Syed Ammal Engineering College, Ramanathapuram

An Autonomous Institution

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.

Regulation 2024

Choice Based Credit System

M.E. Manufacturing Engineering

CURRICULUM & SYLLABI FOR SEMESTERS I TO IV

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

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
Graduates of the programme M.E. Manufacturing Engineering will able **PEO 1**. To prepare students to know and utilize the modern manufacturing facility in order to improve productivity. **PEO 2.** To impart skills to use smart machines and apply latest technology in manufacturing field to innovate production process that will be useful to the Society **PEO 3.** To imbibe skills for integrated problem-solving techniques to optimize the Manufacturing resources for sustainable development **PEO 4:** To develop research attitude, new product, and process to solve problems in the field of manufacturing and to prepare the necessary reports.

PROGRAMME OUTCOMES (POs)

Manufacturing Engineering Graduates will be able to

PO 1. Carry out research/investigation independently and development work to solve practical problems

PO 2. Write and present a substantial technical report/document

PO 3. Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO 4. Design systems, components, or processes meeting specified needs for the manufacturing industry and to improve its efficiency.

PO 5. Use modern equipment and problem-solving tools for improving the manufacturing systems and processes in all aspects including technical, financial and management

PO 6. Pursue higher studies / pursue their career or entrepreneur in manufacturing and allied industries

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On successful completion of the programme, the Graduates of M.E. Manufacturing Engineering Degree shall exhibit the following:

PSO 1. Apply advanced manufacturing technologies, automation, and digital integration to enhance precision, efficiency, and productivity in modern manufacturing systems

PSO 2. Innovate sustainable and research-driven manufacturing solutions by optimizing processes, minimizing environmental impact, and advancing material and product development.

SEMESTER-I

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1		Induction Programme		-	-	-	-	0
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	**17**	**1**	**6**	**24**	**21**

SEMESTER-II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	24MF201T	Optimization Techniques in Manufacturing	PCC	3	0	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								
7	24MF201P	Automation and Metal Forming Laboratory	PCC	0	0	3	3	1.5
8	24MF202P	Advanced Manufacturing Processes Laboratory	PCC	0	0	3	3	1.5
			Total	**21**	**0**	**6**	**27**	**24**

SEMESTER-III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1		Professional Elective III	PEC	3	0	0	3	3
2		Professional Elective IV	PEC	3	0	0	3	3
3		Professional Elective V	PEC	3	0	0	3	3
4		Open Elective	OEC	3	0	0	3	3
PRACTICAL								
5		Project Work I	EEC	0	0	12	12	6
			Total	12	0	12	24	18

SEMESTER-IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICAL								
1		Project Work II	EEC	0	0	24	24	12
			Total	0	0	24	24	12

TOTAL CREDITS: 75

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	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	24MF101T	Advances in Manufacturing Processes	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 Metal Forming 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 Methodologyand 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 Manufacture 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

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.		English for Research Paper Writing	2	0	0	0
2.		Disaster Management	2	0	0	0
3.		Constitution of India	2	0	0	0
4.		நற்றமிழ் இலக்கியம்	2	0	0	0

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

SUMMARY

S.No	Course 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
	Total Credits	21	24	18	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)

SEMESTER I

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

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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, the students will be able to

CO 1: Analyze the performance in terms of probabilities and distributions achieved by the determined solutions.

CO 2: Be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.

CO 3: Apply the basic principles underlying statistical inference(hypothesis testing).

CO 4: Demonstrate knowledge of applicable large sample theory of estimators and tests.

CO 5: 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's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	2	3	4	5	6	1	2
1	2	-	-	-	-	2	-	-
2	-	-	-	-	-	-	-	-
3	2	-	-	-	1	2	-	-
4	-	-	3	1	-	-	-	-
5	-	-	3	-	-	2	-	-
Avg.	**0.8**	**-**	**1.2**	**0.2**	**0.2**	**1.2**	**-**	**-**

1-Low, 2-Medium, 3-High, '-' - No correlation

24MF101T	ADVANCES IN MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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

COURSE OUTCOMES:

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

CO 1: Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials.

CO 2: Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.

CO 3: Analyze the different bulk metal forming process mechanics using different analysis

CO 4: Acquire the knowledge in mechanical micromachining processes.

