ANNA UNIVERSITY, CHENNAI
NON- AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY

M.E. MANUFACTURING ENGINEERING
REGULATIONS 2021

CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTERS CURRICULA & SYLLABI

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs): (3)

I.	To prepare students to know and utilize the modern manufacturing facility in order to improve productivity.
II.	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
III.	To imbibe skills for integrated problem-solving techniques to optimize the Manufacturing resources for sustainable development
IV.	To develop research attitude, new product, and process to solve problems in the field of manufacturing and to prepare the necessary reports.

2. PROGRAMME OUTCOMES (POs):

PO	Programme Outcomes
1.	An ability to independently carry out research/investigation and development work to solve practical problems
2.	An ability to write and present a substantial technical report/document
3.	Students should be able to 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
4.	An ability to design systems, components, or processes meeting specified needs for the manufacturing industry and to improve its efficiency.
5.	To use modern equipment and problem-solving tools for improving the manufacturing systems and processes in all aspects including technical, financial and management
6.	To pursue higher studies / pursue their career or entrepreneur in manufacturing and allied industries

3. PEO / PO Mapping:

PEO	PO					
	1	**2**	**3**	**4**	**5**	**6**
I	-	-	3	-	3	2
II	2	2	-	3	3	-
III	1	-	2	3	3	-
IV	3	2	-	-	-	2

PROGRAM ARTICULATION MATRIX OF M.E. MANUFACTURING ENGINEERING

Year	Semester	Course Name	PO					
			1	2	3	4	5	6
I	I	Applied Probability and Statistics for Manufacturing Engineering	2	-	3	1	1	2
		Advances in Manufacturing Processes	1	-	3	1	2	2
		Advances in Casting and Welding	1.3	-	2.5	3	2	1.3
		Theory of Metal Cutting	1	-	2.3	1.5	2	1
		Computer Aided Manufacturing	1.5	2	-	2.5	2	1.3
		Research Methodology and IPR	2	2	2.5	2.4	2	1
		Professional Elective -I						
		Audit Course – I*						
		CAD/CAM Laboratory	1	2	-	2.5	2.25	1.25
		Technical Seminar	1	1.6	3	-	2	-
	II	Optimization Techniques in Manufacturing	1.25	2	-	2.5	2.33	2
		Advances in Metrology and Inspection	1	-	3	1	1.75	1.25
		Theory of Metal Forming	1	-	1.5	2	1.5	2.5
		Additive Manufacturing	1.5	-	2.5	3	2	2.5
		Fluid Power Automation	1	-	3	2	3	2.5
		Professional Elective -II						
		Audit Course – II*						
		Automation and Metal Forming Laboratory	-	2	1	2	2.33	1
		Advanced Manufacturing Processes Laboratory	1	1	3	2	3	2
II	III	Professional Elective –III						
		Professional Elective -IV						
		Professional Elective -IV						
		Open Elective						
		Project Work I	1.75	2	2.5	2.5	2	2
	IV	Project Work II	1.75	2	2.5	2.5	2	2

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I TO IV SEMESTERS CURRICULA AND I SEMESTER SYLLABUS

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4155	Applied Probability and Statistics for Manufacturing Engineering	FC	3	1	0	4	4
2.	MF4101	Advances in Manufacturing Processes	PCC	3	0	0	3	3
3.	MF4102	Advances in Casting and Welding	PCC	3	0	0	3	3
4.	MF4103	Theory of Metal Cutting	PCC	3	0	0	3	3
5.	CM4151	Computer Aided Manufacturing	PCC	3	0	0	3	3
6.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
7.		Audit Course – I*	AC	2	0	0	2	0
PRACTICALS								
8.	MF4111	CAD/CAM Laboratory	PCC	0	0	4	4	2
9.	MF4112	Technical Seminar	EEC	0	0	2	2	1
			TOTAL	**19**	**1**	**6**	**26**	**21**

* Audit Course is optional

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MF4201	Optimization Techniques in Manufacturing	PCC	3	0	0	3	3
2.	MF4202	Advances in Metrology and Inspection	PCC	3	0	0	3	3
3.	MF4203	Theory of Metal Forming	PCC	3	0	0	3	3
4.	MF4204	Additive Manufacturing	PCC	3	0	0	3	3
5.	MF4205	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
8.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
9.	MF4211	Automation and Metal Forming Laboratory	PCC	0	0	3	3	1.5
10.	MF4212	Advanced Manufacturing Processes Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**23**	**0**	**6**	**29**	**24**

* Audit Course is optional

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	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
PRACTICALS								
5.	MF4311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**12**	**24**	**18**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	MF4411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 75

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA4155	Applied Probability and Statistics for Manufacturing	3	1	0	4	1

PROGRAM CORE COURSES (PCC)

Sl.No	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1	MF4101	Advances in Manufacturing Processes	3	0	0	3	1
2	MF4102	Advances in Casting and Welding	3	0	0	3	1
3	MF4103	Theory of Metal Cutting	3	0	0	3	1
4	CM4151	Computer Aided Manufacturing	3	0	0	3	1
5	MF4111	CAD/CAM Laboratory	0	0	4	2	1
6	MF4201	Optimization Techniques in Manufacturing	3	0	0	3	2
7	MF4202	Advances in Metrology and Inspection	3	0	0	3	2
8	MF4203	Theory of Metal Forming	3	0	0	3	2
9	MF4204	Additive Manufacturing	3	0	0	3	2
10	MF4205	Fluid Power Automation	3	0	0	3	2
11	MF4211	Automation and Metal Forming Laboratory	0	0	3	1.5	2
12	MF4212	Advanced Manufacturing Processes Laboratory	0	0	3	1.5	2

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.		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.	MF4071	Design for Manufacture and Assembly	PEC	3	0	0	3	3
2.	MF4001	Micro Manufacturing	PEC	3	0	0	3	3
3.	MF4002	Quality and Reliability Engineering	PEC	3	0	0	3	3
4.	MF4003	Finite Element Methods for Manufacturing Engineering	PEC	3	0	0	3	3
5.	MF4004	Materials Management	PEC	3	0	0	3	3
6.	MF4005	Industrial Ergonomics	PEC	3	0	0	3	3
7.	MF4006	Polymers and Composite Materials	PEC	3	0	0	3	3
8.	MF4072	Non-Destructive Testing	PEC	3	0	0	3	3
9.	MF4007	Lean Manufacturing	PEC	3	0	0	3	3
10.	MF4008	Robot Design and Programming	PEC	3	0	0	3	3
11.	MF4009	MEMS and Nanotechnology	PEC	3	0	0	3	3
12.	CM4071	Green Manufacturing	PEC	3	0	0	3	3

SEMESTER III, ELECTIVES - III, IV & V

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MF4010	Computer Aided Product Design	PEC	3	0	0	3	3
2.	MF4011	Process Planning and Cost Estimation	PEC	3	0	0	3	3
3.	MF4073	Manufacturing Management	PEC	3	0	0	3	3
4.	MF4012	Nanotechnology	PEC	3	0	0	3	3
5.	MF4013	Materials Testing and Characterization Techniques	PEC	3	0	0	3	3
6.	MF4014	Mechatronics	PEC	3	0	0	3	3
7.	MR4071	Internet of Things for Manufacturing	PEC	3	0	0	3	3
8.	IS4071	Data Analytics	PEC	3	0	0	3	3
9.	CM4072	Manufacturing System Simulation	PEC	3	0	0	3	3
10.	PD4351	Product Lifecycle Management	PEC	3	0	0	3	3
11.	MF4015	Product Design and Development	PEC	3	0	0	3	3
12.	MF4016	Entrepreneurship Development	PEC	3	0	0	3	3
13.	MF4020	Industrial Safety	PEC	3	0	0	3	3
14.	MF4017	Advances in Materials	PEC	3	0	0	3	3
15.	MF4018	Artificial Intelligence	PEC	3	0	0	3	3
16.	MF4019	Smart Manufacturing and Industry 4.0	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.	AX4091	English for Research Paper Writing	2	0	0	0
2.	AX4092	Disaster Management	2	0	0	0
3.	AX4093	Constitution of India	2	0	0	0
4.	AX4094	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.	MF4311	Project Work - I	0	0	12	6	3
2.	MF4411	Project Work-II	0	0	24	12	4
TOTAL CREDITS							**18**

SUMMARY

	Name of the Programme: M.E Manufacturing Engineering					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	4	0	0	0	4
2.	PCC	14	18	0	0	32
3.	PEC	0	6	9	0	15
4.	RMC	2	0	0	0	2
5.	OEC	0	0	3	0	3
6.	EEC	1	0	6	12	19
7.	Non-Credit/Audit Course	0	0	0	0	0
8.	**TOTAL CREDIT**	**21**	**24**	**18**	**12**	**75**

MA4155 APPLIED PROBABILITY AND STATISTICS FOR MANUFACTURING ENGINEERING

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

1. To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
2. To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables.
3. To apply the small and large sample tests through test of hypothesis.
4. To understand the basic concepts of sampling distributions and statistical properties of point estimators.
5. 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 design.

