices)
- Audit Course – Non-credit course

SEMESTER 1

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	24MA002T	Applied Probability and Statistics for Manufacturing Engineering	FC	3	1	0	4	4
2.	24MF101T	Advances in Manufacturing Processes	PCC	3	0	0	3	3
3.	24MF102T	Advances in Casting and Welding	PCC	3	0	0	3	3
4.	24MF103T	Theory of Metal Cutting	PCC	3	0	0	3	3
5.	24MF104T	Computer Aided Manufacturing	PCC	3	0	0	3	3
6.	24RM101T	Research Methodology and IPR	RMC	2	0	0	2	2
PRACTICALS								
8.	24MF101P	CAD/CAM Laboratory	PCC	0	0	4	4	2
9.	24TM202P	Technical Seminar	EEC	0	0	2	2	1
			TOTAL	**19**	**1**	**6**	**26**	**21**

[$]Audit Course Level I is offered for NSS students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER 2

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	24MF201T	Optimization Techniques in Manufacturing	PCC	2	1	0	3	3
2.	24MF202T	Advances in Metrology and Inspection	PCC	3	0	0	3	3
3.	24MF203T	Theory of Metal Forming	PCC	3	0	0	3	3
4.	24MF204T	Additive Manufacturing	PCC	3	0	0	3	3
5.	24MF205T	Fluid Power Automation	PCC	3	0	0	3	3
6.		Professional Elective I	PEC	3	0	0	3	3
7.		Professional Elective II	PEC	3	0	0	3	3
PRACTICALS								
9.	24MF201P	Automation and Metal Forming Laboratory	PCC	0	0	3	3	1.5
10.	24MF202P	Advanced Manufacturing Processes Laboratory	PCC	0	0	3	3	1.5
TOTAL				**23**	**0**	**6**	**29**	**24**

[$]Audit Course Level II is offered for NSS students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

Total Credits: 45

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	24MA002T	Applied Probability and Statistics for Manufacturing	3	1	0	4	1

PROFESSIONAL CORE COURSES (PCC)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	24MF101T	Advances in Manufacturing Process	PCC	3	0	0	3	3
2.	24MF102T	Advances in Casting and Welding	PCC	3	0	0	3	3
3.	24MF103T	Theory of Metal Cutting	PCC	3	0	0	3	3
4.	24MF104T	Computer Aided Manufacturing	PCC	3	0	0	3	3
5.	24MF101P	CAD/CAM Laboratory	PCC	0	0	4	4	2
6.	24MF201T	Optimization Techniques in Manufacturing	PCC	3	1	0	3	4
7.	24MF202T	Advances in Metrology and Inspection	PCC	3	0	0	3	3
8.	24MF203T	Theory of Metal Forming	PCC	3	0	0	3	3
9.	24MF204T	Additive Manufacturing	PCC	3	0	0	3	3
10.	24MF205T	Fluid Power Automation	PCC	3	0	0	3	3
11.	24MF201P	Automation and MetalForming Laboratory	PCC	0	0	3	3	1.5
12.	24MF202P	Advanced Manufacturing Processes Laboratory	PCC	0	0	3	3	1.5

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	24RM101T	Research Methodology and IPR	2	0	0	2	1
TOTAL CREDITS						**2**	

PROFESSIONAL ELECTIVES FOR M.E. MANUFACTURING ENGINEERING

SEMESTER II, ELECTIVES - I & II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	24MF101E	Design for Manufacturing and Assembly	PEC	3	0	0	3	3
2.	24MF102E	Micro Manufacturing	PEC	3	0	0	3	3
3.	24MF103E	Quality and Reliability Engineering	PEC	3	0	0	3	3
4.	24MF104E	Finite Element Methods for Manufacturing Engineering	PEC	3	0	0	3	3
5.	24MF105E	Materials Management	PEC	3	0	0	3	3
6.	24MF106E	Industrial Ergonomics	PEC	3	0	0	3	3
7.	24MF107E	Polymers and Composite Materials	PEC	3	0	0	3	3
8.	24MF108E	Non Destructive Testing	PEC	3	0	0	3	3
9.	24MF109E	Lean Manufacturing	PEC	3	0	0	3	3
10.	24MF110E	Robot Design and Programming	PEC	3	0	0	3	3
11.	24MF111E	MEMS and Nanotechnology	PEC	3	0	0	3	3
12.	24MF112E	Green Manufacturing	PEC	3	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	24TM202P	Technical Seminar	0	0	2	1	1

SEMESTER I

24MA002T	**APPLIED PROBABILITY AND STATISTICS FOR MANUFACTURING ENGINEERING**	**L T P C** **3 1 0 4**

COURSE OBJECTIVES:

- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables.
- To apply the small and large sample tests through test of hypothesis.
- To understand the basic concepts of sampling distributions and statistical properties of point estimators.
- To understand the concept of analysis of variance and use it to investigate factorial dependence

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III TESTING OF HYPOTHESIS 12

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions — Tests for independence of attributes and goodness of fit.

UNIT IV ESTIMATION THEORY 12

Interval estimation for population mean - Standard deviation - Difference in means, proportion ratio of standard deviations and variances.

UNIT V DESIGN OF EXPERIMENTS 12

Completely randomized design – Randomized block design – Latin square design – 2^2 Factorial designs.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- Analyze the performance in terms of probabilities and distributions achieved by the determined solutions.

- Be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.
- Apply the basic principles underlying statistical inference(hypothesis testing).
- Demonstrate knowledge of applicable large sample theory of estimators and tests.
- Obtain a better understanding of the importance of the methods in modern industrial processes

REFERENCES :

1. Devore,J.L.,"Probability and Statistics for Engineering and Sciences", 8th Edition, Cengage Learning, 2014.
2. Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", 12th Edition, Sultan and Sons, New Delhi, 2020.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education, Asia, 2016.
4. Rice, J. A., "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.
5. Ross, S. M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.

CO-PO Mapping

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	2	-	-	-	-	2
2	-	-	-	-	-	-
3	2	-	-	-	1	2
4	-	-	3	1	-	-
5	-	-	3	-	-	2
Avg.	2	-	3	1	1	2

24MF101T ADVANCES IN MANUFACTURING PROCESSES

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.
- To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations.
- To impart knowledge about principles and criteria of yielding during forming of metals, analysis of different bulk metal forming processes following different analysis approach.
- To give awareness of different techniques used in Micro and Nano manufacturing.
- To introduce students the basics of /rapid prototyping and its applications in various fields, reverse engineering techniques.

UNIT I ENERGY ASSISTED MANUFACTURING PROCESSES 9

Introduction – mechanism of materials removal and operating parameters of: Plasma Arc Machining – Laser Beam Machining – Electron Beam Machining – Electrical Discharge Machining – Ultrasonic Machining – Water Jet Machining – Abrasive water jet Machining – Abrasive jet Machining – Ion Beam Machining.

UNIT II PRECISION MACHINING 9

Electro chemical Machining- Ultra Precision turning and grinding- Chemical Mechanical Polishing (CMP) - ELID process — Partial ductile mode grinding-Ultra precision grinding- Binderless wheel — Free form optics. aspherical surface generation Grinding wheel- Design and selection of grinding wheel- High-speed grinding- High-speed milling- Diamond turning.

UNIT III ADVANCES IN METAL FORMING 9

Orbital forging, Isothermal forging, Warm forging, Overview of Powder Metal techniques –Hot and Cold isostatic pressing - high speed extrusion, rubber pad forming, Hydroforming, Superplastic forming, Peen forming-micro blanking –Powder rolling — Tooling and process parameters.

UNIT IV MICRO MACHININING AND NANO FABRICATION 9

Theory of micromachining – Micromachining Processes – Micro-milling – Micro-drilling – Micro-turning – Micro-grinding — Micro-polishing — Principle of Micro EDM — Micro wire EDM — Planetary Micro EDM — Reverse Micro EDM – Advantages, Challenges. Nano fabrication process - Nano machining techniques – Top / Bottom up Nano fabrication techniques - Sub micron lithographic technique, conventional film growth technique, Chemical etching, Quantum dot fabrication techniques – MOCVD – Epitaxy techniques.