CO 5: 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's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	2	3	4	5	6	1	2
1	3	2	3	3	3	2	2	3
2	3	2	3	3	3	2	-	3
3	3	2	3	3	3	-	-	3
4	3	2	3	3	3	2	-	3
5	3	2	3	3	3	3	3	3
Avg.	3	2	3	3	3	1.8	1	3

1-Low, 2-Medium, 3-High, '-' - No correlation

24MF102T ADVANCES IN CASTING AND WELDING L T P C

3 0 0 3

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Impart knowledge on basic concepts and advances in casting and welding processes.

CO 2: Know and perform solid state and special welding processes.

CO 3: Understand and analyze the material structures after welding.

CO 4: Design the weldments for various materials.

CO 5: Attain the knowledge about various welding defects and inspection methods

REFERENCES:

1. ASM Hand book vol.6," welding Brazing & Soldering", 2010
2. ASM Hand book, 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.
6. Iotrowski – "Robotic welding – A guide to selection and application" – Society of mechanical Engineers, 1987.
7. Jain P.L., "Principles of Foundry Technology", Tata McGraw Hill Publishers, 2003
8. Lancaster.J.F. – "Metallurgy of welding" – George Alien & Unwin Publishers, 1999.
9. Parmer R.S., "Welding Engineering and Technology", Khanna Publishers,2002

10. Schwariz, M.M. – "Source book on innovative welding processes" – American Society for Metals (OHIO), 1981
11. Srinivasan N.K., "Welding Technology", Khanna Tech Publishers, 2002
12. P N Rao "Manufacturing Technology" , Vol 1, 3rd edition ,2011

CO's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
1	1	-	-	-	-	1	2	3
2	-	-	2	3	2	-	-	3
3	1	-	-	-	2	1	-	3
4	-	-	-	-	-	2	-	3
5	2	-	3	-	-	-	3	3
Avg.	**1**	**0.4**	**1**	**0.6**	**0.8**	**0.8**	**1**	**3**

1-Low, 2-Medium, 3-High, '-' - No correlation

24MF103T THEORY OF METAL CUTTING

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- To familiarize with the basic principles of metal cutting
- To familiarize the students various cutting tool materials and its wear mechanisms during the machining operation.
- To 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 **9**

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, the students will be able to

CO 1: Know Basics of orthogonal cutting, oblique cutting and chip formation
CO 2: Learn Different tool materials, tool life and tool wear mechanisms
CO 3: Understand necessity for a cutting fluid and cutting efficiency
CO 4: Learn basics of the Single and Multipoint cutting tools
CO 5: Analyze 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

CO's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	2	3	4	5	6	1	2
1	3	-	2	2	0	-	-	2
2	3	-	2	2	2	-	-	2
3	3	-	-	2	2	-	2	-
4	3	-	2	2	2	-	-	2
5	3	-	2	2	2	-	-	2
Avg.	**3**	**0**	**1.6**	**2**	**2**	**0**	**0.4**	**1.6**

1-Low, 2-Medium, 3-High, '-' - No correlation

24MF104T COMPUTER AIDED MANUFACTURING L T P C

3 0 0 3

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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 the course, the students will be able to

CO 1: Recognize the importance of CAD, CAM, CIM, Engineering product specification and interpreting geometric specifications.

CO 2: Improve knowledge on the integration of CAD and CAM.

CO 3: Exhibit competency in manual part program and generation of CNC part program using CAM packages.

CO 4: Describe the implementation of CAD and CAM in manufacturing processes.

CO 5: 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.
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CO's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	2	3	4	5	6	1	2
1	3	2	2	2	2	1	2	3
2	3	2	2	3	3	1	2	3
3	3	2	2	3	3	1	2	3
4	3	2	2	3	3	1	2	3
5	3	2	2	3	3	2	2	3
Avg.	3	2	2	2.8	2.8	1.2	2	3

1-Low, 2-Medium, 3-High, '-' - No correlation

24RM101T RESEARCH METHODOLOGY AND IPR

L	T	P	C
3	0	0	3

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.

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

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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.
- To 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

- Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving canned cycle
- 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.
- 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.

- Mechanical Drawing: Machining and surface finish symbols and tolerances in dimensioning.
- CAD: Introduction to CAD, CAM, software in product life cycle.
- 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.
- 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

- Bearing
- Couplings
- Gears
- Sheet metal components
- Jigs, Fixtures and Die assemblies.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO 1: 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.