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					
	1	2	3	4	5	6
1	2	-	-	-	-	2
2	-	-	-	-	-	-
3	2	-	-	-	1	2
4	-	-	3	1	-	-
5	-	-	3	-	-	2
Avg.	2	-	3	1	1	2

MF4101 ADVANCES IN MANUFACTURING PROCESSES L T P C
3 0 0 3

OBJECTIVES:

1. To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.
2. 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.
3. To impart knowledge about principles and criteria of yielding during forming of metals, analysis of different bulk metal forming processes following different analysis approach.
4. To give awareness of different techniques used in Micro and Nano manufacturing.
5. 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

1. Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials.
2. Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.
3. Analyze the different bulk metal forming process mechanics using different analysis
4. Acquire the knowledge in mechanical micromachining processes.
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-PO Mapping

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

MF4102 ADVANCES IN CASTING AND WELDING L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To study the metallurgical concepts and applications of casting and welding process.
2. To acquire knowledge in CAD of casting and automation of the welding process.
3. To know various solid state and special welding processes.
4. To introduce metallurgy of welding.
5. 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.
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-PO Mapping

CO	PO					
	1	2	3	4	5	6
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

MF4103 **THEORY OF METAL CUTTING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To make the students to familiar with the basic principles of metal cutting
2. To familiarise the students various cutting tool materials and its wear mechanisms during the machining operation.
3. Differentiate between single point and multi point cutting tools
4. To study the heat generation during machining and the necessity for cutting fluid
5. 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.

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

TOTAL: 45 PERIODS

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.

CM4151 COMPUTER AIDED MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To introduce the evolution of CAD, CAM, CIM, engineering product specification and interpreting geometric specifications.
2. To train the candidates on the integration of Computer Aided Design and Computer Aided Manufacturing.
3. To impart knowledge on manual part program and generation of CNC part program using Computer Aided Manufacturing packages.
4. To introduce with the implementation of CAD and CAM in manufacturing process.
5. 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 ,2009, ISBN: 978-0131429192.
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					
	1	2	3	4	5	6
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

RM4151 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.

MF4111 CAD / CAM LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES:

1. To introduce components and assemblies used in machines and use of 3D parametric CAD, CAM software for mechanical design.
2. 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.
3. 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.
4. 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
5. 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;

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.
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.
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.
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.
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-PO Mapping

CO	PO					
	1	2	3	4	5	6
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

MF4112 **TECHNICAL SEMINAR** **L T P C**
0 0 2 1

OBJECTIVES:

(1) To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology

(2) To ensure that students possess a comprehensive understanding of the latest development in his chosen area

(3) 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.

OUTCOME:

At the end of this course the students are expected;

(1) To develop skills to search, read, write, comprehend and present research papers in the areas of manufacturing engineering.

(2) Updated with the latest technology in the field of Manufacturing Engineering

(3) Able to plot graph, sketch, bring out the visual about his understanding on various topics

TOTAL: 30 PERIODS

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	1	-	-	2	-
2	1	2	3	-	2	-
3	1	2	3	-	2	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
Avg.	1	1.66	3	-	2	-

MF4201 **OPTIMIZATION TECHNIQUES IN MANUFACTURING** **L T P C**
3 0 0 3

OBJECTIVES:

1) To make use of the optimization techniques while modelling and solving the engineering problems of different fields.
2) To apply Linear Programming and Dynamic Programming to provide solutions for different problems
3) Learn classical optimization techniques and numerical methods of optimization.
4) Know the basics of different evolutionary algorithms.
5) 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:

1) At the end of this course the students will be expected to introduce the various optimization techniques and their advancements.
2) Ability to go in research by applying optimization techniques in problems of Engineering and Technology
3) Use classical optimization techniques and numerical methods of optimization.
4) Describe the basics of different evolutionary algorithms
5) 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	PO					
	1	2	3	4	5	6
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

MF4202 ADVANCES IN METROLOGY AND INSPECTION L T P C
3 0 0 3

OBJECTIVES:

1) To teach the students basic concepts in various methods of engineering measurement techniques and applications
2) To make them understand the importance of measurement and inspection in manufacturing industries.
3) To understand the use of Light rays and Laser beams for measurement and their merits
4) To make the students capable of learning to operate and use advanced metrological devices with ease in industrial environments.
5) 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

1. Understand the advanced measurement principles with ease.
2. Operate sophisticated and accurate measuring instruments.
3. Understand the various inspection methods and tools
4. Design and develop new measuring methods.
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", 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	PO					
	1	2	3	4	5	6
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

MF4203 THEORY OF METAL FORMING L T P C
3 1 0 4

OBJECTIVES:

1) To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
2) To study the thermo mechanical regimes and its requirements of metal forming
3) To learn the art of processing and making of powder metallurgy components
4) To learn the effect of friction and lubrication in Metal forming
5) 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.

OUTCOMES:

1) At the end of this course the students are expected to upgrade their knowledge on various metal forming techniques and formability
2) Apply the theory of plasticity for various types of metal forming process.
3) Apply the concept of powder metallurgy to make prismatic components
4) Understand Non-traditional forming processes.
5) 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 Mapping

CO	PO					
	1	2	3	4	5	6
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

MF4204 ADDITIVE MANUFACTURING L T P C
3 0 0 3

OBJECTIVE:

1) To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology
2) Gain insights on the need, advantages and limitations of additive manufacturing (AM) versus traditional manufacturing
3) Find out the various applications of AM, Deployment levels, Innovative and optimized product design
4) To explore the potential of additive manufacturing in different industrial sectors.
5) 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

OUTCOMES:

1) The students are expected to learn about a variety of Additive Manufacturing (AM) technologies.
2) Describe additive manufacturing and explain its advantages and disadvantages
3) Explain the processes used in additive manufacturing for a range of materials and applications
4) understand the role of additive manufacturing in the design process and their potential to support Design and manufacturing,
5) 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	PO					
	1	2	3	4	5	6
1	2	-	2	-	-	-
2	1	-	-	-	-	2
3	-	-	3	-	2	-
4	-	-	-	3	-	-
5	-	-	-	-	2	3
Avg.	1.5	-	2.5	3	2	2.5

MF4205 FLUID POWER AUTOMATION L T P C
3 0 0 3

OBJECTIVES:

1) To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
2) To train the students in designing the hydraulic and pneumatic circuits using various design procedures.
3) To understand the concept and principle operation of automation systems and their controls.
4) To provide knowledge levels needed for PLC programming and operating
5) 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

OUTCOMES:

1) At the end of this course the students are familiarized in the area of hydraulics, pneumatic and fluid power components and its functions.
2) Recognize the standard symbols used in fluid power circuits and assess the suitable component for a particular application
3) Construct the hydraulic circuits for an industrial application.
4) Build a pneumatic circuit and apply them to real life problems.
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
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					
	1	2	3	4	5	6
1	1	-	-	-	-	-
2	1	-	3	-	-	2
3	-	-	3	2	-	-
4	1	-	-	2	3	-
5	-	-	-	-	-	3
Avg.	1	-	3	2	3	2.5

MF4211 AUTOMATION AND METAL FORMING LABORATORY L T P C
0 0 3 1.5

OBJECTIVE

1) To train the students on the basic concepts of metal forming processes
2) To determine metal forming parameters for a given shape.
3) To learn the automation systems using fluid power control systems
4) To learn and use automation studio software
5) 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

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					
	1	2	3	4	5	6
1	-	2	1	2	-	-
2	-	2	-	2	-	-
3	-	2	-	-	3	1
4	-	2	-	-	2	1
5	-	2	-	-	2	1
Avg.	-	2	1	2	2.33	1

MF4212 ADVANCED MANUFACTURING PROCESSES LABORATORY L T P C

(Students can do any three sets for this lab out of the given four i.e. I, II, III, IV) **0 0 3 1.5**

COURSE OBJECTIVES

(1) To analyses the forces in machining
(2) To perform modelling and simulation of manufacturing processes
(3) To develop product using rapid prototyping
(4) To program a robot for an autonomous movement
(5) 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.

III 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:

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

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
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

MF4311 **PROJECT WORK – I** **L T P C**
0 0 12 6

OBJECTIVES:
(1) To develop knowledge to formulate a real-world problem.
(2) To break up the goal and evolve procedures
(3) To use different tools and techniques to arrive at a solution
(4) To validate the results analytically and experimentally
(5) To prepare a report and give a presentation

Student shall identify a minor problem related to the field of Manufacturing and carry out a literature survey/case studies/data collection. Student is supposed to formulate Engineering solutions to the problem, methodology to test their hypothesis/solutions and validate it theoretically/practically, planned and executed within the stipulated time Observations, results and inference should be documented and presented as report in the prescribed format.