UNIT V RAPID PROTOTYPING AND SURFACE MODIFICATION TECHNIQUES 9

Introduction – Classification – Principle advantages limitations and applications- Rapid Prototyping - Rapid Manufacturing - Rapid Tooling and Future Rapid Prototyping Processes -Stereolithography (SLA) — 3D Printing (3DP) — Selective Laser Sintering (SLS) — Laminated Object Manufacturing (LOM) — Fused Deposition Modelling (FDM) Introduction, Process descriptions, Materials, process variations, economic considerations, applications, design aspects and quality issues — CVD — PVD — Electroplating — Hot Dip Coating — Thermal Spraying.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials.
- Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.
- Analyze the different bulk metal forming process mechanics using different analysis
- Acquire the knowledge in mechanical micromachining processes.
- Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping Technologies

REFERENCES

1. Benedict,G.F.,"Non Traditional manufacturing Processes",CRC press,2011
2. Madou, M.J., Fundamentals of Micro fabrication: The Science of Miniaturization, Second Edition, CRC Press (ISBN: 0849308267),2006
3. McGeough,J.A.,"Advanced methods of Machining",Springer,2011
4. Narayanaswamy, R., Theory of Metal Forming Plasticity, Narosa Publishers,2000.
5. Pandey, P.S. and Shah.N., "Modern Manufacturing Processes", Tata McGraw Hill, 2017.
6. Serope Kalpakjian., "Manufacturing Engineering and Technology" Pearson Education,2018

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	-	-	-	-	-
2	-	-	-	-	2	-
3	-	-	3	-	-	2
4	1	-	-	-	2	-
5	-	-	-	1	-	-
Avg.	1	-	3	1	2	2

24MF102T	ADVANCES IN CASTING AND WELDING	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To study the metallurgical concepts and applications of casting and welding process.
- To acquire knowledge in CAD of casting and automation of the welding process.
- To know various solid state and special welding processes.
- To introduce metallurgy of welding.
- To design the weldments for various materials. To gain knowledge on various welding defects and inspection methods.

UNIT I CASTING DESIGN **9**

Heat transfer between metal and mould —– Design considerations in casting — Designing for directional solidification and minimum stresses - principles and design of gating and riser-Melting and casting quality

UNIT II CASTING METALLURGY **9**

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

UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT **9**

Shell moulding, precision investment casting, CO_2 moulding, centrifugal casting, Die casting,

Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry — sand reclamation — material handling in foundry pollution control in foundry —— Computer aided design of casting.

UNIT IV WELDING METALLURGY AND DESIGN 9

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

UNIT V RECENT TRENDS IN WELDING 9

Friction welding, Friction stir welding – Explosive welding – Diffusion bonding – High frequency induction welding – Ultrasonic welding – Electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- Narrow gap, Hybrid twin wire active TIG – Tandem MIG- Modern brazing and soldering techniques — Induction, Dip resistance, Diffusion processes — Hot gas, Wave and vapour phase soldering. Overview of automation of welding in aerospace, Nuclear, surface transport vehicles and underwater welding.

COURSE OUTCOMES:

- At the end of this course the students are expected to impart knowledge on basic concepts and advances in casting and welding processes.
- Know and perform solid state and special welding processes.
- Understand and analyze the material structures after welding.
- Design the weldments for various materials.
- Attain the knowledge about various welding defects and inspection methods.

TOTAL: 45 PERIODS

REFERENCES:

1. ASM Handbook vol.6, welding Brazing & Soldering, 2010
2. ASM Handbook, Vol 15, Casting, 2008
3. Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2005
4. Cornu.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
5. Heineloper & Rosenthal, Principles of Metal Casting, Tata McGraw Hill, 2017.
   – Robotic welding – A guide to selection and application – Society of mechanicalEngineers, 1987.
6. Jain P.L., Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003
7. Lancaster.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1999.
8. Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002
9. Schwariz, M.M. – Source book on innovative welding processes – American Societyfor Metals (OHIO), 1981
10. Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002
11. P N Rao Manufacturing Technology , Vol 1, 3rd edition ,2011

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	-	-	-	-	1
2	-	-	2	3	2	-
3	1	-	-	-	2	1
4	-	-	-	-	-	2
5	2	-	3	-	-	-
Avg.	1.33	-	2.5	3	2	1.33

24MF103T THEORY OF METAL CUTTING **L T P C**

3 0 0 3

COURSE OBJECTIVES:

To make the students to familiar with the basic principles of metal cutting

- To familiarize the students various cutting tool materials and its wear mechanisms during the machining operation.
- Differentiate between single point and multi point cutting tools
- To study the heat generation during machining and the necessity for cutting fluid
- To study the effect of vibrations during machining

UNIT I INTRODUCTION

Need for rational approach to the problem of cutting materials-observation made in the cutting of metals-basic mechanism of chip formation-thin and thick zone modes-types of chips-chip breaker-orthogonal Vs oblique cutting- force velocity relationship for shear plane angle in orthogonal cutting-energy consideration in machining-review of Merchant, Lee and Shafter theories-critical comparison.

UNIT II SYSTEM OF TOOL NOMENCLATURE 9

Nomenclature of single point cutting tool and nomenclature of multi point cutting tools — Twist Drill — milling cutter - System of tool nomenclature and conversion of rake angles-nomenclature of multi point tools like drills, milling- conventional Vs climb milling, mean cross sectional area of chip in milling-specific cutting pressure.

UNIT III THERMAL ASPECTS OF MACHINING 9

Heat distribution in machining-effects of various parameters on temperature-methods of temperature measurement in machining-hot machining- Cutting fluid – properties – types of cutting fluids – Selection of cutting fluids.

UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR 9

Essential requirements of tool materials-development of tool materials-ISO specification for inserts and tool holders- Tool geometry - Mechanisms of tool wear – Abrasion – Adhesion – Diffusion – Types of tool wear – flank wear – crater wear – Tool life – Tool life equations - factors affecting tool life – Illustrative problems- conventional and accelerated tool life tests-concept of machinability index-economics of machining

UNIT V WEAR MECHANISMS AND CHATTER IN MACHINING 9

Processing and Machining — Measuring Techniques — Reasons for failure of cutting tools and forms of wear- mechanisms of wear-chatter in machining-factors affecting chatter in machining-types of chatter-mechanism of chatter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course students will be familiar with

- Basics of orthogonal cutting, oblique cutting and chip formation
- Different tool materials, tool life and tool wear mechanisms
- Necessity for a cutting fluid and cutting efficiency
- Single and Multipoint cutting tools
- Effect of vibrations and surface roughness during machining

REFERENCES

1.Bhattacharya.A., Metal Cutting Theory and practice, Central Book Publishers, India,2012..
2.Boothroid D.G. & Knight W.A., Fundamentals of machining and machine tools, Marcel Dekker, Newyork, 2005.
3.Shaw.M.C.Metal cutting principles, Oxford Clare don press, 2012.
4.B L Juneja and G S Sekhon., Fundamentals of Metal Cutting and Machine Tools, 2017

24MF104T	**COMPUTER AIDED MANUFACTURING**	**L T P C** **3 0 0 3**

COURSE OBJECTIVES:

- To introduce the evolution of CAD, CAM, CIM, engineering product specification and interpreting geometric specifications.
- To train the candidates on the integration of Computer Aided Design and Computer Aided Manufacturing.
- To impart knowledge on manual part program and generation of CNC part program using Computer Aided Manufacturing packages.
- To introduce with the implementation of CAD and CAM in manufacturing process.
- To introduce the importance of Internet of Things in Computer Aided Manufacturing.

UNIT I INTRODUCTION TO CAM **9**

Introduction CAD, CAM, CAE, CIM, system configuration for CAM including hardware and software, evolution of product realization, historical development, engineering product specification. Geometric Tolerancing - ASME standard, interpreting geometric specifications, multiple part features and datum.

UNIT II CAD AND CAM INTEGRATION **9**

Introduction - Networking - Techniques, components, interface cards, network standards, Graphics standards - Graphical kernel system, Data exchange format - IGES and STEP.

Process planning, Computer Aided Process Planning (CAPP), Product life cycle management (PLM), Enterprise resource planning (ERP).

UNIT III PROGRAMMING OF CNC MACHINES 9

Structure of CNC program, Coordinate system, G & M codes, cutter radius compensation, tool nose radius compensation, tool wear compensation, canned cycles, mirroring features, Manual part programming for CNC turning, machining center, wire electric discharge machining, abrasive water jet cutting machine, bulk and sheet metal forming, generation of CNC program using CAM softwares.