CO 2: 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.

CO 3: 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.

CO 4: 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.

CO 5: 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's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
1	3	2	2	3	2	1	2	3
2	3	2	2	3	3	1	2	3
3	3	2	2	3	3	1	2	3
4	3	2	2	3	3	1	2	3
5	3	3	2	3	3	2	2	3
Avg.	**3**	**2.2**	**2**	**3**	**2.8**	**1.2**	**2**	**3**

1-Low, 2-Medium, 3-High, '-' - No correlation

24TM202P	TECHNICAL SEMINAR	L	T	P	C
		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.

COURSE OUTCOMES:

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

CO 1: Develop skills to search, read, write, comprehend and present research papers in the areas of manufacturing engineering.

CO 2: Update the latest technology in the field of Manufacturing Engineering

CO 3: plot graph, sketch, bring out the visual about his understanding on various topics

CO's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	2	3	4	5	6	1	2
1	3	3	3	2	2	2	2	2
2	3	2	3	2	3	3	3	3
3	3	2	2	2	2	2	2	3
Avg.	**3**	**2.3**	**2.7**	**2**	**2.3**	**2.3**	**2.3**	**2.7**

1-Low, 2-Medium, 3-High, '-' - No correlation

SEMESTER II

		L	T	P	C
24MF201T	**OPTIMIZATION TECHNIQUES IN MANUFACTURING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- To make use of the optimization techniques while modeling and solving the engineering problems of different fields.
- To apply Linear Programming and Dynamic Programming to provide solutions for different problems
- To learn classical optimization techniques and numerical methods of optimization.
- To 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

COURSE OUTCOMES:

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

CO 1: Introduce the various optimization techniques and their advancements

CO 2: Apply various optimization techniques in problems of Engineering and Technology

CO 3: Use classical optimization techniques and numerical methods of optimization

CO 4: Describe the basics of different evolutionary algorithm

CO 5: 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's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
1	2	-	-	3	2	-	2	2
2	1	-	-	2	3	-	2	3
3	1	-	-	2	2	-	3	2
4	-	2	-	2	-	-	3	2
5	1	-	-	-	-	2	2	3
Avg.	**1**	**0.4**	**-**	**1.8**	**1.4**	**0.4**	**2.4**	**2.4**

1-Low, 2-Medium, 3-High, '-' - No correlation

24MF202T ADVANCES IN METROLOGY AND INSPECTION

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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

COURSE OUTCOMES:

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

CO 1: Understand the advanced measurement principles with ease.

CO 2: Operate sophisticated and accurate measuring instruments.

CO 3: Understand the various inspection methods and tools.

CO 4: Design and develop new measuring methods.

CO 5: 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", Khanna 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. White house, D.J., "Surface and their measurement", Hermes Penton Ltd, 2004.

CO's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
1	2	1	-	2	2	-	2	2
2	2	-	-	3	3	1	2	3
3	2	-	-	2	2	-	3	3
4	3	2	2	3	3	2	3	3
5	2	1	-	3	3	2	2	3
Avg.	**2.2**	**0.8**	**0.4**	**2.6**	**2.6**	**1**	**2.4**	**2.8**

1-Low, 2-Medium, 3-High, '-' - No correlation

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

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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 — Super plastic 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Upgrade their knowledge on various metal forming techniques and formability

CO 2: Apply the theory of plasticity for various types of metal forming process.

CO 3: Apply the concept of powder metallurgy to make prismatic components

CO 4: Understand Non-traditional forming processes.

CO 5: Understand the purpose of surface treatment in metal forming applications

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
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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's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
1	3	2	2	3	2	1	3	2
2	3	-	2	3	3	1	3	3
3	2	-	2	3	3	-	3	3
4	2	1	2	3	3	-	2	3
5	2	1	-	2	3	-	2	2
Avg.	**2.4**	**0.8**	**1.6**	**2.8**	**2.8**	**0.4**	**2.6**	**2.6**

1-Low, 2-Medium, 3-High, '-' - No correlation

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

3 0 0 3

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology
- To gain insights on the need, advantages and limitations of additive manufacturing (AM) versus traditional manufacturing
- To 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 SYSTEMS **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:

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

CO 1: Learn about a variety of Additive Manufacturing (AM) technologies.