TOTAL: 180 PERIODS

OUTCOMES
After successful completion of this course, the students should be able to
(1) Design and analyze, an identified problem using scientific tools
(2) Simulation/ Theoretical analysis of a physical system
(3) Integrate various domain knowledge for a sustainable solution.
(4) Set Goals, Targets, timeline, plan and execute activities of the project
(5) Disseminate work both in oral and written format**.**

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	2		3	2	
2	2	2		1		
3	2	2	3	3	2	
4	2	2		3		2
5	-	2	2			2
Avg	1.75	2	2.5	2.5	2	2

MF4411 **PROJECT WORK – II** **L T P C**
0 0 24 12

OBJECTIVES:
(1) To develop knowledge to formulate a real-world problem.
(2) To break up the goal and evolve procedures
(3) To use different tools and techniques to arrive at a solution
(4) To validate the results analytically and experimentally
(5) To prepare a report and give a presentation

Student shall identify a major/critical problem related to the field of Manufacturing and carry out a literature survey/case studies/data collection. Student supposed to formulate Engineering solutions to

set objectives, methodology to test their hypothesis/solutions and validate it theoretically/practically, planned and executed within the stipulated time.
Observations, results and inferences should be documented and presented as report in the prescribed format.

TOTAL: 360 PERIODS

OUTCOMES

After successful completion of this course, the students should be able to
(1) Design and analyze, an identified problem using scientific tools and research
(2) simulation/ Theoretical analysis of a physical system
(3) Integrate various domain knowledge in carrying out experimental work and provide a sustainable solution.
(4) Set Goals, Targets, timeline, plan and execute activities of the project
(5) Disseminate work both in oral and written format.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	2		3	2	
2	2	2		1		
3	2	2	3	3	2	
4	2	2		3		2
5	-	2	2			2
Avg	1.75	2	2.5	2.5	2	2

MF4071 DESIGN FOR MANUFACTURE AND ASSEMBLY L T P C
3 0 0 3

OBJECTIVES:

(1) To apply various design rules in manufacturing processes
(2) To evaluate the process by design guidelines for optimum design
(3) To analyze the rules of concepts of GD& T
(4) To make the students to learn about tolerance analysis and allocation, geometrical tolerances
(5) Guide lines 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 – Boothroyd and Dewhurst method of DFMA – DCS – Vis/VSA – 3D Dimensional control – Statistical tolerance Analysis Software – Applications.

TOTAL: 45 PERIODS

OUTCOMES :

At the end of this course the students are expected

(1)To impart the knowledge about the significance of design for manufacturing and assembly

(2)To apply the principle of tolerancing in design

(3)Evaluate the process of GD & T using design guidelines

(4)Apply tolerance allocation and tolerance charting in design

(5)Apply guidelines for manufacturing and assembly

REFERENCES:

1. Alex Krulikowski, “Fundamentals GD&T”, Delmar Thomson Learning, 1997.
2. C.M. Creveling, “Tolerance Design – A handbook for Developing Optimal Specifications”, Addison – Wesley, 1997.
3. James D. Meadows, ‘Geometric Dimensioning and Tolerancing”, Marcel Dekker Inc., 1995.
4. James G. Bralla, “Handbook of Product Design for Manufacturing”, McGraw Hill, 1986.
5. Oliver R. Wade, “Tolerance Control in Design and Manufacturing”, Industrial Press, NY, 1967.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
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

MF4001 **MICRO MANUFACTURING** **L T P C**
3 0 0 3

OBJECTIVES:

(1) The objective of the course is to acquaint the students with the principles of micro manufacturing
(2) To learn basic machine tools used in micro manufacturing and developments in the micro manufacturing process
(3) To familiarize with the research trends in the area of micro manufacturing process.
(4) To learn various polishing techniques
(5) 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

OUTCOMES:

At the end of this course the students are well experienced

(6) To impart the principles of various basic micro manufacturing process
(7) To know and perform micro machining
(8) Research various micro machining process to optimize the process variables
(9) Attain knowledge about polishing techniques
(10) Measure and analyse the various parameters of micro machined components

REFERENCES:

1. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN:8122422578.
2. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
3. Jain V.K., 'Introduction to Micro machining' Narosa Publishing House, 2011
4. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002
5. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012
6. Janocha H., Actuators – Basics and applications, Springer publishers – 2012
7. Mcgeoug.J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.
8. www.cmxr.com/industrial/
9. www.sciencemag.org.handbook

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	-	-	3	-	-	-
2	1	-	-	-	2	-
3	3	1	-	-	-	-
4	-	-	-	-	2	2
5	1	-	-	-	2	-
Avg	1.66	1	-	-	2	2

MF4002 QUALITY AND RELIABILITY ENGINEERING L T P C
3 0 0 3

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

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.

(1) Apply control chart techniques in production process
(2) Understand inspection by sampling techniques
(3) Able to do reliable design
(4) Improve the availability of equipment through proper maintenance
(5) 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” Prentice Hall, 1993.
3. Charles E Ebling, An Introduction to Reliability and Maintainability Engineering, Tata-McGraw Hill, 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-Wiley and Sons Inc, 2002

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
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

MF4003 FINITE ELEMENT METHODS FOR MANUFACTURING ENGINEERING **L T P C 3 0 0 3**

OBJECTIVE:

(1) To familiarize the students with fundamentals of finite element method,
(2) To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.
(3) Acquaint students with finite element formulations and theories
(4) Develop the ability to perform finite element analyses and evaluate the results of a select set of manufacturing processes,
(5) 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 analysis in solid mechanics and heat transfer.

UNIT III 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—Non linear 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

OUTCOMES :

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

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

REFERENCES:

1. Bathe, K.J., Finite Element procedures in Engineering Analysis, 1990
2. Kobayash,S, Soo-ik-Oh and Altan,T, Metal Forming and the Finite Element Methods, Oxford University Press, 1989.
3. Lewis R.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, Pergammon press, 2005.
5. Reddy, J.N. An Introduction to the Finite Element Method, McGraw Hill,2005.
6. Seshu P., Textbook of Finite Element Analysis, PHI Learning Pvt. Ltd, 2004.
7. www.pollockeng.com
8. www.tbook.com

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	2
2	2	-	-	3	-	-
3	-	-	3	2	-	-
4	2	-	-	3	-	-
5	-	-	-	-	2	1
Avg.	1.66	-	3	2.66	2	1.5

MF4004 **MATERIALS MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVE:

To introduce the students
(1) the various concepts of materials management
(2) familiarize them with vendor development and rating
(3) the various aspects of Logistics and storage
(4) Planning and Forecasting of the need
(5) Various aspects of Inventory management

UNIT I INTRODUCTION **9**
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**
ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are
(1) Familiarized with the various concepts and functions of material management
(2) Able to handle the purchase and stores Independently
(3) Understand Logistics and inventory pricing
(4) Materials planning and periodic replenishment of material
(5) 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, Anuratha Publications, 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, Prentice Hall of India, 2005.
5. Guptha P.K. and Heera, Operations Research, Suttan Chand & Sons, 2007.
6. Lamer Lee and Donald W.Dobler, Purchasing and Material Management, Text and cases, Tata McGraw Hill, 2006.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	2
2	-	-	3	-	-	-
3	-	-	3	-	-	-
4	-	-	-	2	-	-
5	-	-	-	3	2	2
Avg.	1	-	3	2.5	2	2

MF4005 INDUSTRIAL ERGONOMICS L T P C
3 0 0 3

OBJECTIVES:

(1) To introduce the concepts of Ergonomics and to indicate the areas of Applications.
(2) Identify ergonomic principles
(3) to increase awareness of the need and role of ergonomics in occupational health
(4) To inculcate analysing skills among the students with respect to work place design, working postures and lifting tasks.
(5) To provide thorough knowledge about assessment about occupational 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 IN DESIGN 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

OUTCOMES:

At the end of this course the students are

(1) updated with various concepts of Ergonomics
(2) able to provide appropriate allowances for the jobs under analysis.
(3) 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.
(4) Students will be able to assess the occupational environmental factors like heat stress, noise, and vibration and RSPM level in the industry.
(5) Maintain a comfortable environment in the work place

REFERENCES:

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

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
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

MF4006 POLYMERS AND COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVES:

(1) To impart knowledge on various polymer processing techniques
(2) To learn about various fibre, Matrix materials and their properties
(3) To learn the methods by which Polymer matrix composites are made
(4) To study about the composites used for High temperature applications
(5) To study the behaviour 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.