UNIT IV CAD AND CAM FOR MANUFACTURING PROCESSES 9

Classification of Manufacturing process, construction and operations, Integration of CAD and CAM in CNC turning center, machining center, electric discharge machining, wire electric discharge machining, abrasive water jet cutting machine, bulk forming, sheet metal forming.

UNIT V IOT IN CAM 9

Introduction, overview of IOT enabled manufacturing system, Real-time and multi-source manufacturing information sensing system, IOT enabled smart assembly station, cloud computing based manufacturing resources configuration method, Real-time key production performances analysis method, Real-time information driven production scheduling system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:
CO1: Recognize the importance of CAD, CAM, CIM, Engineering product specification and interpreting geometric specifications.
CO2: Improve knowledge on the integration of CAD and CAM.
CO3: Exhibit competency in manual part program and generation of CNC part program using CAM packages. CO4: Describe the implementation of CAD and CAM in manufacturing processes.
CO5: Explain applications of IOT in computer aided manufacturing

REFERENCES:

1. Chang T.C., Wysk, R.A. and Wang.H.P., "Computer Aided Manufacturing", Pearson Prentice Hall, India
2. HMT,"Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.
3. Rao P.N., "CAD/CAM", 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, India, 2012, ISBN-13: 978-0070681934.
4. Radhakrishnan P., "Computer Numerical Control ", New Central Book Agency, India,2013.
5. Nee Y.C., Soh K. Ong, Yun G. Wang., "Computer Applications in Near Net-Shape Operations", Springer, United Kingdom, 2012.
6. Yingfeng Zhang and Fei Tao, "Optimization of Manufacturing Systems Using the Internet of

CO-PO Mapping

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
1	-	-	-	2	2	-
2	-	-	-	-	2	1
3	1	2	-	3	-	-
4	2	-	-	-	1	2
5	-	-	-	-	3	1
Avg.	1.5	2	-	2.5	2	1.33

24RM101T	RESEARCH METHODOLOGY AND IPR	L T P C 2 0 0 2

UNIT I RESEARCH DESIGN **6**

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES **6**

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying

UNIT III DATA ANALYSIS AND REPORTING **6**

Overview of Multivariate analysis, Hypotheses testing and Measures of Association-Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS **6**

Intellectual Property — The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS **6**

Patents — objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL: 30 PERIODS

REFERENCES

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods",

Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

		L T P C
24MF101P	**CAD / CAM LABORATORY**	**0 0 4 2**

COURSE OBJECTIVES:

To introduce components and assemblies used in machines and use of 3D parametric CAD, CAM software for mechanical design.

- To provide an experiential learning environment using projects done by student groups, while applying CAD, CAE software tools to design mechanisms and structures for mechanical design evaluation, optimization of mass properties, static-stresses, deformations, etc. with experimental validation of simulation models.
- To do some exercises in tool pre-setting and work piece referencing on CNC machine tools, manual part programming for CNC turning and milling centres.
- Use of software for simulation of turned and milled parts and simple surfaces, Automatic Cutter location data generation from CAD Models in APT format and post-processing for machining on CNC machines using standard CAD/CAM software
- To produce an industrial component and measure to verify its conformity with the design

CAM LABORATORY

1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving canned cycle
2. Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle. Study of Sensors, Transducers & PLC: Hall-effect sensor, Pressure sensors, Strain gauge, PLC, LVDT, Load cell, Angular potentiometer, Torque, Temperature & Optical Transducers.
3. Standards, types, applications and working of following components and assemblies, Machine Components: Screw fasteners, Riveted joints, Keys, Cotters and joints, Shaft couplings, Pipe joints and fittings. Assemblies: Bearings, Hangers and brackets, Steam and IC engine parts, Valves, Some important machine assemblies.
4. Mechanical Drawing: Machining and surface finish symbols and tolerances in dimensioning.
5. CAD: Introduction to CAD, CAM, software in product life cycle.
6. Geometric Modelling: Parametric sketching and modelling, constrained model dimensioning, Relating dimensions and parameters. Feature and sequence of feature editing. Material addition and removal for extrude, revolve, blend, helical sweep, swept blend, variable section sweep. References and construction features of points, axis, curves, planes, surfaces. Cosmetic features, representation of welded joints, Draft and ribs features, chamfers, rounds, standard holes. Assembly modelling. Automatic production drawing creation and detailing for dimensions, BOM, Ballooning, sectioned views etc.

7. Productivity Enhancement Tools in CAD Software: Feature patterns, duplication, grouping, suppression. Top-down vs. bottom-up design

CAD LABORATORY

2D modelling and 3D modelling of components such as

1. Bearing
2. Couplings
3. Gears
4. Sheet metal components
5. Jigs, Fixtures and Die assemblies.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course the students are expected to

- Interpret mechanical drawings for components, assemblies and use parametric 3D CAD software tools in the correct manner for creating their geometric part models, assemblies and automated drawings.
- Apply the concepts of machining for the purpose of selection of appropriate machining centres, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.
- Create and validate NC part program data using manual data input (MDI) and automatically using standard commercial CAM package for manufacturing of required component using CNC milling or turning applications.
- Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.
- Create and demonstrate the technical documentation for design/ selection of suitable drive technologies, precision components and an overall CNC machine tool system for automation of machining operations using appropriate multi-axis CNC technology

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	-	-	-	2	1
2	-	-	-	3	2	1
3	-	-	-	-	2	1
4	-	2	-	2	3	-
5	-	-	-	-	-	2
Avg.	1	2	-	2.5	2.25	1.25

		L T P C
24TM202P	TECHNICAL SEMINAR	0 0 2 1

COURSE OBJECTIVES:

- To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology
- To ensure that students possess a comprehensive understanding of the latest development in his chosen area
- To ensure that students are getting updated with latest technology
- A group of 2 students have to choose a problem and carry out scientific systematic investigation experimentally/ theoretically in suggesting a viable solution. At the end of the semester, each group of students have to submit a report for evaluation.
- Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

OUTCOMES:

At the end of this course the students are expected;

- To develop skills to search, read, write, comprehend and present research papers in the areas of manufacturing engineering.
- Updated with the latest technology in the field of Manufacturing Engineering
- Able to plot graph, sketch, bring out the visual about his understanding on various topics

TOTAL: 30 PERIODS

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	-	-	2	-
2	1	2	3	-	2	-
3	1	2	3	-	2	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
Avg.	1	1.66	3	-	2	-

SEMESTER II

24MF201T OPTIMIZATION TECHNIQUES IN MANUFACTURING **L T P C**

2 1 0 3

OBJECTIVES:

- To make use of the optimization techniques while modelling and solving the engineering problems of different fields.
- To apply Linear Programming and Dynamic Programming to provide solutions for different problems
- Learn classical optimization techniques and numerical methods of optimization.
- Know the basics of different evolutionary algorithms.
- To understand and differentiate traditional and non-traditional methods of Optimization.

UNIT I INTRODUCTION 9

Optimization — Historical Development — Engineering applications of optimization — Statement of an Optimization problem – classification of optimization problems.

UNIT II CLASSIC OPTIMIZATION TECHNIQUES 9

Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming.

UNIT III NON-LINEAR PROGRAMMING 9

Introduction — Lagrangeon Method — Kuhn-Tucker conditions — Quadratic programming — Separable programming – Stochastic programming – Geometric programming

UNIT IV INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES 9

Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

UNIT V ADVANCES IN SIMULATION 9

Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course the students will be expected to introduce the various optimization techniques and their advancements.
- Ability to go in research by applying optimization techniques in problems of Engineering and Technology
- Use classical optimization techniques and numerical methods of optimization.
- Describe the basics of different evolutionary algorithms
- Ability to solve the mathematical results and numerical techniques of optimization theory to concrete Engineering problems by using computer software

REFERENCES:

1. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
2. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997
3. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994

4. R. Panneerselvam, “Operations Research”, Prentice Hall of India Private Limited, New Delhi 1 – 2005
5. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	2	-	-	3	2	-
2	1	-	-	2	3	-
3	1	-	-	2	2	-
4	-	2	-	-	-	-
5	1	-	-	3	-	2
Avg.	1.25	2	-	2.5	2.33	2

24MF202T **ADVANCES IN METROLOGY AND INSPECTION** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To teach the students basic concepts in various methods of engineering measurement techniques and applications
- To make them understand the importance of measurement and inspection in manufacturing industries.
- To understand the use of Light rays and Laser beams for measurement and their merits
- To make the students capable of learning to operate and use advanced metrological devices with ease in industrial environments.
- To teach the use of computer for measuring and processing of measured quantity

UNIT I CONCEPTS OF METROLOGY 9

Terminologies — Standards of measurement — Errors in measurement — Interchangeability and Selective assembly – Accuracy and Precision – Calibration of instruments – Basics of Dimensional metrology and Form metrology

UNIT II MEASUREMENT OF SURFACE ROUGHNESS 9

Definitions – Types of Surface Texture: Surface Roughness Measurement Methods- Comparison, Contact and Non-Contact type roughness measuring devices, 3D Surface Roughness Measurement, Nano Level Surface Roughness Measurement — Instruments.