CO 2: Describe additive manufacturing and explain its advantages and disadvantages

CO 3: Explain the processes used in additive manufacturing for a range of materials and applications

CO 4: Understand the role of additive manufacturing in the design process and their potential

to support Design and manufacturing,

CO 5: Do 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's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
1	3	2	2	3	3	2	3	2
2	2	2	1	2	2	1	2	2
3	3	2	2	3	3	2	3	3
4	3	2	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3
Avg.	2.8	2.2	2.2	2.8	2.8	2.2	2.8	2.6

1-Low, 2-Medium, 3-High, '-' - No correlation

24MF205T FLUID POWER AUTOMATION L T P C

3 0 0 3

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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
- To implement automation systems in Industry.

UNIT I INTRODUCTION **9**

Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatic – 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 the course, the students will be able to

CO 1: Familiarize in the area of hydraulic, pneumatic and fluid power components and its functions.

CO 2: Recognize the standard symbols used in fluid power circuits and assess the suitable component for a particular application

CO 3: Construct the hydraulic circuits for an industrial application.

CO 4: Build a pneumatic circuit and apply them to real life problems.

CO 5: 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
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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's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
1	3	1	2	3	2	1	3	2
2	2	1	1	3	3	1	2	2
3	3	2	2	3	3	2	3	3
4	3	2	2	3	3	2	3	3
5	3	2	3	3	3	3	3	3
Avg.	**2.8**	**1.6**	**2**	**3**	**2.8**	**1.8**	**2.8**	**2.6**

1-Low, 2-Medium, 3-High, '-' - No correlation

24MF201P	**AUTOMATION AND METAL FORMING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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:

METAL FORMING LAB:

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 the course, the students will be able to

CO 1: Impart practical knowledge on bulk metal forming processes

CO 2: Know various symbols used in Hydraulic and Pneumatic circuits

CO 3: Conduct few sheet metals forming processes and analyze the parameters

CO 4: Design hydraulic circuits for industrial applications

CO 5: Learn how to use automation studio

CO's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
1	3	1	2	3	2	1	3	3
2	2	1	1	2	2	1	2	2

3	3	2	2	3	3	2	3	3
4	3	2	3	3	3	3	3	3
5	3	2	2	3	3	3	3	3
Avg.	**2.8**	**1.6**	**2**	**2.8**	**2.6**	**2**	**2.8**	**2.8**

1-Low, 2-Medium, 3-High, '-' - No correlation

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

COURSE OBJECTIVES:

Upon completing this course, the students will be able

- 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

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

I ADVANCED MACHINING PROCESS

- Analysis of cutting forces during turning/drilling process.
- Analysis of temperature during turning/drilling process.
- Study on the effect of process parameters in Electro-Chemical/Electric-Discharge Machining

II PROCESS MODELLING

- Analysis of stress strain distribution in a structural loading of composite bar using MATLAB codes.
- Transient heat transfer analysis of a rectangular slab using a FEA package.
- Modeling & simulation of forging/rolling/machining process using a FEA package.

II RAPID PROTOTYPING

- Selection of Rapid Prototyping Technology.
- Product development activity – Concept design and Detailed design.
- Product development activity – Engineering analysis and Prototype development.

IV ROBOTICS

- Determination of maximum and minimum position of links.
- Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
- Estimation of accuracy, repeatability and resolution.
- Robot programming and simulation for pick and place
- Robot programming and simulation for Color identification
- Robot programming and simulation for Shape identification

COURSE OUTCOMES:

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

CO 1: Perform modeling and simulation of manufacturing processes
CO 2: Analyze the process using an FEA package
CO 3: Competence to execute product development phases
CO 4: Simple programming for robotic applications
CO 5: Use EDM/ECM for machining different materials

CO's – PO's & PSO's MAPPING

CO	PO						PSO	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
1	3	2	2	3	3	2	3	3
2	3	2	2	3	3	2	3	3
3	3	2	3	3	3	3	3	3
4	2	2	2	3	3	3	2	3
5	3	2	2	3	3	2	3	3
Avg.	**2.8**	**2**	**2.2**	**3**	**3**	**2.4**	**2.8**	**3**

1-Low, 2-Medium, 3-High, '-' - No correlation