UNIT IV PROCESSING OF METAL MATRIX COMPOSITES 9

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

UNIT V 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

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. ASM Handbook – Composites, Vol-21, 2001, ISBN: 978-0-87170-703-1.
2. Harold Belofsky, Plastics, Product Design and Process Engineering, Hanser Publishers, 2002.
3. Jamal Y. Sheikh-Ahmad, Machining of Polymer Composites, Springer, USA, 2009. ISBN: 978-0-387-35539-9.
4. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, 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. and Newman.S., Composite Materials Technology, Hanser Publishers, 2003.
7. Said Jahanmir, Ramulu M. and Philp Koshy, Machining of Ceramics and Composites, Marcel Dekker Inc., New York, 1999, ISBN: 0-8247-0178-x.
8. Seamour, E.B. Modern Plastics Technology, Prentice Hall, 2002

CO-PO Mapping

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

MF4072 NON-DESTRUCTIVE TESTING L T P C
3 0 0 3

OBJECTIVES:

(1) To stress the importance of NDT in Engineering.
(2) To select the appropriate NDT Technique
(3) To familiarize with different NDT Technique
(4) To impart various knowledge to check the weld quality of various structures, pressure vessels
(5) 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, App lications.
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 Intergranular 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

OUTCOMES:

At the end of this course the students

(1) Realize the importance of various NDT Techniques
(2) Are expected to have hands on experience on all types of NDT techniques
(3) Will choose appropriate technique for testing
(4) Will Compare the merits of various NDT Techniques
(5) Characterize the flaws and defects and provide solutions

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., “Practical Non Destructive Testing” Narosa publishing house, New Delhi, 2002
2. Krautkramer. J., “Ultra Sonic Testing of Materials”, 1st Edition, Springer – Verlag Publication, New York, 1996.
3. Peter J. Shull “Non-Destructive Evaluation: Theory, Techniques and Application” Marcel Dekker, Inc., New York, 2002
4. www.ndt.net

CO-PO Mapping

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	-	-	-	-
2	-	-	3	-	-	1
3	-	-	-	2	-	-
4	-	-	-	-	1	-
5	1	-	-	2	-	1
Avg.	1	-	3	2	1	1

MF4007 LEAN MANUFACTURING L T P C
3 0 0 3

OBJECTIVE:

(1) To implement lean manufacturing concepts in the factories.
(2) Understand the distinction between mass and lean production and to be able to assess the difference in a manufacturing environment
(3) Understand the various elements of Lean systems
(4) Learn the importance of JIT
(5) 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 STABILITY OF LEAN SYSTEM: 9

Standards in the lean system – 5S system – 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

(1) To know the necessity for a Lean Manufacturing system
(2) To Differentiate between the conventional Mass production system with Lean system
(3) In effectively implement the principles of JIT
(4) To apply the Inspection tools effectively in the Lean systems
(5) To apply Hoshin planning system to create a 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	PO					
	1	2	3	4	5	6
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

MF4008 ROBOT DESIGN AND PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

(1) To impart knowledge about different types of robots and configuration
(2) To gain fundamental knowledge on robot manipulators.
(3) To provide a brief knowledge on geometry, kinematics, dynamics, motion planning and control
(4) To impart knowledge in Robot designing and programming
(5) 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 III 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 & AI TECHNIQUES 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, magnetostrictive 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

OUTCOMES:

At the end of this course the students are expected

(1) Classify and configure robots

(2) Apply the kinematic arrangement of robots and its applications in the area of manufacturing sectors

(3) To select sensors for different application

(4) To build a robot for any type of application

(5) To develop and Expert system

REFERENCES:

1. Gordon Mair, 'Industrial Robotics', Prentice Hall (U.K.) 1988
2. Groover.M.P. Industrial Robotics, McGraw – Hill International edition, 1996.
3. Saeed.B. Niku, 'Introduction to Robotics, Analysis, system, Applications', Pearson educations, 2002
4. Wesley E Snyder R, 'Industrial Robots, Computer Interfacing and Control', Prentice Hall International Edition, 1988.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	2	-	-	-
2	-	-	-	3	3	-
3	-	-	3	2	-	-
4	1	-	-	2	-	-
5	1	-	2	-	-	2
Avg	1	-	2.33	2.33	3	1

MF4009 MEMS AND NANOTECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

(1) To inspire the students to expect to the trends in manufacturing of micro components

(2) Familiarise the students with various fabrication techniques for micro components.

(3) Acquaint them with various sensors and actuators

(4) Introduce them the various methods of developing nano materials

(5) Make them understand characterization tools

UNIT I OVER VIEW OF MEMS AND MICROSYSTEMS 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

OUTCOMES:

At the end of this course the students are expected

(1) Realise the need of micro electromechanical systems.
(2) Develop a knowledge to select a sensor for an application
(3) Develop a nano material
(4) characterize the Nano material
(5) Develop an Electromechanical systems

REFERENCES:

1. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
2. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.
3. Mark Madou , Fundamentals of Microfabrication, CRC Press, New York, 1997.
4. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN : 8493-9138-5
5. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
6. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN:470-85106-6
7. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
8. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc.,2013,ISBN : 978-93-82291-39-8

CO	PO					
	1	2	3	4	5	6
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

CM4071 GREEN MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES

1. To expose the students to the basics of environmental sustainability and impact assessment objectives.
2. To incorporate knowledge about the environmental based improvements towards lean manufacturing systems.
3. To analyze various machineries with intent to conserve energy
4. To analyze hazardous and solid wastes with intent to point out areas of adverse environmental impact and how this impact could be minimized or prevented.
5. To impart the knowledge about the need, procedure and benefits of Green-Co rating.

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- Assessment Process – Types of Rating – Green Co-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 schemes 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.

CO-PO MAPPING:

Course Outcomes	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	-	1	1	1
CO2	1	-	-	1	1	1
CO3	1	-	-	1	1	1
CO4	1	-	-	1	1	1
CO5	1	-	-	1	1	1
AVG.	1	-	-	1	1	1

REFERENCES:

1. Dornfield David, Green Manufacturing, Springer, 2013
2. Davim J Paulo, Green Manufacturing Processes and Systems, Springer, 2013
3. Cairncrss and Francis – Costing the earth – Harvard Business School Press – 2009
4. World Commission on Environment and Development (WCED), Our Common Future, Oxford
5. University Press 2005.
6. Green Co Case Study Booklet, CII – Sohrabji Godrej Green Business Centre, 2015

MF4010 COMPUTER AIDED PRODUCT DESIGN L T P C

3 0 0 3

OBJECTIVES:

(1) To Learn the basic concepts of Designing and Drafting.
(2) To Learn the computer aided modelling and various concepts of product design.
(3) Integrating CAE, CAD, CAM tools in product design and asses the quality and performance of products.
(4) To learn reliability and Maintainability concepts.
(5) To learn the failure analysis tools for improvement

UNIT I INTRODUCTION 9

Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

UNIT II COMPUTER GRAPHICS FUNDAMENTALS AND GEOMETRIC MODEL 9

Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations – projections – curves - Geometric Modelling – types – Wire frame surface and solid modeling – Boundary Representation, constructive solid geometry – Graphics standards – assembly modeling – use of software packages

UNIT III PRODUCT DESIGN CONCEPTS AND PRODUCT DATA MANAGEMENT 9

Understanding customer needs – Product function modelling – Function trees and function structures – Product tear down methods – Bench marking – Product portfolio – concept generation and selection – Product Data Management – concepts – Collaborative product design– manufacturing planning factor – Customization factor – Product life cycle management.

UNIT IV PRODUCT DESIGN TOOLS & TECHNIQUES 9

Product modeling – types of product models; product development process tools – TRIZ – Altshuller's inventive principles – Modeling of product metrics – Design for reliability – design for manufacturability – machining, casting, and metal forming – design for assembly and disassembly - Design for environment

UNIT V PRODUCT DESIGN TECHNIQUES 9

FMEA – QFD – Poka Yoke - DOE – Taguchi method of DOE – Quality loss functions – Design for product life cycle.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students are expected

(1) To model a product using CAD software.
(2) Assess the data for the need for a new product
(3) To apply the various design concepts and design tools and techniques while designing a product.
(4) To know the challenges in the product development
(5) To apply the failure analysis in the product design

REFERENCES:

1. Biren Prasad, "Concurrent Engineering Fundamentals Vol.11", Prentice Hall, 1997.
2. David F.Rogers.J, Alan Adams, "Mathematical Elements for Computer Graphics", McGraw Hill, 1990
3. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 1991.
4. James G.Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill, 1994
5. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, 2000

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	-
2	-	1	-	3	2	1
3	-	-	3	2	2	1
4	-	-	-	2	-	-
5	1	1	-	2	-	2
Avg.	1	1	3	2.25	2	1.33

MF4011 PROCESS PLANNING AND COST ESTIMATION L T P C
3 0 0 3

OBJECTIVES:

(1) To introduce the process planning concepts and its necessity
(2) Economical planning of tools and equipment requirement
(3) Differentiate between cost accounting and cost estimation
(4) Cost Estimation and analysis
(4) To estimate time for various machining operations

UNIT I INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection, Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods – Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation – Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs – Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time – Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring – Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

TOTAL: 45 PERIODS

OUTCOMES:

(1)Explain the concept of selection and steps in process planning, tooling, equipment selection and material evaluation

(2)Calculate process parameters and select Jig, Fixtures and quality assurance methods

(3) Apply the methods of costing and to explain the concept of estimation.