UNIT III INTERFEROMETRY 9

Introduction, Principles of light interference — Interferometers — Measurement and Calibration — Laser Interferometry applications - strain –pressure – displacement – vibration

UNIT IV MEASURING MACHINES AND LASER METROLOGY 9

Tool Makers Microscope –height gauges- Coordinate Measuring Machines — Applications — Laser Micrometer, Laser Scanning gauge, Computer Aided Inspection techniques - In-process inspection, Machine Vision system- automated visual inspection -Applications.

UNIT V IMAGE PROCESSING FOR METROLOGY 9

Overview, Computer imaging systems, Image Analysis, Pre-processing, Human vision system, Image model Image enhancement, grey scale models, histogram models, Image Transforms - Examples.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students are expected to

- Understand the advanced measurement principles with ease.
- Operate sophisticated and accurate measuring instruments.
- Understand the various inspection methods and tools
- Design and develop new measuring methods.
- Apply computers in Measurement

REFERENCES

1. "ASTE Handbook of Industries Metrology", Prentice Hall of India Ltd., 1992.
2. Bewoor, A.K. and Kulkarni,V.A.,"Metrology and Measurement", Tata Mc Graw-Hill, 2009.
3. Galyer, F.W. and Shotbolt, C.R., "Metrology for engineers", ELBS, 1990.
4. Gupta, I.C., "A Text Book of engineering metrology", Dhanpat Rai and Sons, 1996.
5. Jain ,R.K.,"Engineering Metrology", Khqanna Publishers, 2008.
6. Rajput,R.K., "Engineering Metrology and Instrumentations", Kataria & Sons Publishers, 2001.
7. Smith,G.T., "Industrial Metrology", Springer, 2002
8. Sonka,M., Hlavac,V. and Boyle.R., "Image Processing, Analysis, and Machine Vision", Cengage- Engineering, 2007.
9. Whitehouse,D.J., "Surface and their measurement", Hermes Penton Ltd, 2004.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	-	-	1	1	-
2	1	-	-	1	-	2
3	1	-	3	-	2	1
4	1	-	-	1	2	1
5	-	-	-	1	2	1
Avg.	1	-	3	1	1.75	1.25

24MF203T	THEORY OF METAL FORMING	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
- To study the thermo mechanical regimes and its requirements of metal forming
- To learn the art of processing and making of powder metallurgy components
- To learn the effect of friction and lubrication in Metal forming
- To study the various surface treatment processes

UNIT I THEORY OF PLASTICITY 9

Theory of plastic deformation — Yield criteria — Tresca and Von-Mises — Distortion energy — Stress-strain relation – Mohr's circle representation of a state of stress – cylindrical and spherical co-ordinate system – upper and lower bound solution methods – Overview of FEM applications in Metal Forming analysis.

UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES 9

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming – Equal Chanel Angular Pressing-High Pressure Torsion- Repetitive Corrugation and Straightening- Accumulative Roll bonding.

UNIT III SHEET METAL FORMING 9

Formability studies — Conventional processes — H E R F techniques — Superplastic forming techniques — Hydro forming — Stretch forming — Water hammer forming — Principles and process parameters — Advantages, Limitations and applications

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES 9

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

UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9

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

COURSE OUTCOMES:

- At the end of this course the students are expected to upgrade their knowledge on various metal forming techniques and formability
- Apply the theory of plasticity for various types of metal forming process.
- Apply the concept of powder metallurgy to make prismatic components
- Understand Non-traditional forming processes.
- Understand the purpose of surface treatment in metal forming applications

TOTAL: 45 PERIODS

REFERENCES:

1. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003
2. ALTAN.T, SOO-IK-oh, GEGEL, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio, 1995.
3. ASM Hand book, Forming and Forging, Ninth edition, Vol – 14, 2003
4. Dieter G.E., Mechanical Metallurgy (Revised Edition II) McGraw Hill Co., 1988
5. Helmi A Youssef, Hassan A. El-Hofy, Manufacturing Technology: Materials, Processes and Equipment, CRC publication press, 2012.
6. Marciniak,Z., Duncan J.L., Hu S.J., 'Mechanics of Sheet Metal Forming', Butterworth-Heinemann An Imprint of Elsevier, 2006
7. Nagpal G.R., Metal Forming Processes- Khanna publishers, 2005.
8. SAE Transactions, Journal of Materials and Manufacturing Section 5, 1993-2007
9. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T, Metal forming and Finite Element Method, Oxford University Press, 2001.
10. Surender Kumar, Technology of Metal Forming Processes, Prentice Hall India Publishers, 2010

CO-PO MAPING

CO	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	-	-	-	-	-	-
2	1	-	-	-	-	-
3	1			2	1	2
4	1	-	2	2	-	-
5	-	-	1	-	2	3
AVG	**1**	**-**	**1.5**	**2**	**1.5**	**2.5**

24MF204T **ADDITIVE MANUFACTURING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology
- Gain insights on the need, advantages and limitations of additive manufacturing (AM) versus traditional manufacturing
- Find out the various applications of AM, Deployment levels, Innovative and optimized product design
- To explore the potential of additive manufacturing in different industrial sectors.
- To apply 3D printing technology for additive manufacturing.

UNIT I INTRODUCTION **9**

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

UNIT II REVERSE ENGINEERING AND CAD MODELLING 9

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

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTE 9

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

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 9

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

UNIT V OTHER ADDITIVE MANUFACTURING SYSTEMS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- The students are expected to learn about a variety of Additive Manufacturing (AM) technologies.
- Describe additive manufacturing and explain its advantages and disadvantages
- Explain the processes used in additive manufacturing for a range of materials and applications
- understand the role of additive manufacturing in the design process and their potential to support Design and manufacturing,
- Case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools

REFERENCES:

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

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	2	-	2	-	-	-
2	1	-	-	-	-	2
3	-	-	3	-	2	-
4	-	-	-	3	-	-
5	-	-	-	-	2	3
AVG	1.5	-	2.5	3	2	2.5

24MF205T	FLUID POWER AUTOMATION	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
- To train the students in designing the hydraulic and pneumatic circuits using various design procedures.
- To understand the concept and principle operation of automation systems and their controls.
- To provide knowledge levels needed for PLC programming and operating
- Ability to implement automation systems in Industry

UNIT I INTRODUCTION 9

Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics – Selection criteria.

UNIT II FLUID POWER GENERATING/UTILIZING ELEMENTS 9

Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics – Linear actuator – Types, mounting details, cushioning – power packs – construction. Reservoir capacity, heat dissipation, accumulators – standard circuit symbols, circuit (flow) analysis.

UNIT III CONTROL AND REGULATION ELEMENTS 9

Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics-electro hydraulic servo valves, Digital valves -Different types-characteristics and performance.

UNIT IV CIRCUIT DESIGN 9

Typical industrial hydraulic circuits-Design methodology — Ladder diagram-cascade, method-truth table- Karnaugh map method-sequencing circuits-combinational and logic circuit.

