UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY : : CHENNAI 600 025

REGULATIONS - 2015

M.E. MANUFACTURING ENGINEERING (FT & PT)

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

I The graduates acquire ability to create model, design, synthesize and analyze essential production operational skills, mechanism and automation system.

II The graduates use their talent, self-confidence, knowledge and engineering practice which facilitate them to presume position of scientific and/or managerial leadership in their career paths.

III The graduates apply their consciousness of moral, professional responsibilities and motivation to practice life-long learning in a team work environment.

PROGRAMME OUTCOMES (PO)

1. Graduate will demonstrate strong basics in mathematics, science and engineering which serve as the foundation for the Programme.
2. Graduate will demonstrate the ability to design and conduct experiments, as well as to analyse and interpret data in the spheres of fundamental engineering.
3. Graduate will demonstrate the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
4. Graduate will become familiar with modern engineering tools and analyse the problems within the domains of Production Technology as the members of multidisciplinary teams
5. Graduate will acquire the capability to identify, formulate and solve engineering problems related to production engineering.
6. Graduate will demonstrate an understanding of professional and ethical responsibility with reference to their career in the field of production engineering.
7. Graduate will be able to communicate effectively both in verbal and non verbal forms.
8. Graduate will be trained towards developing and understanding the impact of development of Production Technology on global, economic, environmental and societal context.
9. Graduate will be capable of understanding the value for life-long learning.
10. Graduate will demonstrate knowledge of contemporary issues pertaining to the health and well being of desirable living forms inhabiting the environment.
11. Graduate will demonstrate the ability to use the techniques, skills and modern engineering tools necessary for engineering practice in the field of Production Engineering.
12. Graduate will be able to design and develop innovative/ manufacturable / marketable / environmental friendly products useful to the nation and the society.

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13. Graduate will be able to manage any organisation well and will be able to emerge as a successful entrepreneur.

Mapping of PEOs with POs

Programme Educational Objectives	Programme Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
I	✓	✓	✓					✓			✓		
II					✓		✓	✓				✓	✓
III				✓		✓		✓	✓	✓			

Illustrate how course outcomes contribute to the Pos

		Subject	Programme Outcome												
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
Year 1	SEM I	Materials technology	✓		✓					✓	✓		✓	✓	✓
		Applied probability and statistics	✓	✓	✓	✓	✓			✓			✓	✓	
		Modern Manufacturing processes	✓		✓					✓	✓		✓	✓	✓
		Fluid power automation	✓	✓	✓	✓	✓	✓		✓				✓	
		Field project management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Elective - I													
		Manufacturing and Automation Lab	✓	✓	✓	✓	✓	✓		✓				✓	
Year 1	SEM II	Material Testing and characterization	✓	✓		✓	✓						✓		
		Production and Operation Management	✓	✓	✓	✓	✓			✓			✓	✓	
		Manufacturing Metrology	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	
		Computer Integrated Manufacturing	✓	✓	✓	✓	✓			✓			✓		
		Elective – II													
		Elective – III													
		CIM and Soft Skill development Lab	✓	✓		✓	✓		✓	✓			✓	✓	✓
Year 2	SEM III	Finite element application in manufacturing	✓	✓		✓	✓	✓		✓		✓	✓	✓	
		Robot Design and	✓	✓		✓	✓	✓		✓		✓	✓	✓	

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		Programming													
		Elective – IV													
		Elective – V													
		Project Phase – I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year 2	**SEM IV**	Project Phase – II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

ELECTIVES

Subject	**Programme Outcome**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**
Optimization Techniques	✓	✓	✓	✓	✓			✓			✓	✓	✓
Theory of Metal Forming	✓	✓	✓	✓	✓	✓		✓				✓	
Processing of Polymers and Composites	✓	✓	✓	✓	✓	✓		✓			✓	✓	
Metal Cutting Theory and Practice	✓		✓	✓							✓	✓	
Computer Aided Product Design	✓	✓		✓	✓			✓			✓	✓	
Supply Chain Management and Logistics	✓			✓		✓	✓	✓					✓
Micro System Technology	✓	✓	✓	✓	✓	✓		✓			✓	✓	
Financial Management	✓			✓		✓	✓	✓					✓
Manufacturing Techniques	✓	✓	✓	✓	✓	✓		✓				✓	
Mechatronics in Manufacturing Processes	✓	✓	✓	✓	✓								
Concepts of Green Manufacturing	✓	✓	✓	✓	✓	✓		✓				✓	
Enterprise Resource Planning-Principles and Applications	✓			✓		✓	✓	✓					✓

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Quality and Reliability Engineering	✓	✓	✓	✓	✓			✓			✓	✓	
Manufacturing of Automotive Parts	✓	✓	✓	✓	✓			✓			✓	✓	
Surface Engineering	✓	✓	✓	✓	✓	✓		✓			✓	✓	
Micro Manufacturing	✓	✓	✓	✓	✓	✓		✓				✓	

UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY : : CHENNAI 600 025

REGULATIONS - 2015

M.E. MANUFACTURING ENGINEERING (FT & PT)

I TO IV SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7103	Applied Probability and Statistics	FC	4	4	0	0	4
2.	MN7101	Field Project Formulation	PC	5	3	0	2	4
3.	MN7102	Fluid Power Automation	PC	3	3	0	0	3
4.	MN7103	Modern Manufacturing Processes	FC	3	3	0	0	3
5.	MN7151	Materials Technology	FC	3	3	0	0	3
6.		Elective – I	PE	3	3	0	0	3
PRACTICALS								
7	MN7111	Manufacturing and Automation lab	PC	4	0	0	4	2
			TOTAL	**25**	**19**	**0**	**6**	**22**

SEMESTER II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MN7201	Computer Integrated Manufacturing	PC	3	3	0	0	3
2.	MN7202	Manufacturing Metrology	PC	5	3	0	2	4
3.	MN7203	Material Testing and Characterization	FC	3	3	0	0	3
4.	MN7204	Production and Operation Management	PC	3	3	0	0	3
5.		Elective – II	PE	3	3	0	0	3
6.		Elective - III	PE	3	3	0	0	3
PRACTICALS								
7	MN7211	CIM and Soft Skill Development Lab	PC	4	0	0	4	2
			TOTAL	**24**	**18**	**0**	**6**	**21**

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SEMESTER III

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MN7301	Finite Element Applications in Manufacturing	PC	5	3	0	2	4
2.	MN7302	Robot Design and Programming	PC	5	3	0	2	4
3.		Elective – IV	PE	3	3	0	0	3
4.		Elective – V	PE	3	3	0	0	3
PRACTICALS								
5	MN7311	Project Work - Phase I	EEC	12	0	0	12	6
			TOTAL	**28**	**12**	**0**	**16**	**20**

SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	MN7411	Project Work - Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

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

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M.E. MANUFACTURING ENGINEERING (PART TIME)

I TO VI SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MN7151	Materials Technology	FC	3	3	0	0	3
2.	MA7103	Applied Probability and Statistics	FC	4	4	0	0	4
3.	MN7103	Modern Manufacturing Processes	FC	3	3	0	0	3
			TOTAL	**10**	**10**	**0**	**0**	**10**

SEMESTER II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MN7102	Fluid Power Automation	PC	3	3	0	0	3
2.	MN7101	Field Project Formulation	PC	5	3	0	2	4
3.		Elective I	PE	3	3	0	0	3
4.		Elective II	PE	3	3	0	0	3
			TOTAL	**14**	**12**	**0**	**2**	**13**