(4) Compute the cost of the product in various shops of production.

(5) Calculate the machining time for various operation

REFERENCES:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.
3. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
4. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	2	-	-	1
2	2	-	-	3	-	2
3	-	1	2	-	-	-
4	1	-	3	2	1	2
5	1	1	-	3	-	3
Avg.	1.66	1	2.33	2.66	1	2

MF4073 MANUFACTURING MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

1. Students will be able to study the concepts in facility planning.
2. Students will be able to study types of plant layout and capacity planning methods.
3. Students will be able to study the concepts of Project management.
4. Students will be able to study the concepts and methods in production planning and control.
5. Students will be able to study the concepts in Inventory and maintenance management.

UNIT-I FACILITY PLANNING 9

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

UNIT-II CAPACITY & LAYOUT PLANNING 9

Types of plant layout, criteria for good layout, Process layout, Assembly line balancing. Computer based solutions to layout problems such as CRAFT, ALDEP, CORELAP and PREP. Capacity planning – Analysis of designed capacity, installed capacity, commissioned capacity, utilized capacity, factors affecting productivity and capacity expansion strategies.

UNIT-III PROJECT MANAGEMENT 9

Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, Project management – its role in functional areas of management, network representation of a project, CPM and PERT techniques – case study

UNIT-IV PRODUCTION PLANNING & CONTROL 9

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

UNIT-V INVENTORY AND MAINTENANCE MANAGEMENT 9

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

TOTAL =45 PERIODS

COURSE OUTCOMES:

On Completion of the course the student will be able to

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

	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	1			1	
CO2	2	1			1	
CO3	2	1			1	
CO4	2	1				
CO5	2	1				
Avg	(10/5)=2	(5/5)=1			(3/3)=1	

REFERENCES:

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

MF4012 NANOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

The course is aimed to
(1) Offer an overview on properties of Nanomaterials in their design and fabrication.
(2) Inculcate insight of the nano defects and doping effects of Nanomaterials in their design fabrication.
(3) Educate them on various nano structuring processes and recent trends
(4) Provide them with knowledge of nanostructure classification and various synthetic approaches.
(5) Make them understand various Nanomaterial characterization techniques

UNIT I OVER VIEW OF NANOTECHNOLOGY 9

Definition – historical development – properties, design and fabrication Nanosystems, working principle ,applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects

UNIT II NANODEFECTS, NANO PARTICLES AND NANOLAYERS 9

Nano defects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties

UNIT III NANOSTRUCTURING 9

Nanophotolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nano-polishing of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays –Near-Field Optics - case studies and Trends

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

OUTCOMES:

At the end of this course the students are expected

(1) Obtain the knowledge on Nano systems and its applications.

(2) Gain the fundamentals of nano defects and properties.

(3) Acquire knowledge about nano structuring and fabrication techniques

(4) Apply the concepts and techniques to design various nanomaterial-based devices

(5) Aware of various morphological techniques and selecting appropriate tools for their future research.

REFERENCES:

1. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
2. Fahrner W.R., Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.
3. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.
4. Mark Madou , Fundamentals of Microfabrication, CRC Press, New York, 1997.
5. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN: 8493-9138-5
6. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
7. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN:470-85106-6
8. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
9. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc.,2013, ISBN: 978-93-82291-39-8

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	-	1
2	1	-	2	-	-	-
3	2	-	3	2	2	-
4	1	-	-	-	2	1
5	1	1	-	-	3	2
Avg.	1.2	1	2.5	2	2.33	1.33

MF4013 MATERIALS TESTING AND CHARACTERIZATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVE:

(1) Make them acquainted with microscopic techniques to analyse crystal structures
(2) Acquire an understanding on the electron microscopic techniques for characterization
(3) Gain a fundamental on chemical and thermal analysis
(4) Provide the knowledge on various static methods to characterize materials
(5) Study the failure of materials under stress

UNIT I MICRO AND CRYSTAL STRUCTURE ANALYSIS 9

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallography – Estimation of grain size – ASTM grain size numbers – Microstructure of Engineering Materials - Elements of Crystallography – X- ray Diffraction – Bragg's law – Techniques of X-ray Crystallography – Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns – Inter planer spacing – Identification of Crystal Structure, Elements of Electron Diffraction.

UNIT II ELECTRON MICROSCOPY 9

Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF & DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction & working of SEM – various Imaging Techniques – Applications- Atomic Force Microscopy- Construction & working of AFM - Applications.

UNIT III CHEMICAL AND THERMAL ANALYSIS 9

Basic Principles, Practice and Applications of X-Ray Spectrometry, Wave Dispersive X-Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravitymetric Analysis (TGA)

UNIT IV MECHANICAL TESTING – STATIC TESTS 9

Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test – Tensile Test – Stress – Strain plot – Proof Stress – Torsion Test - Ductility Measurement – Impact Test – Charpy & Izod – DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

UNIT V MECHANICAL TESTING – DYNAMIC TESTS 9

Fatigue – Low & High Cycle Fatigues – Rotating Beam & Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – AE Tests-modal analysis - Applications of Dynamic Tests.

TOTAL: 45 PERIODS

OUTCOMES:

1) At the end of this course the students are expected
2) to be knowledgeable in microstructure evaluation, crystal structure analysis,
3) to take images in electron microscopy and process those images,
4) to do Chemical Thermal Analysis,
5) Analyse the results of static and dynamic mechanical testing.

REFERENCES:

1. ASM Hand book-Materials characterization, Vol – 10, 2004.
2. Culity B.D., Stock S.R& Stock S., Elements of X ray Diffraction, (3rd Edition). Prentice Hall, 2001.
3. Davis J. R., Tensile Testing, 2nd Edition, ASM International, 2004.
4. Davis, H.E., Hauck G. & Troxell G.E., The Testing of engineering Materials, (4th Edition), McGraw Hill, College Divn., 1982.
5. Dieter G.E., Mechanical Metallurgy, (3rd Edition), ISBN: 0070168938, McGraw Hill, 1988.
6. Goldsten,I.J., Dale.E., Echin.N.P.& Joy D.C., Scanning Electron Microscopy & X ray-Micro Analysis, (2nd Edition), ISBN – 0306441756, Plenum Publishing Corp., 2000.
7. Grundy P.J. and Jones G.A., Electron Microscopy in the Study of Materials, Edward Arnold Limited, 1976.
8. Morita.S, Wiesendanger.R, and Meyer.E, “Non-contact Atomic Force Microscopy” Springer, 2002,
9. Newby J., Metals Hand Book- Metallography & Micro Structures, (9th Edition), ASM International, 1989.
10. Suryanarayana A. V. K., Testing of metallic materials, (2nd Edition), BS publications, 2007.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	-	1	-	-	-	1
2	1	-	3	2	-	-
3	1	-	-	-	2	3
4	1	2	-	-	-	-
5	1	2	3	-	-	1
Avg.	1	1.66	3	2	2	1.66

MF4014 **MECHATRONICS** **L T P C**
3 0 0 3

OBJECTIVES:

(1) Understand key elements of Mechatronics system, representation into block diagram
(2) It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.
(3) Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller
(4) Understand the concept of PLC system and its ladder programming, and significance of
PLC systems in industrial application
(5) Understand the PLC used in home appliances

UNIT I INTRODUCTION 9

Introduction to Mechatronics-systems – Mechatronics approach to modern engineering and design – Need of Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics – Mechatronics elements.

UNIT II SENSORS AND TRANSDUCERS 9

Introduction – Performance Terminology – Potentiometers – Strain gauges – I VDT – Eddy current sensor – Hall effect sensor – Capacitance sensors – Digital transducers – Temperature sensors – Optical sensors – Piezo electric sensor-ultrasonic sensors – Proximity sensors – Signal processing techniques.

UNIT III MICROPROCESSORS AND MICROCONTROLLERS 9

Introduction – Architectures of 8 – bit microcontrollers (8051) series, PIC Microcontrollers (16f xxx) series – Assembly language programming instruction format, addressing modes, instruction sets, Basic program examples interface of keypads, LEDs, A/D and D/A Converters, RS 232 serial communication interface, classification of memories.

UNIT IV ACTUATORS 9

Switching Devices, Classification of actuators – Electrical actuators – Solid state relays, solenoids, D.C. motors, Servo motors, Stepper motors – Interfacing with microcontroller through H-bridge Circuits – Piezoelectric actuators.

UNIT V MECHATRONIC SYSTEMS 9

Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies – Engine management system, Automatic camera, Automatic wishing machine, Pick and place robots.