UNIT V ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS 9

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder

diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- At the end of this course the students are familiarized in the area of hydraulics, pneumatic and fluid power components and its functions.
- Recognize the standard symbols used in fluid power circuits and assess the suitable component for a particular application
- Construct the hydraulic circuits for an industrial application.
- Build a pneumatic circuit and apply them to real life problems.
- Design and develop a PLC controlled pneumatic circuit for industrial application

REFERENCES:

1. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988
2. Dudbey. A. Peace, Basic Fluid Power, Prentice Hall Inc, 1967.
3. E.C.Fitch and J.B.Suryaatmadyn. Introduction to fluid logic, McGraw Hill, 1978
4. Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967
5. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994.
6. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979
7. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003

CO-PO Mapping

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	PO6
1	1	-	-	-	-	-
2	1	-	3	-	-	2
3	-	-	3	2	-	-
4	1	-	-	2	3	-
5	-	-	-	-	-	3
Avg.	**1**	**-**	**3**	**2**	**3**	**2.5**

24MF201P	**AUTOMATION AND METAL FORMING LABORATORY**	**L T P C**

		0 0 3 1.5

COURSE OBJECTIVES

- To train the students on the basic concepts of metal forming processes
- To determine metal forming parameters for a given shape.
- To learn the automation systems using fluid power control systems
- To learn and use automation studio software
- To learn PLC and its importance in Fluid power applications

EXPERIMENTS

1. Determination of strain hardening exponent
2. Determination of strain rate sensitivity index
3. Construction of formability limit diagram
4. Determination of efficiency in water hammer forming
5. Determination of interface friction factor
6. Determination of extrusion load
7. Study on two high rolling process

AUTOMATION LAB

1. Simulation of single and double acting cylinder circuits
2. Simulation of Hydraulic circuits
3. Simulation of electro pneumatic circuits
4. Simulation of electro hydraulic circuits
5. Simulation of PLC circuits
6. Software simulation of fluid power circuits using Automation studio.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course the students are expected

1) To impart practical knowledge on bulk metal forming processes
2) Know various symbols used in Hydraulic and Pneumatic circuits
3) Conduct few sheet metals forming processes and analyse the parameters
4) Design hydraulic circuits for industrial applications
5) Learnt how to use automation studio

CO-PO MAPPING

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
1	-	2	1	2	-	-
2	-	2	-	2	-	-
3	-	2	-	-	3	1
4	-	2	-	-	2	1
5	-	2	-	-	2	1
Avg.	1	2	1	2	2.33	1

24MF202P	ADVANCED MANUFACTURING PROCESSES LABORATORY	L T P C 0 0 3 1.5

(Students can do any three sets for this lab out of the given four i.e. I, II, III, IV)

COURSE OBJECTIVES

- To analyses the forces in machining
- To perform modeling and simulation of manufacturing processes
- To develop product using rapid prototyping
- To program a robot for an autonomous movement
- To analyze product Life cycle

I ADVANCED MACHINING PROCESS

(1) Analysis of cutting forces during turning/drilling process.

(2) Analysis of temperature during turning/drilling process.

(3) Study on the effect of process parameters in Electro-Chemical/Electric-Discharge Machining

II PROCESS MODELLING

1. Analysis of stress strain distribution in a structural loading of composite bar using MATLAB codes.

2. Transient heat transfer analysis of a rectangular slab using a FEA package.

3. Modeling & simulation of forging/rolling/machining process using a FEA package.

II RAPID PROTOTYPING

(1) Selection of Rapid Prototyping Technology.

(2) Product development activity – Concept design and Detailed design.

(3) Product development activity – Engineering analysis and Prototype development.

IV ROBOTICS

(1) Determination of maximum and minimum position of links.

(2) Verification of transformation (Position and orientation) with respect to gripper and world coordinate system

(3) Estimation of accuracy, repeatability and resolution.

(4) Robot programming and simulation for pick and place

(5) Robot programming and simulation for Color identification

(6) Robot programming and simulation for Shape identification

COURSE OUTCOMES:

- Perform modelling and simulation of manufacturing processes
- Analyze the process using an FEA package
- Competence to execute product development phases
- Simple programming for robotic applications
- Use EDM/ECM for machining different materials

CO-PO MAPPING

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	1	-	2	3	2
2	1	1	-	2	3	-
3	-	1	-	2	-	2
4	-	1	-	2	-	2
5	1	1	3	-	-	2
Avg.	1	1	3	2	3	2

PROFESSIONAL ELECTIVES

SEMESTER II, ELECTIVES - I & II

24MF101E	DESIGN FOR MANUFACTURE AND ASSEMBLY	L T P C
		3 0 0 3

OBJECTIVES:

- To apply various design rules in manufacturing processes
- To evaluate the process by design guide lines for optimum design
- To analyze the rules of concepts of GD&T
- To make the students to learn about tolerance analysis and allocation, geometrical tolerances
- Guidelines for design for manufacturing and assembly with suitable examples.

UNIT I TOLERANCE ANALYSIS 9

Introduction – Concepts, definitions and relationships of tolerancing – Matching design tolerances with appropriate manufacturing process – manufacturing process capability metrics – Worst care, statistical tolerance Analysis – Linear and Non-Linear Analysis – Sensitivity Analysis – Taguchi's Approach to tolerance design.

UNIT II TOLERANCE ALLOCATION 9

Tolerance synthesis – Computer Aided tolerancing – Traditional cost based analysis – Taguchi's quality loss function – Application of the Quadratic loss function to Tolerancing – Principles of selective Assembly – Problems.

UNIT III GD&T 9

Fundamentals of geometric dimensioning and tolerancing – Rules and concepts of GD&T – Form controls – Datum systems – Orientation controls – Tolerance of position – Concentricity and

symmetry controls – Run out controls – Profile controls.

UNIT IV TOLERANCE CHARTING 9

Nature of the tolerance buildup – structure and setup of the tolerance chart – piece part sketches for tolerance charts – Arithmetic ground rules for tolerance charts – Determination of Required balance dimensions – Determination of Mean working Dimensions – Automatic tolerance charting – Tolerance charting of Angular surfaces.

UNIT V MANUFACTURING GUIDELINES 9

DFM guidelines for casting, weldment design – Formed metal components – Turned parts – Milled, Drilled parts– Non-metallic parts – Computer Aided DFM software –Booth royd and Dewhurst method of DFMA – DCS – Vis/VSA – 3D Dimensional control – Statistical tolerance Analysis Software – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are expected

- To impart the knowledge about the significance of design for manufacturing and assembly
- To apply the principle of tolerance in design
- Evaluate the process of GD & tolerance design guidelines
- Apply tolerance allocation and tolerance charting in design
- Apply guidelines for manufacturing and assembly

REFERENCES:

1. AlexKrulikowski,"FundamentalsGD&T",DelmarThomsonLearning,1997.
2. C.M. Creveling, "Tolerance Design – A handbook for Developing Optimal Specifications" Addison–Wesley, 1997.
3. James D. Meadows,' Geometric Dimensioning and Tolerancing",MarcelDekkerInc.,1995.
4. JamesG.Bralla,"HandbookofProductDesignforManufacturing",McGrawHill,1986.
5. OliverR.Wade,"ToleranceControlinDesignandManufacturing",IndustrialPress,NY,1967.

CO-PO Mapping

CO	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	1	-	-	3	-	-
2	1	1	-	2	2	-
3	-	-	3	2	2	-
4	1	-	-	-	-	-
5	-	-	-	2	2	2
Avg	**1**	**1**	**3**	**2.25**	**2**	**2**

24MF102E	MICRO MANUFACTURING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- The objective of the course is to acquaint the students with the principles of micro manufacturing
- To learn basic machine tools used in micro manufacturing and developments in the micro manufacturing process
- To familiarize with the research trends in the area of micro manufacturing process.
- To learn various polishing techniques
- To study the various measuring techniques used for micro/ nano components

UNIT I MECHANICAL MICRO MACHINING **9**

Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.

UNIT II BEAM ENERGY BASED MICRO MACHINING **9**

Electron Beam Micro Machining – Laser Beam Micro Machining – Electric Discharge Micro Machining – Ion Beam Micro Machining –Plasma Beam Micro Machining –Hybrid Micro machining –Electro Discharge Grinding – Electro Chemical spark micro machining – Electrolytic in process Dressing.

UNIT III NANO POLISHING **9**

Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemo- mechanical Polishing.

UNIT IV MICRO FORMING AND WELDING **9**

Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding.