SEMESTER III

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MN7203	Material Testing and Characterization	FC	3	3	0	0	3
2.	MN7204	Production and Operation Management	PC	3	3	0	0	3
3.		Elective III	PE	3	3	0	0	3
PRACTICALS								
7	MN7111	Manufacturing and Automation Lab	PC	4	0	0	4	2
			TOTAL	**13**	**9**	**0**	**4**	**11**

SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MN7202	Manufacturing Metrology	PC	5	3	0	2	4
2.	MN7201	Computer Integrated Manufacturing	PC	3	3	0	0	3
3.		Elective – IV	PE	3	3	0	0	3
PRACTICALS								
7	MN7211	CIM and Soft Skill Development Lab	PC	4	0	0	4	2
			TOTAL	**15**	**9**	**0**	**6**	**12**

SEMESTER V

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MN7301	Finite Element Applications in Manufacturing	PC	5	3	0	2	4
2.	MN7302	Robot Design and Programming	PC	5	3	0	2	4
3.		Elective – V	PE	3	3	0	0	3
PRACTICALS								
7	MN7311	Project Work - Phase I	EEC	12	0	0	12	6
			TOTAL	**25**	**9**	**0**	**16**	**17**

SEMESTER VI

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	MN7411	Project Work - Phase II	EEC	12	0	0	24	12
			TOTAL	**12**	**0**	**0**	**24**	**12**

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

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FOUNDATION COURSES (FC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1		Applied Probability and Statistics	FC	4	4	0	0	4
2		Materials Technology	FC	3	3	0	0	3
3		Modern Manufacturing Processes	FC	3	3	0	0	3
4		Material Testing and Characterization	FC	3	3	0	0	3

PROFESSIONAL COURSES (PC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1		Fluid Power Automation	PC	5	3	0	2	4
2		Field Project Formulation	PC	5	3	0	2	4
3		Manufacturing and Automation lab	PC	4	0	0	4	2
4		Production and Operation Management	PC	3	3	0	0	3
5		Manufacturing Metrology	PC	5	3	0	2	4
6		Computer Integrated Manufacturing	PC	3	3	0	0	3
7		CIM and Soft Skill Development Lab	PC	4	0	0	4	2
8		Finite Element Applications in Manufacturing	PC	5	3	0	2	4
9		Robot Design and Programming	PC	5	3	0	2	4

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PROFESSIONAL ELECTIVES (PE)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ED7080	Surface Engineering	PE	3	3	0	0	3
2.	MN7001	Computer Aided Product Design	PE	3	3	0	0	3
3.	MN7002	Concepts of Green Manufacturing	PE	3	3	0	0	3
4.	MN7003	Enterprise Resource Planning Principles and Applications	PE	3	3	0	0	3
5.	MN7004	Financial Management	PE	3	3	0	0	3
6.	MN7005	Manufacturing of Automotive Parts	PE	3	3	0	0	3
7.	MN7006	Manufacturing Techniques	PE	3	3	0	0	3
8.	MN7007	Mechatronics in Manufacturing Processes	PE	3	3	0	0	3
9.	MN7008	Metal Cutting Theory and Practice	PE	3	3	0	0	3
10.	MN7009	Micro Manufacturing	PE	3	3	0	0	3
11.	MN7010	Micro System Technology	PE	3	3	0	0	3
12.	MN7011	Optimization Techniques	PE	3	3	0	0	3
13.	MN7012	Processing of Polymers and Composites	PE	3	3	0	0	3
14.	MN7013	Quality and Reliability Engineering	PE	3	3	0	0	3
15.	MN7014	Supply Chain Management and Logistics	PE	3	3	0	0	3
16.	MN7015	Theory of Metal Forming	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1		Project Work - Phase I	EEC	12	0	0	12	6
2		Project Work - Phase II	EEC	24	0	0	24	12

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MN7103 APPLIED PROBABILITY AND STATISTICS L T P C
4 0 0 4

AIM:
To introduce the concepts of probability, sampling techniques, estimation to the students.

OBJECTIVE:
- To train the students so that they will be able to design experiments and use these concepts for research.

UNIT I PROBABILITY THEORY 15
Random variables – probability density and distribution functions-moment generating and characteristic functions – Binomial, Poisson, Normal distributions and their applications.

UNIT II SAMPLING THEORY 15
Sampling distributions – Standard error – t, F, Chi square distributions – applications.

UNIT III ESTIMATION THEORY 10
Interval estimation for population mean, standard deviation, difference in means, preparation ratio of standard deviations and variances.

UNIT IV TESTING OF HYPOTHESIS AND ANOVA 10
Hypothesis testing – Small samples – Tests concerning proportion, means, standard deviations – Tests based on chi square – and Redistribution - test One, two factor models-Design of experiments.

UNIT V ANOVA 10
Design of experiments – One, Two factor Models

TOTAL: 60 PERIODS

OUTCOMES:
- To introduce the concepts of probability, sampling techniques, estimation to the students.
- To impart knowledge in the field of ANOVA

REFERENCES:

1. Levin and Rubin, Statistics for Management, Pearson Education India, 2011
2. John.E.Freunds, ―Mathematical statistics with applications‖, Pierson Education India, 2011
3. Gupta and Kapoor, Fundamentals of Applied Statistics, Sultan chand, 2006.
4. Hooda, Statistics for Business and Economics, Macmillan India, 2001

MN7101 FIELD PROJECT FORMULATION L T P C
3 0 2 4

AIM: To introduce the various concepts of Research Methodology

OBJECTIVE
- To introduce various types of Research Design

- To introduce various sampling techniques, statistical analysis and interpretation of the results.

UNIT I INTRODUCTION 15

Meaning of Research – Objectives of Research – Motivation in Research – Types of Research – Research approaches – Significance of Research Method versus Methodology – Research and Scientific Method – Importance of Knowing how research is done – Research Process – Criteria of Good Research – Problems encountered by Researchers in India. What is a Research Problem – Selecting the problem – Necessity of defining the problem – Technique involved in defining a problem.

UNIT II RESEARCH DESIGN 10

Meaning of Research design – Need for Research Design – features of Good Design – Important concepts relating to Research Design – Different Research designs – Basic Principles of Experimental Designs – Developing a Research Plan.

UNIT III SAMPLING DESIGN 10

Census and Sample survey – Implications of a Sample Design – Steps in Sampling Design – Criteria for selecting a Sampling Procedure – Characteristics of a Good Sample Design Different Types of Sample Designs – How to select a Random Sample – Random Sample from an indicate universe – Complex Random Sampling Designs.

UNIT IV PROCESSING AND ANALYSIS OF DATA 10

Processing operation – Some problems in Processing – Elements/Types of Analysis – Statistics in Research – Measures of Central Tendency – Measures of Dispersion – Measures of Asymmetry (Skewness) – Measures of Relationship – Simple Regression Analysis – Multiple Correlation and Regression Partial Correlation – Association in case of Attributes – Other Measures – Summary chart concerning Analysis of Data.

UNIT V INTERPRETATION, REPORT WRITING 15

Meaning of Interpretation – Why interpretation – Technique of interpretation – Precaution in interpretation – Significance of Report writing – Different steps in report writing – Layout of the Research report – Types of reports – Oral presentation – Mechanics of writing Research Reports – Computer and Computer Technology – The computer system – Important characteristics – The binary number system – Computer applications.

TOTAL: 60 PERIODS

OUTCOMES:

- To introduce various types of Research Design
- To introduce various sampling techniques, statistical analysis and interpretating of the results.

REFERENCE:

1. R. Panner Selvam, ―Research Methodology‖, Prentice Hall of India, New Delhi, 2004.
2. Research Methodology – C.R. Kothari, Wishwa Prakashan Publishers, India, 2001.
3. Murray R. Spigel, ―Theory and problem of Statistics‖, Schaum Publishing Co., New York. 2000.