TOTAL: 45 PERIODS

OUTCOMES:

The student will be able to

(1) Identify the key elements of mechatronics system and its representation in terms of block diagram.
(2) Understand the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O
(3) Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
(4) Differentiate between traditional design and Mechatronics design
(5) Apply the mechatronics concepts in home appliances

REFERENCES:

1. Devadas shetty, Richard A. Kolk, “Mechatronics System Design”, PWS Publishing Company, 2001.
2. M.A. Mazidi & J.G. Mazidi, 8051 Micrcontroller and embedded systems, 2002
3. R.K.Rajput.A Text Book of Mechatronics, Chand &Co, 2007
4. W.Bolton, “MICHATRONICS” Pearson Education Limited, 2004

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	2	-	-
2	1	-	3	2	1	-
3	1	-	3	3	-	2
4	1	-	-	2	-	1
5	1	-	-	-	-	3
Avg.	1	-	3	1.75	1	2

MR4071 INTERNET OF THINGS FOR MANUFACTURING L T P C

3 0 0 3

COURSE OBJECTIVES:

1. To understand the basics of IoT, Opportunities and challenges in IoT
2. To design a IoT solution
3. To develop an IoT protype
4. To explain the various protocols used in IoT and Localization
5. To examine the applications of IoT in Manufacturing

UNIT I INTRODUCTION 9

Technology of the IoT and applications,. IoT data management requirements, Architecture of IoT, Security issues Opportunities for IoT -Issues in implementing IoT. Technological challenges, RFID and the Electronic Product Code (EPC) network, the web of things.

UNIT II DESIGN OF IoT 9

Design challenges in IoT -Standardization, Security and privacy, Infrastructure, Analytics. Design steps for implementing IoT.

UNIT III PROTOTYPING OF IoT 9

Design principles for connected devices -Embedded devices, physical design, online components, embedded coding system. Informed Manufacturing plant – Elements, IoT implementation in Transportation and logistics, Energy and utilities, Automotive Connected supply chain, Plant floor control automation, remote monitoring, Management of critical assets, Energy management and resource optimization, proactive maintenance.

UNIT IV PREREQUISITES FOR IoT 9

IOT Technologies Wireless protocols low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and data-intensive IoT for continuous recognition applications Data storage and analysis Localization algorithms Localization for mobile systems

UNIT V APPLICATION IN MANUFACTURING 9

Applications HCI and IoT world - Multilingual interactions Robotics and Autonomous Vehicles Sensing and data processing-Simultaneous mapping and localization-Levels of autonomy, Smart factories, Future research challenges

TOTAL : 45 PERIODS

COURSE OUTCOME:

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

CO1: Identify the Opportunities and challenges in IoT
CO2: Propose a suitable IoT design
CO3: Develop an optimized IoT protype
CO4: Understand the various protocols used in IoT and Localization
CO5: Understand the applications of IoT in Manufacturing

REFERENCES:

1. Adrian McEwan and Hakim Cassimally, “Designing the internet of things”, Wiley, 2013

2. Code Halos: How the Digital Lives of People, Things, and Organizations are Changing the Rules of Business, by Malcolm Frank, Paul Roehrig and Ben Pring, published by John Wiley & Sons.

3. Internet of Things: A Hands-On Approach by Vijay Madisetti, Arshdeep Bahga, VPT; 1st edition 2014.

4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, “From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence” Elsevier

5. Meta Products -Building the Internet of Things by Wimer Hazenberg, Menno Huisman, BIS Publishers 2014.

CO	PO					
	1	2	3	4	5	6
1	1		2	1		
2	1		2			3
3	1		2			3
4	1		2			3
5	1		2			3
Avg	(5/5)=1		(10/5)=2	(1/1)=1		(12/4)=3

IS4071 DATA ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

1. Recognize the importance of data analytics
2. Exhibit competence on data analytics packages
3. Apply solution methodologies for industrial problems.

UNIT I INTRODUCTION 9

Introduction to Multivariate Statistics-Degree of Relationship among Variables-Review of Univariate and Bivariate Statistics-Screening Data Prior to Analysis-Missing Data, Outliers, Normality, Linearity, and Homoscedasticity.

UNIT II MULTIPLE REGRESSION 9

Multiple Regression- Linear and Nonlinear techniques- Backward-Forward-Stepwise Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).

UNIT III LOGISTIC REGRESSION 9

Regression with binary dependent variable -Simple Discriminant Analysis Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).

UNIT IV PRINCIPAL COMPONENT ANALYSIS 9

Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).

UNIT V LATENT VARIABLE MODELS 9

Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis-Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To recognize the importance of data analytics
- To Exhibit competence on data analytics packages
- To apply solution methodologies for industrial problems.

REFERENCES:

1. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. "Multivariate data analysis", (7th edition). Pearson India. 2015

2. Tabachnick, B. G., & Fidell, L. S., "Using multivariate statistics", (5th edition). Pearson Prentice Hall, 2001

3. Gujarati, D. N. , "Basic econometrics", Tata McGraw-Hill Education, 2012

4. Malhotra, N. K., " Marketing research: An applied orientation", 5/e. Pearson Education India, 2008

5. Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. " Applied multiple regression/correlation analysis for the behavioral sciences", Routledge., 2013

6. Han, J., Kamber, M., & Pei, J. "Data mining: concepts and techniques: concepts and techniques", Elsevier, 2011.

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

1-low, 2-medium, 3-high, '-"- no correlation

CM4072 MANUFACTURING SYSTEM SIMULATION L T P C

3 0 0 3

OBJECTIVE:

(1) To introduce computer simulation technologies and techniques
(2) To introduce concepts of modeling layers of society's critical infrastructure networks
(3) Demonstrate an understanding of the concepts of manufacturing towards solving productivity related problems
(4) Develop a virtual model to solve industrial engineering related issues such as capacity utilization, line balancing
(5) To build tools to view and control simulations and their results

UNIT I INTRODUCTION 9

Systems and modeling – statistical models in simulation -discrete and continuous system - Monte Carlo Simulation. Simulation of Single Server Queuing System. Simulation of manufacturing shop Simulation of Inventory System

UNIT II RANDOM NUMBERS 9

Random number generation -Properties of Random Numbers –Generation of Pseudo Random Numbers – Techniques –Tests for Random Numbers

UNIT III RANDOM VARIATES 9

Random variate generation-Inverse Transform Technique –Direct Transform Techniques Convolution Method Acceptance Rejection Technique– Routines for Random Variate Generation, Testing -Analysis of simulation data.

UNIT IV ANALYSIS OF SIMULATION DATA 9

Input modelling-Fitness tests – verification and validation of simulation models – output analysis for a single model, Comparison and evaluation of alternate system design, Optimization using simulation.

UNIT V SIMULATION LANGUAGES 9

Simulation languages and packages-Case studies in WITNESS; FLEXSIM, ARENA, SIMQUICK- Simulation based optimization-Modelling and Simulation with Petrinets -Case studies in manufacturing and material handling system.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the Manufacturing Models of Discrete event systems
CO2: Develop the Uncertainty using Random numbers and Random Variates
CO3: Analyze the verification & valediction of Models and Optimization
CO4: Demonstrate the concepts of modeling layers of society's critical infrastructure networks
CO5: Make use of tools to view and control simulations

REFERENCES

1. Geoffrey Gordon, "System Simulation", 2nd Edition, Prentice Hall, India, 2020.
2. Jerry Banks & John S.Carson, Barry L Nelson, “Discrete event system simulation”, Prentice Hall,2000.
3. Law A.M, “Simulation Modelling and Analysis”,Fifth edition, Tata Mc Graw Hill,2014.
4. NarsinghDeo, “System Simulation with Digital Computer”,Fith edition, Prentice Hall,2014.
5. Pidd, M, “Computer Simulation in Management Science”, Fifth edition,John Wiley & Sons, Inc,2016.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	-	-	-	3	2	1
2	1	-	-	2	2	1
3	1	-	3	-	-	-
4	-	-	-	-	2	1
5	-	-	-	-	3	1
Avg.	1	-	3	2.5	2.25	1

PD4351 PRODUCT LIFE CYCLE MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

1. To understand history, concepts and terminology of PLM
2. To understand functions and features of PLM/PDM
3. To understand different modules offered in commercial PLM/PDM tools
4. To demonstrate PLM/PDM approaches for industrial applications
5. To Use PLM/PDM with legacy data bases, CAx & ERP systems

UNIT I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM).PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT III DETAILS OF MODULES IN APDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools

UNIT IV ROLE OF PLM ININDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organization, users, product or service, process performance.

UNIT V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL:45PERIODS

OUTCOMES:

The students will be able to

1. Summarize the history, concepts and terminology of PLM
2. Use the functions and features of PLM/PDM
3. Use different modules offered in commercial PLM/PDM tools.
4. Implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAx& ERP systems.