UNIT V RECENT TRENDS AND APPLICATIONS **9**

Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are well experienced

- To impart the principles of various basic micro manufacturing process
- To know and perform micro machining
- Research various micro machining process to optimize the process variables
- Attain knowledge about polishing techniques
- Measure and analyze the various parameters of micro machined components

REFERENCES:

1. Bandyo padhyay.A.K., Nano Materials, New age international publishers,NewDelhi,2008,ISBN:8122422578.
2. Bharat Bhushan, Handbook of nano technology, springer, Germany,2010.
3. JainV.K.,' Introduction to Micro machining' Narosa Publishing House, 2011
4. JainV.K.,AdvancedMachiningProcesses,AlliedPublishers,Delhi,2002
5. JainV.K.,MicroManufacturingProcesses,CRCPress,Taylor&FrancisGroup,2012
6. JanochaH.,Actuators–Basicsandapplications,Springerpublishers–2012
7. Mcgeoug.J.A.,MicromachiningofEngineeringMaterials,CRCpress2001,ISBN-10:0824706447.
8. www.cmxr.com/industrial/
9. www.sciencemag.org.handbook

CO-PO Mapping

CO	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	-	-	3	-	-	-
2	1	-	-	-	2	-
3	3	1	-	-	-	-
4	-	-	-	-	2	2
5	1	-	-	-	2	-
Avg	**1.66**	**1**	**-**	**-**	**2**	**2**

24MF103E	**QUALITY AND RELIABILITY ENGINEERING**	**L T P C**
		3 0 0 3

COURSE OBJECTIVES:

- To make the students construct the various quality control charts for variables and attributes
- To study the various sampling plans
- To make the students design for reliability
- To learn different methods of improving reliability
- To learn the basics of maintainability.

UNIT I QUALITY & STATISTICAL PROCESS CONTROL 9

Quality – Definition – Quality Assurance – Variation in process – Factors – process capability – control charts – variables X, R and X, - Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts – charts for variables – Quality rating – Short run SPC.

UNIT II ACCEPTANCE SAMPLING 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer's risk and consumer's risk.AQL, LTPD, AOQL, Concepts – standard sampling plans for AQL and LTPD – use of standard sampling plans.

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

Fundamentals – factorial experiments – random design, Latin square design – Taguchi method – Loss function– experiments – S/N ratio and performance measure – Orthogonal array.

UNIT IV CONCEPT OF RELIABILITY 9

Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, Weibull, lognormal – Reliability of system and models – serial, parallel and combined configuration – Markov analysis, load sharing systems, standby systems, covariant models, static models, dynamic models.

UNIT V DESIGN FOR RELIABILITY AND MAINTAINABILITY 9

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are exposed to the various quality control techniques, to understand the importance and concept of reliability and maintainability in industries.

- Apply control chart techniques in production process
- Understand inspection by sampling techniques
- Able to do reliable design
- Improve the availability of equipment through proper maintenance
- Know how to improve the reliability

REFERENCES:

1. Amata Mitra"Fundamentals of Quality Control and improvement" Pearson Education,2002.
2. Bester field D.H.," Quality Control"PrenticeHall,1993.
3. Charles Ebling, An Introduction to Reliability and Maintainability Engineering, Tata-McGrawHill,2000.
4. David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.
5. Dhillon, Engineering Maintainability–How to design for reliability and easy maintenance, PHI,2008.
6. Patrick D To' corner, Practical Reliability Engineering,John-WileyandSonsInc,2002

CO-PO Mapping

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	1	-	3	2	1	1
2	-	-	-	3	-	-
3	-	-	-	2	-	2
4	1	-	3	-	2	-
5	-	-	-	2	-	1
Avg.	**1**	**-**	**3**	**2.25**	**1.5**	**1.33**

24MF104E	FINITE ELEMENT METHODS FOR MANUFACTURING ENGINEERING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To familiarize the students with fundamentals of finite element method,
- To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.
- Acquaint students with finite element formulations and theories
- Develop the ability to perform finite element analyses and evaluate the results of a select set of manufacturing processes,
- Provide exposure to practical problems and their solutions, through simulations using the finite element software

UNIT I INTRODUCTION 9

Fundamentals – Initial, boundary and eigen value problems – weighted residual, Galerkin and Rayleigh Ritz methods - Integration by parts – Basics of variational formulation – Polynomial and Nodal approximation.

UNIT II ONE DIMENSIONAL ANALYSIS 9

Steps in FEM – Discretization. Interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing – One dimensional analysisin solid mechanics and heat transfer.

UNITI II SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS 9

Shape functions for one and two dimensional elements- Three nodded triangular and four nodded quadrilateral element Global and natural co-ordinates—Nonlinear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.

UNIT IV COMPUTER IMPLEMENTATION 9

Pre Processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages – Development of code for one dimensional analysis and validation

UNIT V ANALYSIS OF PRODUCTION PROCESSES 9

FE analysis of metal casting – special considerations, latent heat incorporation, gap element – Time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure – Basic concepts of plasticity and fracture–Solid and flow formulation–small incremental deformation formulation–Fracture criteria – FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency – FE analysis of welding.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are highly confident in

- Fundamentals of Finite Element Methods.
- Perform one dimensional and Two-dimensional analysis using FEA
- Perform finite element formulations to solve problems
- Perform finite element analyses and evaluate the results of a select set of manufacturing processes,
- Provide simulations through FE Software

REFERENCES:

1. Bathe,K.J., Finite Element procedures in Engineering Analysis,1990
2. Kobayash,S,Soo-ik-OhandAltan,T, Metal Forming and the Finite Element Methods,Oxford University Press, 1989.
3. LewisR.W. Morgan,K, Thomas,H.R.and Seetharaman,K.N. The Finite Element Method in Heat Transfer Analysis, John Wiley, 1994.
4. Rao,S.S., Finite Element method in engineering,Pergammonpress,2005.
5. Reddy,J.N. An Introduction to the Finite Element Method,McGrawHill,2005.
6. SeshuP., Text book of Finite Element Analysis ,PHILearningPvt.Ltd,2004.
7. www.pollockeng.com
8. www.tbook.com

CO-PO Mapping

CO	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	1	-	-	-	-	2
2	2	-	-	3	-	-
3	-	-	3	2	-	-
4	2	-	-	3	-	-
5	-	-	-	-	2	1
Avg.	**1.66**	**-**	**3**	**2.66**	**2**	**1.5**

24MF105E	**MATERIALS MANAGEMENT**	**L T P C**
		3 0 0 3

COURSE OBJECTIVES:

To introduce the students

- The various concepts of materials management
- Familiarize them with vendor development and rating
- The various aspects of Logistics and storage
- Planning and Forecasting of the need
- Various aspects of Inventory management

UNIT I INTRODUCTION

Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II MANAGEMENT OF PURCHASE 9

Purchasing policies and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Methods of purchasing – Imports – Buyer – Seller relationship – Negotiations.

UNIT III MANAGEMENT OF STORES AND LOGISTICS 9

Stores function – Location – Layout – Stock taking – Materials handling – Transportation – Insurance – Codification – Inventory pricing – stores management – safety – warehousing – Distribution linear programming – Traveling Salesman problems – Network analysis – Logistics Management.

UNIT IV MATERIALS PLANNING 9

Forecasting – Materials requirements planning – Quantity – Periodic – Deterministic models – Finite production.

UNIT V INVENTORY MANAGEMENT 9

ABCanalysis – Aggregateplanning – Lotsize under constraints–Justin Time (JIT) system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are

- Familiarized with the various concepts and functions of material management
- Able to handle the purchase and stores Independently
- Understand Logistics and inventory pricing
- Materials planning and periodic replenishment of material
- Just in time techniques and inventory management

REFERENCES

1. Dr. R. Kesavan, C.Elanchezian and T.SundarSelwyn, Engineering Management –Eswar Press –2005.
2. Dr.R. Kesavan, C.Elanchezian and B.Vijaya Ramnath, Production Planning and Control, AnurathaPublications, Chennai, 2008.
3. G.Reghuram,N.Rangaraj, Logistics and supply chain management–cases and concepts, Macmillan India Ltd., 2006.
4. Gopalakrishnan.P,Handbook of Materials Management,PrenticeHallofIndia,2005.
5. GupthaP.K.andHeera, Operations Research, Suttan Chand&Sons,2007.
6. LamerLeeandDonaldW.Dobler, Purchasing and Material Management, Textandcases,Tata McGraw Hill, 2006.

CO-PO Mapping

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	-	-	-	-	2
2	-	-	3	-	-	-
3	-	-	3	-	-	-
4	-	-	-	2	-	-
5	-	-	-	3	2	2
Avg.	1	-	3	2.5	2	2

24MF106E	INDUSTRIAL ERGONOMICS	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To introduce the concepts of Ergonomics and to indicate the areas of Applications.
- Identify ergonomic principles
- To increase awareness of the need and role of ergonomics in occupational health
- To inculcate analyzing skills among the students with respect to work place design, working postures and lifting tasks.
- To provide thorough knowledge about assessment about occupation a exposure to heat stress, noise, vibrations

UNIT I INTRODUCTION 9

Concepts of human factors engineering and ergonomics – Man – machine system and design philosophy– Physical work – Heat stress – manual lifting – work posture – repetitive motion.