MN7102 **FLUID POWER AUTOMATION** **L T P C**
3 0 0 3

AIM:

To impart knowledge in the area of hydraulics, pneumatic and fluid power components and its functions.

OBJECTIVE:

- To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
- To train the students in designing the hydraulics and pneumatic circuits using various design procedures.

UNIT I INTRODUCTION **5**

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

UNIT II FLUID POWER GENERATING/UTILIZING ELEMENTS **10**

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 **10**

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-Different types-characteristics and performance.

UNIT IV CIRCUIT DESIGN **10**

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 **10**

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

- The students will be able to understand the working principle of hydraulic and pneumatic components and its selection and design the hydraulic and pneumatic circuits for different applications

REFERENCES:

1. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003.
2. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994.
3. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988
4. E.C.Fitch and J.B.Suryaatmadyn. Introduction to fluid logic, McGraw Hill, 1978

5. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979
6. Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967
7. Dudbey. A. Peace, Basic Fluid Power, Prentice Hall Inc, 1967.

MN7103 MODERN MANUFACTURING PROCESSES L T P C
3 0 0 3

AIM:

To expose the students in the art of manufacturing new products due to the development of new materials and processes. The students will totally get a feel of the relevant suitable process while evaluating and deciding.

OBJECTIVE:

- To inform the students about the various alternative manufacturing processes available.
- To develop an altitude to look for the unconventional manufacturing process to machine
- To make them to understand and appreciate the latest manufacturing process for micro fabrication and devices.

UNIT I NEWER MACHINING PROCESSES - I 9

(Non thermal energy) – Abrasive machining – water jet machining - ultrasonic machining – chemical machining – electro chemical machining – construction working principle – steps - types – process parameters – derivations – problems, merits, demerits and applications .

UNIT II NEWER MACHINING PROCESS – II 9

Wire cut EDM - Electro chemical machining – ECG - Electric discharge machining – construction – principle – types – control - circuits – tool design – merits, demerits & applications.

UNIT III NEWER MACHINING PROCESS – III 9

Laser beam machining – Electron beam machining – Plasma arc machining – Ion beam machining – construction working principle types – process parameter – derivations – problems, merits, demerits and applications.

UNIT IV FABRICATION OF MICRO DEVICES 9

Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication.

UNIT V MICROFABRICATION TECHNOLOGY 9

Wafer preparation – monolithic processing – moulding – PCB board hybrid & mcm technology – programmable devices & ASIC – electronic material and processing.– steriolithography SAW devices, Surface Mount Technology,

TOTAL: 45 PERIODS

OUTCOMES:

- To inform the students about the various alternative manufacturing processes available.
- To develop an altitude to look for the unconventional manufacturing process to machine
- To make them to understand and appreciate the latest manufacturing process for micro fabrication and devices.

REFERENCES:

1. Serope kelpekijian & stevan r. schmid- manufacturing process engg material – 2003
2. Micro senors Mems & smart devices- Julian W.Hardner – 2002
3. Brahem T. Smith, Advanced machining I.F.S. UK 1989.
4. Jaeger R.C., Introduction to microelectronic fabrication Addison Wesley, 1988. 5. Nario Taniguchi – Nano technology – Oxford University Press 1996.
5. Pandey P.C. & Shan HS Modern Machining Processes, Standard Publishing Co., 1980 7. More Madon, Fundamentals of Microfabrication, CRC Press, 1997.

MN7151 MATERIALS TECHNOLOGY L T P C

3 0 0 3

AIM: To impart knowledge on the advanced concepts of material technology

OBJECTIVES:

- To make the students to understand on elastic, plastic and fractured behaviour of engineering materials.
- To train the students in selection of metallic and non-metallic materials for the various engineering applications.

UNIT I ELASTIC AND PLASTIC BEHAVIOR 10

Elasticity in metals and polymers Anelastic and visco-elastic behaviour – Mechanism of plastic deformation and non metallic shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Deformation of non crystalline materials.

UNIT II FRACTURE BEHAVIOUR 10

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

UNIT III SELECTION OF MATERIALS 10

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability

corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

UNIT IV MODERN METALLIC MATERIALS 8

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

UNIT V NON METALLIC MATERIALS 7

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al2O3, SiC, Si3N4 CBN and diamond – properties, processing and applications.

TOTAL: 45 PERIODS

OUTCOMES:

- To impart knowledge on the advanced concepts of material technology
- To impart knowledge in the elastic, plastic, fracture behaviour of materials.
- The students will be able to understand the application and selection of materials for aerospace, automobile, marine etc.

REFERENCES:

1. Ashby M.F., Material Selection in Mechanical Design, 3rd Edition, Butter Worth 2005.
2. ASM Hand book, Vol.11, Failure Analysis and Prevention, (10th Edition), ASM, 2002.
3. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineering materials, (3rd edition), Butterworth-Heiremann, 2001.
4. Thomas H. Courtney, Mechanical Behaviour of Materials, (2nd edition), McGraw Hill, 2000
5. Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4th Edition) Jaico, 1999
6. George E.Dieter, Mechanical Metallurgy, McGraw Hill, 1988

MN7111 MANUFACTURING AND AUTOMATION LAB L T P C
0 0 4 2

OBJECTIVE:

1. To study the functional aspects of different pneumatic and hydraulic Components and its use in circuits.
2. To train the student in machining and prototyping the models using advanced manufacturing machines

MANUFACTURING LAB

1. Plate cutting in abrasive water jet machine
2. Micro hole drilling in ECM
3. Model fabrication in simple CNC router machine
4. 3D model fabrication using RPT machine
5. A study on WEDM Machine and its operations

AUTOMATION LAB

1. Study and use of pneumatic and hydraulic elements.
2. Simulation of speed control circuits in a hydraulic trainer.
3. Simulation of hydraulic circuits in a hydraulic trainer.
4. Simulation of single and double acting cylinder circuits using different directional control values.
5. One shot and regenerative pneumatic circuits.
6. Sequencing of pneumatic circuits.
7. Simulation of Electro-pneumatic circuits.
8. Simulation of Logic pneumatic circuits.
9. Simulation of electro pneumatic sequencing circuits.
10. Simulation of PLC based electro pneumatic sequencing circuits.
11. Simulation of pneumatic circuits using PLC.
12. To design and connect the circuits for the given problem (case study).
13. To compare the ladder diagram for electrical and PLC control for the given sequence.
14. Simulation of circuit for the given sequence using software.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to design, model and automate simple and complicated industrial automation using hydraulics and pneumatics
- The students will be able to understand the cutting edge technology by operating the advanced manufacturing machines and the student will be able to do some research work in the manufacturing area

MN7201 COMPUTER INTEGRATED MANUFACTURING L T P C
3 0 0 3

AIM: To expose the students on the need of automation and integration

OBJECTIVES:

- To teach the role of computers in processing of information knowing across the various stages and various departments in a manufacturing industries
- To train them in process planning.

UNIT I INTRODUCTION 6

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – Impact of CIM on personnel – CIM status.

UNIT II AUTOMATED MANUFACTURING SYSTEMS 10

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of

Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types of vehicles and AGVs applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance.

UNIT III GROUP TECHNOLOGY AND FMS 10

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS ─ FMS applications, Benefits.

UNIT IV PROCESS PLANNING 10

Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – selecting among casting process, forming process and machining process. Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study. Typical process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning.

UNIT V TYPES OF PROCESS CONTROL AND AUTOMATIC DATA CAPTURE 9

Introduction to process model formulation – linear feed back control systems – Optimal control – Adaptive control –Sequence control and PLC. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control. Overview of Automatic identification methods – Bar code technology – Other Automatic data capture technologies.