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	2	2	1	-	-
2	2	2	2	1	-	-
3	2	1	2	1	-	-
4	1	1	3	1	-	-
5	1	1	1	1	-	-
Avg	1.4	1.4	2	1	-	-

1- Low 2- Medium 3- High

REFERENCES

1. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition).
2. International Journal of Product Lifecycle Management, Inderscience Publishers
3. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
4. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007.
5. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
6. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.

MF4015 PRODUCT DESIGN AND DEVELOPMENT L T P C
3 0 0 3

OBJECTIVE:

(1) Learn to know the necessity for a New Product by analysing the market trend
(2) Select methodology and process for development
(3) Generate detailed specifications for the given architecture
(4) Integrating CAE, CAD, CAM tools in product design and asses the quality and performance of products
(5) Make a prototype of a problem adhering to design principles to enhance manufacturability

UNIT I PRODUCT DEVELOPMENT AND CONCEPT SELECTION 9

Product development process – Product development organizations- Identifying the customer needs – Establishing the product specifications – concept generation – Concept selection.

UNIT II PRODUCT ARCHITECTURE 9

Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT III INDUSTRIAL AND MANUFACTURING DESIGN 9

Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration - Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors

UNIT IV PROTOTYPING AND ECONOMIC ANALYSIS 9

Principles of prototyping – Planning for prototypes - Elements of economic analysis – Base case financial model – Sensitivity analysis – Influence of the quantitative factors

UNIT V MANAGING PRODUCT DEVELOPMENT PROJECTS 9

Sequential, parallel and coupled tasks - Baseline project planning – Project Budget Project execution – Project evaluation- patents- patent search-patent laws International code for patents.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students are expected to

(1) Identify the need for a New Product
(2) design and develop various products
(3) Work out the cost of developing a product
(4) Will be able to prototype the product
(5) Know how to patent the new design or the product

REFERENCES:

1. Charles Gevirtz, Developing New products with TQM, McGraw – Hill International editions, 1994
2. Karal .T. Ulrich, Steven D.Eppinger, Product Design and Development, McGRAW-HILL International Editions.2003.
3. S.Rosenthal, Effective product design and development, Irwin 1992.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	2	-	-	3	-	1
2	1	-	3	1	1	1
3	-	-	-	2	2	1
4	1	-	3	3	2	1
5	1	-	-	-	2	2
Avg.	1.25	-	3	2.25	1.75	1.2

MF4016 ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

OBJECTIVE:

(1) To develop and strengthen entrepreneurial quality and motivation in students.
(2) To impart knowledge on the competencies necessary to establish new ventures
(3) To inculcate strategic thinking, budgeting and ethical behaviour which are vital to enhance entrepreneurial skills
(4) To establish start-ups and small businesses
(5) To evaluate the business and monitor

UNIT I ENTREPRENEURAL COMPETENCE 9

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successfull, Entrepreneur – Knowledge and Skills of Entrepreneur.

UNIT II ENTREPRENEURAL ENVIRONMENT 9

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services - Central and State Government Industrial Policies and Regulations - International Business.

UNIT III BUSINESS PLAN PREPARATION 9

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

UNIT IV LAUNCHING OF SMALL BUSINESS 9

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.

UNIT V MANAGEMENT OF SMALL BUSINESS 9

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

TOTAL: 45 PERIODS

COURSE OUTCOME:

Students will

(1) Gain knowledge and skills needed to run a business.
(2) Innovate and solve challenges in business
(3) Determine risks in the trade and respond effectively
(4) Utilize tools and develop strategies to manage business
(5) Establish start-ups and Evaluate the business

REFERENCES:

1. Hisrich, Entrepreneurship, Edition 9, Tata McGraw Hill, New Delhi, 2014
2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, (Revised Edition) 2013.
3. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra, 2nd Edition ,2005
4. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.
5. P.Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai 1997.
6. Arya Kumar. Entrepreneurship. Pearson, 2012.
7. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage, 2012

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	2	1	-	-
2	1	1	-	2	1	1
3	1	-	3	2	-	-
4	-	-	-	2	2	3
5	1	1	-	-	2	2
Avg.	1	1	2.5	1.75	1.66	2

MF4020 **INDUSTRIAL SAFETY** **L T P C**
3 0 0 3

OBJECTIVES:

(1) To develop and strengthen the safety ideas and motivate the students to impart basic safety skills
(2) To know about Industrial safety programs, Industrial laws, regulations and source models
(3) To understand about fire and explosion, preventive methods, relief and its sizing methods
(4) To assess the safety of human beings from toxic substances
(5) To analyse industrial hazards and its risk assessment.

UNIT I OPERATIONAL SAFETY 9

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipes metal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – planning security and risk assessments, on – site and off site. Control of major industrial hazards.

UNIT II SAFETY APPRAISAL AND ANALYSIS 9

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation. Measurement of safety performance, accident reporting and investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT III OCCUPATIONAL HEALTH 9

Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV SAFETY AND HEALTH REGULATIONS 9

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT V SAFETY MANAGEMENT 9

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students are

(1) Expected to gain knowledge and skills needed to run an industry with utmost safety precautions.
(2) Understand the industrial laws, regulations and source models.
(3) Apply the methods of prevention of fire and explosions.
(4) Analyse the effect of release of toxic substances
(5) Understand the methods of hazard identification and preventive measures.

REFERENCES:

1. John V Grimaldi, Safety Management. AITB publishers, 2003.
2. John.V Grimaldi and Rollin. H Simonds, “Safety Management”, All India traveller book seller, New Delhi – 1989.
3. Krishnan N.V, “Safety in Industry”, Jaico Publisher House, 1996.

4. Singh, U.K and Dewan, J.M., “Safety, Security And Risk Management”, APH publishing company, New Delhi, 1996.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	2	1	1
2	-	-	3	2	1	-
3	1	1	-	2	2	2
4	1	1	-	2	-	2
5	-	1	-	2	1	2
Avg.	1	1	3	2	1.25	1.75

MF4017 ADVANCES IN MATERIALS L T P C
3 0 0 3

COURSE OBJECTIVES

(1) Understand major types of special steels such as HSLA, TRIP, Dual and Tool steels and cast-irons
(2) To study the polymer behaviour and develop polymer composites
(3) To study energy conversion materials
(4) To learn about various materials used for bio implants
(5) To understand the advantage of materials at Nano scale

UNIT I METALLIC MATERIALS 9

Classification of metallic materials - Ferrous and nonferrous.
Ferrous metals and alloys-Introduction to specifications – types of steels, alloy steels, tool steels; stainless steels, HSLA, TRIP steels, TWIP steels. Shape memory alloys – Intermetallic – Superalloys- Titanium and Magnesium alloys – Bulk metallic glass –high entropy alloys- metamaterials –topological materials

UNIT II POLYMERS AND COMPOSITES 9

Structure of polymers, characterization and applications of polymers: mechanical behavior of polymers, strengthening of polymers, crystallization and glass transition phenomenon and types of polymers.

Composites: Particle reinforced composites, fiber reinforced composites – influence of fiber length, orientation and concentration. Fiber phase, matrix phase, metal matrix composites, polymer matrix composites, ceramic matrix composites, carbon – carbon composites, hybrid composites and structural composites.

UNIT III ENERGY MATERIALS 9

Need for high performance energy materials - carbon nanostructure based energy conversion and storage materials - nanomaterials for solar cell applications - next generation energy storage materials – Li and Ni based batteries, fuel cells.

UNIT IV BIO MATERIALS 9

Introduction to biomaterials; need for biomaterials; Salient properties of important material classes; Property requirement of biomaterials; Metallic implant materials, ceramic implant materials, polymeric implant materials, composites as biomaterials; Orthopedic, dental and other applications.

Biomaterials preparation and characterization; Processing and properties of different bio ceramic materials; Mechanical and physical properties evaluation of biomaterials; New and novel materials for biomedical applications. Design concept of developing new materials for bio-implant applications; Nanomaterials and nanocomposites for medical applications

UNIT V NANO MATERIALS 9

Concept of nano materials – scale / dimensional aspects, Top-down and bottom-up approaches for preparing nano materials Advantages and limitations at the nano level – thermodynamic aspects at the nano level, health and environmental issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students would be able to:

(1) Understand the various ferrous alloys and their applications
(2) Understand different types of composite materials and polymers
(3) Understand Solar materials
(4) Understand the properties of different biomaterials
(5) Understand the structure and behavior of Nano materials

REFERENCES

1. Avner S. H., 'Introduction to Physical Metallurgy', 2nd Edition, McGraw Hill, 1974
2. Leslie W. C., 'The Physical Metallurgy of Steels', McGraw Hill, 1982
3. Pickering P. B., 'Physical Metallurgy and the Design of Steels', Applied Science Publishers, 1983
4.Hench L. Larry, and Jones J., (Editors), Biomaterials, Artificial organs and Tissue Engineering, Woodhead Publishing Limited, 2005.
5. Gunter Schmid, "Nanoparticles: From Theory to Applications", Wiley-VCH Verlag GmbH & Co., 2004.
6.Brick R. M., Gorden R. B, Phillips A., 'Structure and Properties of Alloys', McGraw Hill, 1965
7.Hench L. Larry, & Wilson J., (Editors), An Introduction to Bio ceramics, World Scientific, 1994.
8. Charles P. Poole, Jr., Frank J. Owens, "Introduction to nano technology", Wiley, 2003.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	2	2	-
2	1	-	3	-	-	-
3	1	-	3	-	-	2
4	1	-	-	-	2	1
5	1	-	-	-	2	1
Avg	1	-	3	2	2	1.33

MF4018 ARTIFICIAL INTELLIGENCE L T P C
3 0 0 3

OBJECTIVES:

The objective of this course is to enable the students to
(1) Understand the basic concepts of intelligent agents
(2) Develop general-purpose problem-solving agents, logical reasoning agents, and agents that
reason under uncertainty
(3) To learn to represent knowledge in solving AI problems
(4) To understand the different ways of designing software agents
(5) Employ AI techniques to solve some of today's real-world problems.