UNIT II ANTHROPOMETRY 9

Physical dimensions of the human body as a working machine – Motion size relationships – Static and dynamic anthropometry – Anthropometric aids – Design principles – Using anthropometric measures for industrial design – Procedure for anthropometric design.

UNIT III DESIGN OF SYSTEMS 9

Displays –Controls–Workplace–Seating –Work process–Duration and rest periods –Hand tool design – Design of visual displays – Design for shift work.

UNIT IV ENVIRONMENTAL FACTORS INDESIGN 9

Temperature – Humidity – Noise – Illumination –Vibration – Measurement of illumination and contrast – use of photometers – Recommended illumination levels.The ageing eye – Use of indirect (reflected) lighting – cost efficiency of illumination – special purpose lighting for inspection and quality control – Measurement of sound – Noise exposure and hearing loss – Hearing protectors – analysis and reduction of noise – Effects of Noise on performance – annoyance of noise and interference with communication – sources of vibration discomfort.

UNIT V WORK PHYSIOLOGY 9

Provision of energy for muscular work – Role of oxygen physical exertion – Measurement of energy expenditure Respiration – Pulse rate and blood pressure during physical work – Physical work capacity and its evaluation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are

- Updated with various concepts of Ergonomics
- Able to provide appropriate allowances for the jobs under analysis.
- Students will be able to analyse and calculate the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.
- Students will be able to assess the occupational environmental factors like heat stress, noise, and vibration and RSPM level in the industry.
- Maintain a comfortable environment in the workplace

REFERENCES:

1. E.J. Mc Cormic &Mark S.Sangers, Human factors in engineering design, McGraw Hill 2007
2. Martin Helander,A guide to the ergonomics of manufacturing ,East Westpress,2007
3. R.S.Bridger Introduction to Ergonomics ,McGrawHill,1995.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	2	-	-	-	-	-
2	-	-	-	3	-	1
3	1	-	2	-	-	-
4	-	-	2	3	2	-
5	1	-	1	2	-	2
Avg.	1.33	-	1.66	2.66	2	1.5

24MF107E	POLYMERS AND COMPOSITE MATERIALS	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on various polymer processing techniques
- To learn about various fibre, Matrix materials and their properties
- To learn the methods by which Polymer matrix composites are made
- To study about the composites used for High temperature applications
- To study the behavior of reinforcements in MMC and PMC

UNIT I PROCESSING OF POLYMERS 9

Chemistry and Classification of Polymers – Properties of Thermo plastics – Properties of Thermosetting Plastics -Extrusion –Injection Moulding –Blow Moulding –Compression and Transfer Moulding –Casting – Thermo Forming. General Machining properties of Plastics – Machining Parameters and their effect – Joining of Plastics – Thermal bonding – Applications.

UNIT II FIBERS AND MATRIX MATERIALS 9

Fibers – Fabrication, Structure, properties and applications – Glass fiber, Boron fiber, carbon fiber, organic fiber, ceramic and metallic fibres - whiskers–Fabrication of Matrix materials – polymers, metals and ceramics and their properties – interfaces – Wettability – Types of bonding at the interface – Tests for measuring interfacial strength - Physical and chemical properties.

UNIT III PROCESSING OF POLYMER MATRIX COMPOSITES 9

Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding with Bulk Moulding Compound and sheet Moulding Compound – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding – interfaces in PMCs - structure, properties and application of PMCs – recycling of PMCs.

UNITIV PROCESSING OF METAL MATRIX COMPOSITES 9

Metallic matrices: aluminium ,titanium ,magnesium, copper alloys – processing of MMCs: l iquid state ,Solid state, in situ fabrication techniques – diffusion bonding – powder metallurgy techniques- interfaces in MMCs – mechanical properties – machining of MMCs – Applications.

UNITV PROCESSING OF CERAMIC MATRIX COMPOSITES AND CARBON-CARBON COMPOSITES 9

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, sol-gel – interfaces in CMCs – mechanical properties and applications of CMCs – Carbon-carbon Composites – applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are expected

- To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites.
- To develop knowledge on processing, interfacial properties and application of composites.
- To have ability to develop new fibre or reinforcement materials
- To differentiate between the composites used in room temperature and High temperature applications

REFERENCES:

1. ASMHandbook–Composites,Vol-21,2001,ISBN:978-0-87170-703-1.
2. HaroldBelofsky,Plastics,ProductDesignandProcessEngineering,HanserPublishers,2002.
3. Jamal Y. Sheikh-Ahmad, Machining of Polymer Composites, Springer, USA, 2009. ISBN: 978-0-387-35539-9.
4. KrishnanKChawla, Composite Materials: Science and Engineering ,InternationalEdition,Springer, 2012, ISBN:978-0-387-74364-6.
5. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010, ISBN:0849342058.
6. Mallick,P.K.andNewman.S., Composite Materials Technology,HanserPublishers,2003.
7. SaidJahanmir,RamuluM.andPhilpKoshy, Machining of Ceramics and Composites,Marcel Dekker Inc., New York, 1999, ISBN: 0-8247-0178-x.
8. Seamour,E.B.ModernPlasticsTechnology,PrenticeHall,2002

CO-PO Mapping

CO	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	1	-	-	3	-	1
2	-	-	1	2	-	-
3	-	-	3	-	2	-
4	1	-	-	-	2	-
5	-	-	1	3	-	1
Avg.	**1**	**-**	**1.66**	**2.66**	**2**	**1**

24MF108E	**NON-DESTRUCTIVE TESTING**	**L T P C**
		3 0 0 3

COURSE OBJECTIVES:

- To stress the importance of NDT in Engineering.
- To select the appropriate NDT Technique
- To familiarize with different NDT Technique
- To impart various knowledge to check the weld quality of various structures, pressure vessels
- Compare the merits of various NDT Techniques

UNIT I NON DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING **9**

Introduction to various non-destructive methods, Comparison of Destructive and Non-destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications. Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods- water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION **9**

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications. Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY **9**

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications. Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV ULTRASONIC TESTING **9**

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through- transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Inter granular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V RADIOGRAPHY **9**

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test. Case studies on defects in cast, rolled, extruded, welded and heat-treated components - Comparison and selection of various NDT techniques

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students

- Realize the importance of various NDT Techniques
- Are expected to have hands on experience on al ltypes of NDT techniques
- Will choose appropriate technique for testing
- Will Compare the merits of various NDT Techniques
- Characterize the flaws and defects and provide solutions

REFERENCES:

1. BaldevRaj,Jeyakumar,T.,Thavasimuthu,M.,"PracticalNonDestructiveTesting"Narosapublishing house, New Delhi, 2002
2. Krautkramer. J., "Ultra Sonic Testing of Materials", 1st Edition, Springer – Verlag Publication, New York, 1996.
3. PeterJ.Shull"Non-DestructiveEvaluation:Theory,TechniquesandApplication"MarcelDekker,Inc., New York, 2002
4. www.ndt.net

CO-PO Mapping

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	-	-	-	-	-
2	-	-	3	-	-	1
3	-	-	-	2	-	-
4	-	-	-	-	1	-
5	1	-	-	2	-	1
Avg.	1	-	3	2	1	1

24MF109E	LEAN MANUFACTURING	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To implement lean manufacturing concepts in the factories.
- Understand the distinction between mass and lean production and to be able to assess the difference in a manufacturing environment
- Understand the various elements of Lean systems
- Learn the importance of JIT
- Understand the various Inspection systems and effectively plan for a Lean system

UNIT I INTRODUCTION: 9

The mass production system – Origin of lean production system – Necessity – Lean revolution in Toyota – Systems and systems thinking – Basic image of lean production – Customer focus – Muda (waste).

UNIT II STABILITYOFLEANSYSTEM: 9

Standardsintheleansystem–5Ssystem –Total Productive Maintenance –standardized work –Elements of standardized work – Charts to define standardized work – Man power reduction – Overall efficiency - standardized work and Kaizen – Common layouts.

UNIT III JUST IN TIME 9

Principles of JIT – JIT system – Kanban – Kanban rules – Expanded role of conveyance – Production levelling – Pull systems – Value stream mapping**.**

UNIT IV JIDOKA (AUTOMATION WITH A HUMAN TOUCH 9

Jidoka concept – Poka-Yoke (mistake proofing) systems – Inspection systems and zone control – Types and use of Poka-Yoke systems – Implementation of Jidoka.