TOTAL : 45 PERIODS

OUTCOMES:

- To teach the role of computers in processing of information knowing across the various stages and various departments in a manufacturing industries
- To train them in process planning.

REFERENCES:

1. Alavudeen and Venkateshwaran, ―Computer Integrated Manufacturing‖, PHI Learning Pvt. Ltd., New Delhi, 2008.
2. Mikell P.Groover, ―Automation, Production system and Computer integrated Manufacturing‖, Prentice Hall of India Pvt. Ltd., 2008.
3. Kant Vajpayee,S., ―Computer Integrated Manufacturing‖, Prentice Hall of India, New Delhi, 2007
4. James A.Retrg, Herry W.Kraebber, ―Computer Integrated Manufacturing‖, Pearson Education, Asia, 2001.

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5. Viswanathan,N., and Narahari,Y., —Performance Modeling and Automated Manufacturing Systems‖, Prentice Hall of India Pvt. Ltd., 2000.
6. Radhakrishnan,P., Subramanian,S., and Raju,V., —CAD/CAM/CIM‖ New Age International Publishers, 2000.
7. Gideon Halevi and Ronald D.Weill, —Principles of Process Planning‖, Chapman Hall, 1995

MN7202 MANUFACTURING METROLOGY L T P C
3 0 2 4

AIM:

To expose the students, the importance of measurement and the various latest measuring techniques using Laser, Coordinate measuring machines and Opto-electronics devices. Also to stress upon the Importance of quality in manufacturing.

OBJECTIVES:

- To impart through knowledge in various latest measurement systems such as laser metrology, coordinate measuring machines and electro-optical devices.
- To train them in the area of precision and quality manufacturing

UNIT I LASER METROLOGY AND PRECISION INSTRUMENTS 15

Introduction – types of lasers – laser in engineering metrology – metrological laser methods for applications in machine systems – Interferometry applications – speckle interferometry – laser interferometers in manufacturing and machine tool alignment testing – laser Doppler technique – laser Doppler anemometry - Laser telemetric systems – detection of microscopic imperfections on high quality surface Pitter NPL gauge interferometer – classification of optical scanning systems – high inertia laser scan technique – rotating mirror technique vibrational deflectors – refractive and diffractive scanners. – laser gauging – bar coding – laser dimensional measurement system.

UNIT II CO-ORDINATE MEASURING SYSTEM 15

Co-ordinate metrology – CMM configurations – hardware components – software – Probe sensors – Displacement devices – performance evaluations – software – hardware – dynamic errors – thermal effects diagram – temperature variations - environment control – applications – Roll of CMM in reverse engineering.

UNIT III OPTO ELECTRONICS AND VISION SYSTEM 12

Opto electronic devices – CCD – On-line and in-process monitoring in production - applications - image analysis and computer vision – Image analysis techniques – spatical feature – Image extraction – segmentation – digital image processing – Vision system for measurement – Comparison laser scanning with vision system

UNIT IV QUALITY IN MANUFACTURING AND DESIGN ENGINEERING 13

Importance of manufacturing planning for quality – initial planning and concept of quality – self controls – defining quality responsibilities on the factory flow – automated manufacturing – overall view of manufacturing planning – process quality audits – Opportunities for improvement in product design – early warning concepts and design assurance – design for basic functional requirements – design for reliability – availability

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– designing for manufacturability and safety – cost of quality – design review - concurrent engineering – improving the effectiveness of product development.

UNIT V QUALITY MANAGEMENT SYSTEM AND CONTINUOUS IMPROVEMENT 15

Need for quality management system – design of quality management system – quality management system requirements – ISO 9001 and other management system and models – basic quality engineering tools - statistical process control – techniques for process design and improvement – Taguchi methods for process improvement – six sigma.

LIST OF EXPERIMENTS

1. Measurement of Angle using Sine bar/bevel protractor.
2. Inspection of Internal and External taper angle.
3. Measurement of Bore Diameter using different instruments.
4. Calibration of a dial gauge.
5. Measurement of Roundness.
6. Inspection of screw thread parameters using three wire method.
7. Measurement of surface texture.
8. Tool makers microscope- thread parameter measurement.
9. Measurement of tool angle by profile projector.
10. Inspection using vision measuring system.
11. Measurements using CMM.
12. Straightness measurement using Autocollimator.
13. Measurements using profile projector.
14. Measurement of dimensions using LASER.

TOTAL: 60 PERIODS

OUTCOMES:

- To impart through knowledge in various latest measurement systems such as laser metrology, coordinate measuring machines and electro-optical devices.
- To train them in the area of precision and quality manufacturing

REFERENCES

1. Oakland J.S. Total Quality Management – Text with cases, Butter worth – Heinemann – An imprint of Elseiver, First Indian Print, New Delhi 2005.
2. Elanchezhian.C, Vijaya Ramnath.B and Sunder Selwyn, T., Engineering Metrology, Eswar Press, Chennai, 2004.
3. Zuech Nello, Understanding and Applying Machine Vision, Marcel Dekker, Inc, 2000
4. John A. Bosch, Giddings and Lewis Dayton, Co-ordinate Measuring Machines and Systems, Marcel Dekker, Inc, 1999.
5. Juran J.M. and Gyna F.M., Quality Planning and Analysis, Tata-McGraw Hill, New Delhi, 1995. 5. Awcock, G.J. and Thomas R, Applied Image Processing, Mc.Graw Hill, Inc. 1996.

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MN7203 MATERIAL TESTING AND CHARACTERIZATION L T P C
3 0 0 3

AIM:

- This course aims to impart knowledge on various techniques of material characterization.

OBJECTIVE:

- On completion of the course the students are expected to be knowledgeable in microstructure evaluation, crystal structure analysis, electron microscopy, Chemical Thermal Analysis, static and dynamic mechanical testing methods.

UNIT I MICRO AND CRYSTAL STRUCTURE ANALYSIS 10

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 8

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:

- The students will be able to test and quantify the mechanical properties of Engineering Materials, Engines and Heat Exchangers

TEXT BOOKS:

1. Culity B.D., Stock S.R& Stock S., Elements of X ray Diffraction, (3rd Edition). Prentice Hall, 2001.
2. Dieter G.E., Mechanical Metallurgy, (3rd Edition), ISBN: 0070168938, McGraw Hill, 1988.
3. Davis, H.E., Hauck G. & Troxell G.E., The Testing of engineering Materials, (4th Edition), McGraw Hill, College Divn., 1982.
4. Suryanarayana A. V. K., Testing of metallic materials, (2nd Edition), BS publications, 2007.

REFERENCES:

1. 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.
2. Newby J., Metals Hand Book- Metallography & Micro Structures, (9th Edition), ASM International, 1989.
3. Grundy P.J. and Jones G.A., Electron Microscopy in the Study of Materials, Edward Arnold Limited, 1976.
4. Morita.S, Wiesendanger.R, and Meyer.E, —Non-contact Atomic Force Microscopyǁ Springer, 2002,
5. Davis J. R., Tensile Testing, 2nd Edition, ASM International, 2004.
6. ASM Hand book-Materials characterization, Vol – 10, 2004.

MN7204 PRODUCTION AND OPERATIONS MANAGEMENT L T P C
3 0 0 3

AIM:

To provide a broad introduction to the field of operations management and explain the concepts, strategies, tools and techniques for managing the transformation process that can lead to competitive advantage.