UNIT I INTELLIGENT AGENTS 9

Introduction to AI –Agents and Environments –Concept of rationality –Nature of environments
–Structure of agents Problem solving agents –search algorithms –uninformed search strategies

UNIT II PROBLEM SOLVING 9

Heuristic search strategies –heuristic functions Local search and optimization problems – local search in continuous space –search with non-deterministic actions –search in partially observable environments –online search agents and unknown environments

UNIT III GAME PLAYING AND CSP 9

Game theory –optimal decisions in games –alpha-beta search –monte-carlo tree search –stochastic games –partially observable games Constraint satisfaction problems – constraint propagation –backtracking search for CSP –local search for CSP –structure of CSP

UNIT IV LOGICAL AGENTS 9

Knowledge-based agents –propositional logic –propositional theorem proving – propositional model checking –agents based on propositional logic First-order logic – syntax and semantics –knowledge representation and engineering –inferences in first-order logic –forward chaining –backward chaining --resolution

UNIT V KNOWLEDGE REPRESENTATION AND PLANNING 9

Ontological engineering –categories and objects –events –mental objects and modal logic –reasoning systems for categories –reasoning with default information Classical planning –algorithms for classical planning –heuristics for planning –hierarchical planning –non deterministic domains –time, schedule, and resources --analysis

TOTAL :45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the students will be able to
1. Explain autonomous agents that make effective decisions in fully informed, partially observable, and
adversarial settings
2. Choose appropriate algorithms for solving given AI problems
3. Design and implement logical reasoning agents
4. Design and implement agents that can reason under uncertainty
5. Apply AI for real world problems

TEXT BOOKS:

1 S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2 I. Bratko, —Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES

1. M. Tim Jones, —Artificial Intelligence: A Systems Approach (Computer Science) ‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, —The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.
3. William F. Clocksin and Christopher S. Mellish, ‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.
4. Gerhard Weiss, —Multi Agent Systems‖, Second Edition, MIT Press, 2013.
5.David L. Poole and Alan K. Mackworth, —Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	2	2	-
2	-	-	-	3	2	-
3	1	-	2	-	-	-
4	-	-	-	3	2	-
5	1	-	-	-	-	2
Avg	1	-	2	2.66	2	2

MF4019 SMART MANUFACTURING AND INDUSTRY 4.0 L T P C
3 0 0 3

COURSE OBJECTIVES

(1) To introduce students to fundamentals of Manufacturing
(2) To familiarize with selection of sensors for various application
(3) To learn the basics of agent-based manufacturing
(4) Understand Cyber physical systems
(5) Provide brief understanding about industry 4.0 concepts in Manufacturing systems

UNIT I SENSORS SMART MANUFACTURING 9

Introduction – Role of sensors in manufacturing automation – operation principles of different sensors – electrical, optical, acoustic, pneumatic, magnetic, electro-optical and vision sensors. Condition monitoring of manufacturing systems – principles – sensors for monitoring force, vibration and noise, selection of sensors and monitoring techniques. Automatic identification techniques for shop floor control – optical character and machine vision sensors – smart / intelligent sensors – integrated sensors, Robot sensors, Micro sensors, Nano sensors.

UNIT II DATA ANALYTICS 9

Introduction to Data and Analytics in a Digital Context (Internet of Things), Product Data Management for Design and Manufacturing (PLM Tools), Typical data challenges (data quality, enrichment, integration of ERP & PLM data), Preparing data for analytics (techniques to improve data quality, integration - ETL)

Advances in data visualization & related tools-Statistical Techniques for Analytics, Descriptive Statistics

Inferential statistics, Regression and ANOVA

UNIT II CYBER PHYSICAL SYSTEMS 9

Concept of Cyber Physical Systems (CPS) and Cyber Physical Production System (CPPS), System Architecture for implementation of CPPS, Components for CPPS, Communication for CPPS

UNIT IV E- MANUFACTURING 9

Introduction of Agent based manufacturing- agent based Manufacturing, Cloud Based Manufacturing Information technology-based Supply chain, Concept of agile manufacturing and E-manufacturing.

UNIT V INDUSTRY 4.0 9

Evaluation of industries, Introduction to Industry 4.0, Challenges in industry 4.0, Impact of Industry 4.0, Case studies on industry 4.0, Introduction to Internet of Things (IoT) and its applications, Smart supply chain and Case studies.

TOTAL :45 PERIODS

COURSE OUTCOMES

The students are expected to appreciate:

(1) Appreciate concepts and basic framework necessary for smart manufacturing
(2) current trends at system level in manufacturing organizations
(3) Use of Sensors and Selection of sensors for various applications
(4) IoT based manufacturing systems
(5) The importance of industry 4.0 concepts at manufacturing systems

TEXT BOOKS:

1. Bahga and V. Madisetti, Internet of Things, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2014, ISBN: 978-0996025515
2. Bahga and V. Madisetti, Cloud Computing, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2013, ISBN: 978-1494435141
3. M. Skilton and F. Hovsepian, The 4th Industrial Revolution: Responding to the Impact of Artificial Intelligence on Business, Springer Nature, 2017, ISBN: 978-3-319-62479-2
4. M. P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing" Pearson Education, 4th Edition, 2016, ISBN: 978-0133499612
5. M. P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas and G. Odrey, Industrial Robotics Technology, Programming and Applications, McGraw Hill, 2nd Edition, 2017 ISBN: 978-1259006210

Reference books:

1. Gilchirst, Industry 4.0: The Industrial Internet of Things, Apress (Springer), 1st Edition, 2016, ISBN: 978-1-4842-2046-7
2. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems, Springer, 1st edition, 2017, ISBN: 978-3319425580
3. T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 1st edition, 2013, ISBN: 978-0133387520.
4. N. Viswanandham, Y. Narhari "Performance Modeling of Automated Manufacturing Systems" Prentice-Hall, 1st Edition, 1994, ISBN: 978-8120308701
5. S. K. Saha, Introduction to Robotics, Tata Mcgraw Hill Education Private Limited, 2nd Edition, ISBN: 978-9332902800

CO-PO Mapping

CO	PO					
	1	2	3	4	5	6
1	1	-	-	-	2	-
2	1	-	-	2	2	-
3	-	-	3	-	2	-
4	-	-	-	3	2	-
5	1	-	3	-	-	2
Avg	1	-	3	2.5	2	2

AUDIT COURSES

AX4091	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

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

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

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

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AX4092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

COURSE OBJECTIVES

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

UNIT I INTRODUCTION 6

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

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

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

UNIT V RISK ASSESSMENT 6

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

TOTAL : 30 PERIODS

COURSE OUTCOMES

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

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi, 2001.

AX4093 CONSTITUTION OF INDIA L T P C
2 0 0 0

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

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

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

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

SUGGESTED READING

- The Constitution of India,1950(Bare Act),Government Publication.
- Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
- M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX4094 **நற்றமிழ் இலக்கியம்**

L T P C

2 0 0 0

UNIT I **சங்க இலக்கியம்** **6**

1. தமிழின் துவக்க நூல் தொல்காப்பியம் – எழுத்து, சொல், பொருள்
2. அகநானூறு (82) - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195) - போரை நிறுத்திய ஔவையார்

UNIT II **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர் - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து – ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III **இரட்டைக் காப்பியங்கள்** **6**

1. கண்ணகியின் புரட்சி
   - சிலப்பதிகார வழக்குரை காதை
     சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV அருள்நெறித் தமிழ்
6

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குத் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்
   ஆகியவை பற்றிய செய்திகள்

UNIT V நவீன தமிழ் இலக்கியம்
6

1. உரைநடைத் தமிழ்,
- தமிழின் முதல் புதினம்,
- தமிழின் முதல் சிறுகதை,
- கட்டுரை இலக்கியம்,
- பயண இலக்கியம்,
- நாடகம்,

2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) -https://ta.wikipedia.org
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம் - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்