UNIT V WORKER INVOLVEMENT AND SYSTEMATIC PLANNING METHODOLOGY 9

Involvement – Activities to support involvement – Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Phases of Hoshin Planning – Lean culture

TOTAL : 45 PERIODS

OUTCOMES:

The student will be competent

- To know the necessity for a Lean Manufacturing system
- To Differentiate between the conventional Mass production system with Lean system
- In effectively implement the principles of JIT
- To apply the Inspection tools effectively in the Lean systems
- To apply Hoshin planning system to create Lean culture in Industry

REFERENCES

1. Dennis P.," Lean Production Simplified: A Plain –Language Guide to the World's Most Powerful Production System", (Second edition), Productivity Press, New York,2007.
2. Liker,J.," The Toyota Way :Fourteen Management Principles from the World's Greatest Manufacturer", McGraw Hill, 2004.
3. Michael, L.G., "Lean Six SIGMA: Combining Six SIGMA Quality with Lean Production Speed", McGraw Hill, 2002.
4. Ohno, T.," Toyota Production System: Beyond Large-Scale Production", Taylor & Francis,Inc., 1988.
5. Rother,M.,and Shook,J.,'Learning to See :Value Stream Mapping to Add Value and Eliminate MUDA", Lean Enterprise Institute, 1999.

CO-PO Mapping

CO	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
1	1	-	-	-	-	-
2	-	1	3	-	1	-
3	-	-	3	-	-	-
4	1	-	-	2	-	1
5	1	2	-	-	2	2
Avg.	**1**	**1.5**	**3**	**2**	**1.5**	**1.5**

24MF110E ROBOT DESIGN AND PROGRAMMING

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge about different types of robots and configuration
- To gain fundamental knowledge on robot manipulators.
- Toprovideabriefknowledgeongeometry,kinematics,dynamics,motionplanning and control
- To impart knowledge in Robot designing and programming
- To familiarize with sensors and actuators used in robots

UNIT I INTRODUCTION **9**

Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

UNIT II ROBOT KINEMATICS 9

Introduction – Matrix representation Homogeneous transformation, forward and inverse – Kinematic equations, Denvit – Hartenbers representations – Inverse Kinematic relations. Fundamental problems with D-H representation, differential motion and velocity of frames – Jacobian, Differential Charges between frames:

UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING 9

Lagrangeon mechanics, dynamic equations for sing, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning, Machine Vision

UNIT IV ROBOT PROGRAMMING & AITE CHNIQUES 9

Types of Programming – Teach Pendant programming – Basic concepts in A1 techniques – Concept of knowledge representations – Expert system and its components.

UNIT V ROBOT SENSORS AND ACTUATORS 9

Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magneto strictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non-contact sensors, infrared sensors, RCC, vision sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are expected

- Classify and configure robots
- Apply the kinematic arrangement of robots and its applications in the area of manufacturing sectors
- To select sensors for different application
- To build a robot for any type of application
- To develop and Expert system

REFERENCES:

1. GordonMair,‘ Industrial Robotics ’,Prentice Hall(U.K.)1988
2. Groover.M.P. Industrial Robotics, McGraw–HillInternationaledition,1996.
3. Saeed.B.Niku,‘ Introduction to Robotics,Analysis,system,Applications’,Pearsoneducations,2002
4. Wesley E Snyder R, ‘Industrial Robots, Computer Interfacing and Control’, Prentice Hall InternationalEdition, 1988.

CO-PO Mapping

CO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	-	2	-	-	-
2	-	-	-	3	3	-
3	-	-	3	2	-	-
4	1	-	-	2	-	-
5	1	-	2	-	-	2
Avg	1	-	2.33	2.33	3	1

24MF111E	MEMS AND NANO TECHNOLOGY	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To inspire the students to expect to the trends in manufacturing of micro components
- Familiarise the students with various fabrication techniques for micro components.
- Acquaint them with various sensors and actuators
- Introduce them the various methods of developing nano materials
- Make them understand and characterization tools

UNIT I OVERVIEW OF MEMS AND MICRO SYSTEMS 9

Definition – historical development – properties, design and fabrication micro-system, microelectronics, working principle, applications and advantages of micro system. Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds - silicon piezo resistors, Gallium arsenide, quartz, polymers for MEMS, conductive polymers.

UNIT II FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING 9

Photolithography, photo resist applications, light sources, ion implantation, diffusion–Oxidation - thermal oxidation, silicon dioxide, chemical vapour deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process – LASER, Electron beam, Ion beam processes – Mask less lithography. Micro system packaging –packaging design– levels of micro system packaging -die level, device level and system level – interfaces in packaging – packaging technologies- Assembly of Microsystems

UNIT III MICRO DEVICES 9

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands - displacement sensors, pressure sensor, flow sensors, Accelerometer, chemical and bio sensor - sensitivity, reliability and response of micro-sensor - micro actuators – applications.

UNIT IV SCIENCE AND SYNTHESIS OF NANO MATERIALS 9

Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture

Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source-based production techniques – Gaseous carbon source-based production techniques – Diamond like carbon coating. Top down and bottom up processes.

UNIT V CHARACTERIZATION OF NANO MATERIALS 9

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunnelling microscopy, atomic force microscopy, diffraction techniques – spectroscopy

techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course the students are expected

- Realise the need of micro electro mechanical systems.
- Develop a knowledge to select a sensor for an application
- Develop a nano material
- Characterize the Nano material
- Develop an Electromechanical systems

REFERENCES:

1. Charles P Poole, Frank J Owens, Introduction to Nanotechnology,JohnWileyandSons,2003
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CO/PO Mapping

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	-	-	2	-	1
2	1	-	-	2	2	-
3	-	-	3	2	-	-
4	-	-	3	2	-	-
5	-	-	-	2	2	2
Avg	1	-	3	2	2	1.5

24MF112E	GREEN MANUFACTURING	L T P C 3 0 0 3

COURSE OBJECTIVES

- To expose the students to the basics of environmental sustainability and impact assessment objectives.
- To incorporate knowledge about the environmental based improvements towards lean manufacturing systems.
- To analyze various machineries with intent to conserve energy
- Toanalyzehazardousandsolidwasteswithintenttopointoutareasofadverse environmental impact and how this impact could be minimized or prevented.
- To impart the knowledge about the need , procedure and benefits of Green-Corating.

UNIT–I ENVIRONMENTAL SUSTAINABILITY AND IMPACT ASSESSMENT 9

Environmental impact assessment objectives – Legislative development – European community directive – Hungarian directive. Strategic environmental assessment and sustainability appraisal. Regional spatial planning and environmental policy.

UNIT–II LEAN MANUFACTURING AND GREEN ENERGY SYSTEM 9

Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing. World energy consumption – Greenhouse effect, Global warming. Energy conservation and measurement principles with their applicability in engineering and process industries.

UNIT–III ENERGY SAVING MACHINERY AND COMPONENTS 9

Electricity Billing: Components and Costs – kVA – Need and Control – Determination of kVA demand and Consumption. Selection of fans, pumps and Compressors – Performance Evaluation – Cause for inefficient operation – scope for energy conservation.

UNIT–IV HAZARDOUS AND SOLID WASTE MANAGEMENT 9

Hazardous waste: definition, terminology, classification and Sources – Need for hazardous waste management: Need, Handling, methods of collection, storage and transport with suitable examples. Solid waste management: Need, Waste prevention and Life cycle assessment. Collection, storage, reuse and recycling of solid waste with suitable examples.

UNIT–V GREEN CO-RATING 9

Ecological Footprint - Need for Green Co-Rating – Green Co-Rating System – Intent – System Approach– Weightage-AssessmentProcess–TypesofRating–GreenCo-Benefits–Case Studies of Green Co-Rating.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

- **CO1:**Understand the Concepts of environmental sustainability and environmental impact assessment objectives
- **CO2:** Apply suitable scheme towards design of green manufacturing requirements.
- **CO3**: Analyze manufacturing processes towards conservation of energy.
- **CO4**: Analyze manufacturing processes towards minimization or prevention of hazardous and solid wastes.
- **CO5**: Acquire Knowledge of green co- rating and its benefits are well known to the students.

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CO-PO MAPPING

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
1	1	-	-	1	1	1
2	1	-	-	1	1	1
3	1	-	-	1	1	1
4	1	-	-	1	1	1
5	1	-	-	1	1	1
AVG.	1	-	-	1	1	1