OBJECTIVE:

Understanding of the strategic and operational decisions in managing manufacturing and service organizations and appreciation of the role of operations management function in an organization.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT 9

Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy – Strategic fit , framework; Supply Chain Management

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN 9

Demand Forecasting – Need, Types, Objectives and Steps. Overview of Qualitative and Quantitative methods. Capacity Planning – Long range, Types, Developing capacity alternatives. Overview of sales and operations planning. Overview of MRP, MRP II and ERP. Facility Location – Theories, Steps in Selection, Location Models. Facility Layout – Principles, Types, Planning tools and techniques.

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS 9

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Work Study – Objectives, Procedure. Method Study and Motion Study. Work Measurement and Productivity – Measuring Productivity and Methods to improve productivity.

UNIT IV MATERIALS MANAGEMENT 9

Materials Management – Objectives, Planning, Budgeting and Control. Purchasing – Objectives, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – Objectives, Costs and control techniques. Overview of JIT.

UNIT V SCHEDULING AND PROJECT MANAGEMENT 9

Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson's Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

OUTCOMES:

- Understanding of the strategic and operational decisions in managing manufacturing and service organizations and appreciation of the role of operations management function in an organization.

TEXTBOOKS

1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, Tata McGraw Hill, 12th Edition, 2010.
2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.

REFERENCES

1. William J Stevenson, Operations Management, Tata McGraw Hill, 9th Edition, 2009.
2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006.
3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
4. Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008.
5. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008.
6. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007.
7. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008.

MN7211 CIM AND SOFT SKILL DEVELOPMENT LAB L T P C
0 0 4 2

AIM:

To impart the knowledge on training the students in the area of CAD/CAM

OBJECTIVES:

1. To teach the students about the drafting of 3D components and analyzing the same using various CAD packages and programming of CNC machines
2. To train them to use the various sensors
3. To enhance the employability skills of students with a special focus on Presentation
4. skills, Group discussion skills and Interview skills
5. To help them improve their soft skills, including report writing, necessary for the workplace situations

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.
3. Study of Sensors, Transducers & PLC: Hall-effect sensor, Pressure sensors, Strain gauge, PLC, LVDT, Load cell, Angular potentiometer, Torque, Temperature & Optical Transducers.

CAD LABORATORY

2D modeling and 3D modeling of components such as

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

SOFTSKILLS LAB

1. Making presentations – introducing oneself – introducing a topic – answering questions individual presentation practice
2. Creating effective PPTs – presenting the visuals effectively
3. Using appropriate body language in professional contexts – gestures, facial expressions, etc.
4. Preparing job applications - writing covering letter and résumé
5. Applying for jobs online - email etiquette
6. Participating in group discussions – understanding group dynamics - brainstorming the topic
7. Training in soft skills - persuasive skills – People skills - questioning and clarifying skills mock GD
8. Writing Project proposals – collecting, analyzing and interpreting data / drafting the final report
9. Attending job interviews – answering questions confidently
10. Interview etiquette – dress code – body language – mock interview

TOTAL: 60 PERIODS

OUTCOMES:

- To teach the students about the drafting of 3D components and analyzing the same using various CAD packages and programming of CNC machines
- To train them to use the various sensors
- To enhance the employability skills of students with a special focus on Presentation
- skills, Group discussion skills and Interview skills
- To help them improve their soft skills, including report writing, necessary for the workplace situations

Attested

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MN7301 FINITE ELEMENT APPLICATIONS IN MANUFACTURING L T P C
3 0 2 4

AIM: To impart knowledge in the area of finite element methods and its application in manufacturing.

OBJECTIVE: To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.

UNIT I INTRODUCTION 10

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 15

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 15

Shape functions for one and two dimensional elements- Three noded 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 10

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 10

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.

Finite element analysis Lab

1. One Dimensional FEA Problem.
    a. Truss structure analysis.
    b. Cantilever beam analysis.
    c. Temperature distribution problem.
2. Two Dimensional FEA Problems.
    a. Plane stress analysis.
    b. Axisymmetric analysis.
    c. Vibration Analysis.
3. Three Dimensional FEA Problems.
    a. 3D Shell Analysis.
    b. 3D Contact Analysis.
4. FEA Application in metal forming like superplastic forming, deep drawing etc
5. FEA Application in Metal cutting

6. FEA Application in Casting process

TOTAL: 60 PERIODS

OUTCOMES:

- The students will be able to apply the principles of Finite Element Analysis to solve problems in the field of production engineering.

REFERENCES:

1. Reddy, J.N. An Introduction to the Finite Element Method, McGraw Hill,2005.
2. Rao, S.S., Finite Element method in engineering, Pergammon press, 2005.
3. Seshu P., Textbook of Finite Element Analysis, PHI Learning Pvt. Ltd, 2004.
4. Lewis R.W. Morgan, K, Thomas, H.R. and Seetharaman, K.N. The Finite Element Method in Heat Transfer Analysis, John Wiley, 1994.
5. Bathe, K.J., Finite Element procedures in Engineering Analysis, 1990
6. Kobayashi,S, Soo-ik-Oh and Altan,T, Metal Forming and the Finite Element Methods, Oxford University Press, 1989.
7. www.tbook.com
8. www.pollockeng.com

MN7302 ROBOT DESIGN AND PROGRAMMING L T P C
3 0 2 4

AIM: To impart knowledge in the area of Robot designing and programming in Robotic languages.

OBJECTIVES:

- To teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors
- To expose the students to build a robot for any type of application

UNIT I INTRODUCTION 12

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

UNIT II ROBOT KINEMATICS 13

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 15

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

UNIT IV ROBOT PROGRAMMING & AI TECHNIQUES 10

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 10

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.

Robotics Lab

1. Modelling and simulation of mechanisms using ADAMS
2. Kinematics and synthesis of 2 DOF RR configuration robot
3. Robotic joint control using stepper motor interfacing
4. Experimental verification of fruedenstein equation for 1 DOF
5. Robot programming for pick and place operation
6. Robot programming for palletizing operation
7. Gripper force analysis for
    a. Screw actuated gripper
    b. Vacuum gripper
    c. Mechanical Linkage type of gripper
8. Dynamic analysis of 1 DOF robot
9. Trajectory planning of 1 DOF robot

TOTAL: 60 PERIODS

OUTCOMES:

- To teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors
- To expose the students to build a robot for any type of application

REFERENCES

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

MN7311 PROJECT WORK PHASE I L T P C
0 0 12 6

OBJECTIVES

- A project topic may be selected based on the literature survey and the creative ideas of the students themselves in consultation with their project supervisor.
- The topic should be so chosen that it will improve and develop the skills to design, fabricate, analyse, test and research. Literature survey and a part of the project work be carried out in phase I.
- The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

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- A project report for phase I is to be submitted at the end.

EVALUATION

- Project work evaluation is based on the Regulations of the Credit system for the Post graduate programmes of Anna University

TOTAL : 90 PERIODS

OUTCOME

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

MN7411 PROJECT WORK PHASE II L T P C
0 0 24 12

OBJECTIVES

- To continue the work from phase I and complete the project work in order to meet the stated objectives of the topic chosen.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Division based on oral presentation and the project report
- To improve the research and development activities of the students.

EVALUATION

- Project work evaluation is based on the Regulations of the Credit system for Post graduate programmes of Anna University

TOTAL = 180 PERIODS

OUTCOME

The students' would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated project outcome of the aimed work.

ED7080 SURFACE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To impart knowledge on surface engineering and surface modification methods that will come in handy to solve the industrial problems. This will also serve as a precursor for future research in the same field.

UNIT I FRICTION 7

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact

UNIT II WEAR 6

Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear- Laws of wear – Theoretical wear models – Wear of metals and non metals - International standards in friction and wear measurements

UNIT III CORROSION 10

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Evaluation of corrosion – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors

UNIT IV SURFACE TREATMENTS 12

Introduction – Surface properties, Superficial layer – Changing surface metallurgy – Wear resistant coatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings

UNIT V ENGINEERING MATERIALS 10

Introduction – Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Applications – Bio Tribology Nano Tribology.

TOTAL: 45 PERIODS

OUTCOMES:

- To impart knowledge on surface engineering and surface modification methods that will come in handy to solve the industrial problems. This will also serve as a precursor for future research in the same field.

REFERENCES

1. G.W.Stachowiak & A.W .Batchelor , “Engineering Tribology”, Butterworth-Heinemann, UK, 2005
2. Rabinowicz.E, “Friction and Wear of materials”, John Willey &Sons ,UK,1995
3. Halling, J. (Editor) – “Principles of Tribology “, Macmillian – 1984.
4. Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994.
5. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,”Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd , New Delhi, 2005 6. Fontana G., “Corrosion Engineering”, McGraw Hill, 1985

MN7001 COMPUTER AIDED PRODUCT DESIGN L T P C

3 0 0 3

AIM: To introduce the computer aided modeling and various concepts of product design.

OBJECTIVES:

- To model a product using CAD software.
- To apply the various design concepts and design tools and techniques while designing a product.

UNIT I INTRODUCTION 8

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 8

Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations – projections – curves - Geometric Modeling – 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 10

Understanding customer needs – Product function modeling – Function trees and function structures – Product tear down methods – Bench marking – Product port folio – 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 10

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:

- The students will be able to apply the principles of automation and employ the computers for various manufacturing activities.

REFERENCES:

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

MN7002 CONCEPTS OF GREEN MANUFACTURING L T P C
3 0 0 3

OBJECTIVE:

- To introduce the concept of Green Manufacturing to the students.

UNIT I AIR POLLUTION SAMPLING AND MEASUREMENT 4

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation-the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone

UNIT II NOISE POLLUTION & CONTROL 10

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise-Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

UNIT III WATER DEMAND, WATER QUALITY 10

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT IV FIRE SAFETY 10

Basic Elements, Causes, Industrial Fires, Explosions, Effects on Environmental, Property & Human Loss, Prevention technique, Building Design, Fire Protection System, contingency plan, Emergency preparedness, Evacuation.

UNIT V SAFETY RADIATION PROTECTION 9

Radiation fundamentals-Types of radiation lonizing and Non-lonizing radiation, their uses and biological effects. Radioactive waste disposal radioactive soil, water and air and their fate. Treatment and disposal Liquid and solid Radioactive wastes.

TOTAL: 45 PERIODS

OUTCOMES:

- To introduce the concept of Green Manufacturing to the students.
-

TEXT BOOKS:

1. Dornfield David, Green Manufacturing, Springer, 2012
2. Davim.J.Pauls, Green Manufacturing Processes and Systems, Springer, 2013

REFERENCES:

1. Cairncrss and Francis – Costing the earth – Harvard Business School Press – 2009
2. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
3. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.

MN7003 ENTERPRISE RESOURCE PLANNING PRINCIPLES AND APPLICATIONS **L T P C 3 0 0 3**

OBJECTIVES:

- To understand the business process of an enterprise
- To grasp the activities of erp project management cycle
- To understand the emerging trends in erp developments

UNIT I INTRODUCTION **8**

Overview of enterprise systems – Evolution - Risks and benefits - Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems.

UNIT II ERP SOLUTIONS AND FUNCTIONAL MODULES **10**

Overview of ERP software solutions- Small, medium and large enterprise vendor solutions, BPR, and best business practices - Business process Management, Functional modules.

UNIT III ERP IMPLEMENTATION **10**

Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work- Training – Data Migration. People Organization in implementation-Consultants, Vendors and Employees.

UNIT IV POST IMPLEMENTATION **8**

Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation.

UNIT V EMERGING TRENDS ON ERP **9**

Extended ERP systems and ERP add-ons -CRM, SCM, Business analytics - Future trends in ERP systems-web enabled, Wireless technologies, cloud computing.

TOTAL: 45 PERIODS

OUTCOMES:

- To understand the business process of an enterprise
- To grasp the activities of erp project management cycle
- To understand the emerging trends in erp developments

TEXTBOOK

1. Alexis Leon, ERP demystified, second Edition Tata McGraw-Hill, 2008.

REFERENCES

1. Sinha P. Magal and Jeffery Word, Essentials of Business Process and Information System, Wiley India, 2012
2. Jagan Nathan Vaman, ERP in Practice, Tata McGraw-Hill, 2008
3. Alexis Leon, Enterprise Resource Planning, second edition, Tata McGraw-Hill, 2008.
4. Mahadeo Jaiswal and Ganesh Vanapalli, ERP Macmillan India, 2009
5. Vinod Kumar Grag and N.K. Venkitakrishnan, ERP- Concepts and Practice, Prentice Hall of India, 2006.
6. Summer, ERP, Pearson Education, 2008

MN7004 **FINANCIAL MANAGEMENT** **L T P C**
3 0 0 3

AIM:

- To introduce the concepts of financial and various functions of financial management so that the students will be able to handle higher level financial decisions.

OBJECTIVES:

- To train students in various functions of finance such as working capital management, current assets management so that students will be able to make investment decisions when they take up senior managerial positions.

UNIT I FINANCIAL ACCOUNTING 8

Accounting principles - Basic records - Preparation and interpretation of profit and loss statement - balance sheet - Fixed assets - Current assets.

UNIT II COST ACCOUNTING 12

Elements of cost - cost classification - material cost - labour costs - overheads - cost of a product - costing systems - cost determination - process - costing - Allocation of overheads - Depreciation - methods.

UNIT III MANAGEMENT OF WORKING CAPITAL 10

Current assets - Estimation of working capital requirements - Management of accounts receivable - Inventory - Cash - Inventory valuation methods.

UNIT IV CAPITAL BUDGETING 8

Significance of capital budgeting - payback period - present value method - accounting rate of return method - Internal rate of return method.

UNIT V PROFIT PLANNING AND ANALYSIS 7

Cost - Volume profit relationship Relevant costs in decision making profit management analysis - Break even analysis.

TOTAL: 45 PERIODS

OUTCOMES:

- To train students in various functions of finance such as working capital management, current assets management so that students will be able to make investment decisions when they take up senior managerial positions

REFERENCES:

1. Presanna Chandra, Financial Management, Tata McGraw Hill, 2011.
2. C.James, Vanhorn, Fundamentals of Financial Management PHI 2008
3. G.B.S. Narang, Production and Costing, Khanna Publishers, 1993.
4. R Kesavan, C.Elanchezian, Vijayaramnath, Process Planning and cost estimation, New Age International Publishers, New Delhi 2004
5. RKesavan, C.Elanchezian, Sundar Selwyn, Engineering Economics and Financial Accounting, Laxmi Publications, New Delhi, 2005.
6. R Kesavan, C. Elanchezian, B.Vijaramnath, Engineering Economics and Cost Analysis Anuratha Publications, Chennai, 2006

MN7005 MANUFACTURING OF AUTOMOTIVE PARTS L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge in various manufacturing methods in developing automotive components.
- To study the principle of automobile engineering.

UNIT I MATERIAL NEEDS IN AUTOMOBILE 9

Requirements of materials in automotive tests – recycling and life cycle consideration. Current materials in use and their future. Advanced in manufacturing and joining techniques. Technical problems and solutions for use of magnesium alloys in automotive industry. Most commonly used composite moulding processes. Renewable materials, barriers and incentives in use of bio-composites.

UNIT II MATERIALS AND TECHNOLOGIES FOR AUTOMOBILE 8

Introduction – steel sheets – high strength steel sheet – "Nano-Hilen" – "BHT" – high strength galvannealed steel sheets – development of inorganic type high lubrication galvannealed steel sheets – organic solid lubricant technology – uses of aluminium in automobiles – uses of plastics in automobiles.

UNIT III MANUFACTURING OF ENGINE PARTS I 10

Introduction – manufacturing of auto piston – manufacturing of pins for automobiles – manufacturing of piston rings – manufacturing of lead storage battery. Manufacturing of valve and valve set – manufacturing of automobile silencer.

UNIT IV MANUFACTURING OF ENGINE PARTS II 8

Manufacturing of automobile chain – manufacturing of cylindrical block. Manufacturing of cylinder liner – manufacturing of automobile control cable – manufacturing of engine moulding PAD – manufacturing of auto locks.

UNIT V MANUFACTURING OF ENGINE PARTS III 10

Manufacturing of automobile chasis and other technologies. Manufacturing of automobile bofy – Manufacturing of disk brack – Manufacturing of brake drum – Manufacturing of gear blank – Manufacturing of gear – casting method – forming method – powder metallurgy – Manufacturing of gear box housing – Manufacturing process of leaf spring – Manufacturing process of automotive tyres – Manufacturing of auto tubes and flaps. Heat treatment of automobiles – forging technologies of automobile parts – painting technology of automobiles.

TOTAL: 45 PERIODS

OUTCOMES:

- To impart knowledge in various manufacturing methods in developing automotive components.
- To study the principle of automobile engineering.

TEXT BOOKS:

1. Heldt.P.M, High speed combustion engines, Oxford publishing Co., New York, 1990.

REFERENCES:

1. Kirpal Singh, Automobile Engineering ., Vol.I & II, Standard Publishers, New Delhi, 1997.

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2. Newton and steels, the motor vehicle, ELBS, 1990
3. Serope Kalpakjian and Steven R. Schmid, Manufacturing Processes for Engineering
4. Materials, Fourth Edition – Pearson Education publications – 2003.
5. Gupta K.M. Automobile Engineering Vol.I & II, Umesh Publishers, 2000.

MN7006 MANUFACTURING TECHNIQUES L T P C
3 0 0 3

AIM:

- To introduce the concepts of financial and various functions of financial management so that the students will be able to handle higher level financial decisions.

OBJECTIVES:

- To expose the students on the various technique developed in manufacturing
- To get an idea to implement the modern manufacturing techniques

UNIT I AGILE PRODUCTION SYSTEM AND PRACTICES 9

Agile production system – the task aligned organization – agile manufacturing production system – production planning and control, quality assurance, purchasing, maintenance, overview of production support, business operation, engineering, human resource, finance and accounting.

Agile practices – Agile practice for product development – manufacturing agile practice – understanding the value of investing in people, removing inappropriate fear from the shop floor – not scarifying agility for perfectionism

UNIT II MANAGEMENT IN THE AGILE ORANIZATION 9

Old management styles, role of manager in an agile organization – vision champion, team leader, coach, business analyzer, supporting the new culture – performance appraisal systems, selection systems, reward and recognition systems, organizational measurement, organizational learning processes.

UNIT III VARIOUS ELEMENTS IN LEAN MANUFACTURING 9

Organization element – communication planning, product – focused responsibility, leadership development, operational roles and responsibilities, workforce preparation. Matrics element – DuPont model, output-based measures, process – driven measures, goal alignment through polity deployment, measurement definition and understanding. Logistics element – planning/control function, A,B,C material handling, service cells, JIT Kanban, demand signals, cell team work plan, mix-model manufacturing. Manufacturing flow element – product/quantity analysis, process mapping, routing analysis, takt time, workload balancing and one piece flow, cell layout, kanban sizing.

UNIT IV VALUE STREAM MAPPING 9

Introduction – primary icons – customer and supplier icons – production control icon – data box icon – truck icon – material direction arrow icon – process icon – push icon – pull icon – information and communication flow icons – secondary icons – developing

the VSM – example illustrating the development of VSM – current state mapping – future state mapping.

UNIT V ADDITIVE MANUFACTURING 9

Introduction – Fused deposition modeling – principle, process parameter, path generation, application. Selective laser sintering – types of machine, principle, process parameters, application. Stereolithography systems - principle, process parameter, process details, data preparation, data files and machine details, application. Laminated object manufacturing – principle of operation, LOM material, solid ground curing – principle of operation, machine details, application.

Basics of Rapid Tooling, software for RP and Rapid manufacturing process optimization

TOTAL: 45 PERIODS

OUTCOMES:

- The students will obtain knowledge to try the relevant technique for manufacturing.
- Students gain confident to improve the manufacturing by adopting the suitable techniques.

REFERENCES:

1. Devadasan S R, Mohan Sivakumar V, Murugesh R and Shalij P R, "Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities", Prentice Hall of India (PHI) Private Limited, New Delhi, India, 2012.
2. Gunasekaran A, "Agile Manufacturing 21st Strategy Competitiveness Strategy", Elsevier Publications, 2001.
3. Goldman S L, Nagal R N and Preiss K, "Agile Competitors and Virtual Organization", Van Nostrand Reinhold, 1995.
4. Pham D T and Dimov S S, "Rapid Manufacturing", Verlag, 2001.
5. Paul F Jacobs, "Stereo lithography and other RP&M Technologies", SME, 1996

MN7007 MECHATRONICS IN MANUFACTURING PROCESSES L T P C

3 0 0 3

OBJECTIVES:

This syllabus is formed to create knowledge in Mechatronics systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

UNIT I INTRODUCTION 7

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 12

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-ultrosonic sensors – Proximity sensors – Signal processing techniques.

UNIT III MICROPROCESSORS AND MICROCONTROLLERS 12

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, leds, A/D and D/A Converters, RS 232 serial communication interface, classification of memories.

UNIT IV ACTUATORS 8

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 6

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:

- This syllabus is formed to create knowledge in Mechatronics systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

REFERENCES:

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

MN7008 METAL CUTTING THEORY AND PRACTICE L T P C

3 0 0 3

AIM:

To impart the knowledge and train the students in the area of metal cutting theory and its importance.

OBJECTIVES:

To make the students familiar with the various principles of metal cutting, cutting tool materials and its wear mechanisms during the machining operation.

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-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 fluids.

UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR 9

Essential requirements of tool materials-development in tool materials-ISO specification for inserts and tool holders-tool life-conventional and accelerated tool life tests-concept of mach inability 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 effecting chatter in machining-types of chatter-mechanism of chatter.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to apply the principles of metal cutting theory and employ the various aspects in manufacturing activities.

REFERENCES

1. Boothroid D.G. & Knight W.A., Fundamentals of machining and machine tools, Marcel Dekker, Newyork, 1989.
2. Shaw.M.C.Metal cutting principles, oxford Clare don press, 1984.
3. Bhattacharya.A., Metal Cutting Theory and practice, Central Book Publishers, India, 1984.

MN7009 MICRO MANUFACTURING L T P C

3 0 0 3

AIM:

To impart the principles of various basic micro manufacturing process

OBJECTIVE:

The objective of the course is to acquaint the students with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.

UNIT I MICRO MACHINING I 10

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 MICRO MACHINING II 10

Beam Energy based micro machining – 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 09

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

UNIT IV MICRO FORMING AND WELDING 09

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 07

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:

The objective of the course is to acquaint the students with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.

REFERENCES:

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

MN7010 MICRO SYSTEM TECHNOLOGY L T P C

3 0 0 3

AIM: To inspire the students to expect to the trends in manufacturing of micro components and measuring systems to nano scale.

OBJECTIVES:

- To expose the students to the evolution of micro electromechanical systems, to the various fabrication techniques and to make students to be aware of micro actuators.
- Also to impart knowledge to the students about nano materials and various nano measurements techniques.

UNIT I OVER VIEW OF MEMS AND MICROSYSTEMS 6

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, Galium arsenide, quartz, polymers for MEMS, conductive polymers.

UNIT II FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING10

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 8

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 10

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 11

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 tunneling 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:

- To expose the students to the evolution of micro electromechanical systems, to the various fabrication techniques and to make students to be aware of micro actuators.
- Also to impart knowledge to the students about nano materials and various nano measurements techniques.

REFERENCES:

1. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN:470-85106-6
2. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003

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

MN7011 OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

AIM:

To introduce the various optimization techniques and their advancements.

OBJECTIVES:

- To make use of the above techniques while modeling and solving the engineering problems of different fields.

UNIT I INTRODUCTION 5

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

UNIT II CLASSIC OPTIMIZATION TECHNIQUES 10

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 12

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:

- The students will be able to study a given problem, formulate and model it suitably, select an appropriate optimisation technique, solve, find and implement the optimal solution.

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REFERENCES:

1. R. Panneerselvam, —Operations Researchll, Prentice Hall of India Private Limited, New Delhi 1 – 2005
2. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997
3. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
4. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994
5. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992

MN7012 PROCESSING OF POLYMERS AND COMPOSITES L T P C
3 0 0 3

AIM:

To impart knowledge on types, physical properties and processing of polymer matrix composites, metal matrix composites and ceramics matrix composites.

OBJECTIVES:

- 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.

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 fibers - 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:

- 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.

REFERENCES:

1. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012, ISBN:978-0-387-74364-6.
2. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010, ISBN:0849342058.
3. Jamal Y. Sheikh-Ahmad, Machining of Polymer Composites, Springer, USA, 2009. ISBN: 978-0-387-35539-9.
4. Mallick, P.K. and Newman.S., Composite Materials Technology, Hanser Publishers, 2003.
5. Harold Belofsky, Plastics, Product Design and Process Engineering, Hanser Publishers, 2002.
6. Seamour, E.B. Modern Plastics Technology, Prentice Hall, 2002
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. ASM Handbook – Composites, Vol-21, 2001, ISBN: 978-0-87170-703-1.

MN7013 QUALITY AND RELIABILITY ENGINEERING L T P C
3 0 0 3

AIM:

- To expose the students to the various quality control techniques and also to understand the importance and concept of reliability and maintainability in industries.

OBJECTIVES:

- To make the students to understand the various quality control techniques and to construct the various quality control charts for variables and attributes and also the design concepts for reliable system and maintenance aspects in industries.

UNIT I QUALITY & STATISTICAL PROCESS CONTROL 8

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 8

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 – Markove analysis, load sharing systems, standby systems, covarient models, static models, dynamic models.

UNIT V DESIGN FOR RELIABILITY AND MAINTAINABILITY 11

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:

- To make the students to understand the various quality control techniques and to construct the various quality control charts for variables and attributes and also the design concepts for reliable system and maintenance aspects in industries.

REFERENCES:

1. Dhillon, Engineering Maintainability – How to design for reliability and easy maintenance, PHI, 2008.
2. Amata Mitra ―Fundamentals of Quality Control and improvement‖ Pearson Education, 2002.
3. Patrick D To‘ corner, Practical Reliability Engineering, John-Wiley and Sons Inc, 2002
4. David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.

5. Charles E Ebling, An Introduction to Reliability and Maintability Engineering, Tata-McGraw Hill, 2000.
6. Bester field D.H., —Quality Control Prentice Hall, 1993.

MN7014 SUPPLY CHAIN MANAGEMENT AND LOGISTICS L T P C
3 0 0 3

OBJECTIVE:

- The objective of this module is to provide the participants with a good knowledge on logistics and supply chain management and how these topics can be related with the organization and their business needs.

UNIT I LOGISTICS MANAGEMENT 9

Logistics Management: Origin and Definition – Types of Logistics – Logistics Management – Ware House Management – Automation and Outsourcing - Customer Service and Logistics Management – A Perspective - Concepts in Logistics and Physical Distribution - Distribution and Inventory

UNIT II INVENTORY CONTROL 9

Types of Inventory Control - Demand Forecasting - Warehousing and Stores Management – Routing - Transportation Management - Some Commercial Aspects in Distribution Management – Codification - Distribution Channel Management - Distribution Resource Planning (DRP) - Logistics in 21st Century

UNIT III SUPPLY CHAIN MANAGEMENT 9

Supply Chain Management: Introduction and Development- Nature and Concept - Importance of Supply Chain - Value Chain - Components of Supply Chain - The Need for Supply Chain - Understanding the Supply Chain Management - Participants in Supply Chain – Global Applications

UNIT IV VALUE OF SUPPLY CHAIN MANAGEMENT 9

Role of a Manager in Supply Chain - Supply Chain Performance Drivers - Key Enablers in Supply Chain Improvement - Inter-relation between Enablers and Levels of Supply Chain Improvement-Systems and Values of Supply Chain

UNIT V SUPPLY CHAIN BUSINESS STRATEGY 9

Aligning the Supply Chain with Business Strategy - SCOR Model –Outsourcing and 3PLs – Fourth Party Logistics – Bull Whip Effect and Supply Chain – Supply Chain Relationships – Conflict Resolution Strategies - Certifications –

TOTAL: 45 PERIODS

OUTCOMES:

- The objective of this module is to provide the participants with a good knowledge on logistics and supply chain management and how these topics can be related with the organization and their business needs.

REFERENCES:

1. G Raghuram & N Rangaraj, Logistics and Supply Chain Management - Cases and Concepts. Mac Millan.

2. Martin Christopher, Logistics & Supply Chain Management: Creating Value-Adding Networks, FT Press.
3. Janat Shah, Supply Chain Management: Text and Cases, 1st Edition, Pearson. Text Book: D K Agrawal, Textbook of Logistics and Supply Chain Management, MacMillan 2003, 1st Edition

MN7015 THEORY OF METAL FORMING L T P C
3 0 0 3

AIM:
To impart knowledge on plasticity, surface treatment for forming of various types of metal forming process.

OBJECTIVES:
- To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
- To study the thermo mechanical regimes and its requirements of metal forming

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.

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 – Advantage, Limitations and application

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

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deformation – Formability of welded blank sheet – Laser structured steel sheet - Formability of laminated sheet.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to apply the principles, of Bulk Metal Forming and Sheet Metal Forming to produce various components of different size and shape.

REFERENCES:

1. Helmi A Youssef, Hassan A. El-Hofy, Manufacturing Technology: Materials, Processes and Equipment, CRC publication press, 2012.
2. SAE Transactions, Journal of Materials and Manufacturing Section 5, 1993-2007
3. Surender kumar, Technology of Metal Forming Processes, Prentice Hall India Publishers,2010
4. Marciniak,Z., Duncan J.L., Hu S.J., ‗Mechanics of Sheet Metal Forming', Butterworth-Heinemann An Imprint of Elesevier, 2006
5. Nagpal G.R., Metal Forming Processes- Khanna publishers, 2005.
6. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003
7. ASM Hand book, Forming and Forging, Ninth edition, Vol – 14, 2003
8. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T,Metal forming and Finite Element Method, Oxford University Press, 2001.
9. Proc. Of National Seminar on ―Advances in Metal Forming‖ MIT, March 2000
10. Dieter G.E., Mechanical Metallurgy (Revised Edition II) McGraw Hill Co., 1988
11. ALTAN.T, SOO-IK-oh, GEGEL, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio, 1995.