NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

(Deemed to be University Under Section 3 of the UGC Act, 1956)
Kumaracoil, Thuckalay

DEPARTMENT OF MECHANICAL ENGINEERING

M.E. Computer Integrated Manufacturing

CURRICULUM AND SYLLABI

REGULATION 2021

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION, Kumaracoil

Regulation : 2021

Curriculum and Syllabi

DEPARTMENT OF MECHANICAL ENGINEERING

M.E COMPUTER INTEGRATED MANUFACTURING

Vision of the University

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

Mission of the University

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

Faculty of Mechanical Engineering

Department of Mechanical Engineering

Vision of the Department

To become a centre of excellence in teaching, research & development by producing innovative and creative mechanical engineers to meet the global challenges.

Mission of the Department

To achieve National and International recognition by providing educational needs & Industry requirements through unique programs in Mechanical Engineering.

Description of the programme

Computer-integrated manufacturing (CIM) refers to the use of computer-controlled machineries and automation systems in manufacturing products. CIM combines various technologies like computer-aided design (CAD) and computer-aided manufacturing (CAM) to provide an error-free manufacturing process that reduces manual labor and automates repetitive tasks. The CIM approach increases the speed of the manufacturing process and uses real-time sensors and closed-loop control processes to automate the manufacturing process. It is widely used in the automotive, aviation, space and ship-building industries.

Programme Educational Objectives - PEO	
PEO-01	To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real life problems
PEO-02	To Impart knowledge to students in recent advances in the Computer Integrated Manufacturing Engineering to educate them to prosper in Manufacturing engineering and research related professions.
PEO-03	To inculcate students with professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate Computer Integrated Manufacturing engineering issues to broader engineering and social context.
PEO-04	To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate Manufacturing engineering issues to broader social context.
PEO-05	To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career

Graduate Attributes-GA	
GA-1	**Advanced Engineering Expertise** Master advanced engineering principles and apply them to design, analyze, and innovate systems that address both present and emerging global challenges across diverse industries.
GA-2	**Leadership in Research and Innovation** Lead groundbreaking research and foster innovation by identifying opportunities for technological advancements, contributing original ideas that push the boundaries of engineering knowledge.
GA-3	**Sustainable Engineering Practices** Develop and implement engineering solutions that integrate sustainability, environmental stewardship, and resource efficiency, ensuring the long-term impact and responsibility of all projects.

GA-4	**Ethical and Strategic Decision-Making** Make informed, ethical decisions in complex engineering contexts, considering societal needs, environmental implications, and the long-term consequences of engineering practices.
GA-5	**Global Competence in Engineering Solutions** Exhibit a deep understanding of global engineering standards and practices, addressing international challenges and cultural sensitivities in engineering projects to make a broader societal impact.
GA-6	**Technological Agility and Lifelong Learning** Stay ahead of technological trends and exhibit agility in learning new tools, methodologies, and technologies, ensuring continuous professional growth in a rapidly evolving engineering landscape.
GA-7	**Interdisciplinary and Collaborative Innovation** Excel in multidisciplinary collaborations, leveraging knowledge from multiple fields to solve complex, large-scale engineering problems that require comprehensive and innovative solutions.
GA-8	**Data-Driven Decision Making** Employ advanced data analytics, machine learning, and computational tools to derive insights and make informed engineering decisions that improve performance, efficiency, and sustainability.
GA-9	**Entrepreneurial Mindset and Innovation Leadership** Cultivate an entrepreneurial mindset, translating engineering innovations into viable products, solutions, or services, and leading teams toward commercialization and societal impact.
GA-10	**Safety, Risk, and Crisis Management** Implement and manage advanced safety protocols and risk mitigation strategies to protect individuals, communities, and ecosystems in engineering practices, particularly in high-stakes and crisis environments.

Programme Outcome - PO	
PO-A	To impart the concepts of Computer Aided Design and Computer Aided Manufacturing engineering through the use of analytical techniques, experiments, computer simulation methods and other modern engineering tools.
PO-B	Able to take up profession in R&D areas, management and teaching activity in the field of mechanical engineering.
PO-C	Engage in industry institute interaction and lifelong learning by adhering to ethical and environmental conditions.
P0-D	Apply the technical skills gained to model and analyze real time projects in the field of Computer Integrated Manufacturing.

PO-E	Graduates will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.
PO-F	Graduates will demonstrate knowledge of professional and ethical responsibilities.
PO-G	Graduates will be able to communicate effectively in both verbal and written form.
PO-H	Graduates will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
PO-I	Graduates will develop confidence for self-education and ability for lifelong learning.

Mapping of Graduate Attributes and Programme Educational Objectives(PEO)

GAs / PEOs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10
PEO-01	**A**	**H**	**A**	**A**	**H**	**A**	**H**	**A**	**A**	**H**
PEO-02	**H**	**H**	**A**	**A**	**H**	**A**	**A**	**A**	**A**	**A**
PEO-03	**A**	**H**	**A**	**A**	**H**	**H**	**H**	**H**	**A**	**A**
PE0-04	**A**	**H**	**A**	**A**	**H**	**A**	**A**	**A**	**H**	**H**
PEO-05	**A**	**A**	**A**	**A**	**H**	**H**	**H**	**H**	**A**	**H**

H- Highly Associated A- Associated Not – Not Associated

Mapping of Graduate Attributes and Programme Outcomes (PO)

GAs / POs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10
PO-A	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**H**	**A**	**H**
PO-B	**A**	**A**	**H**	**A**	**A**	**A**	**H**	**A**	**A**	**A**
PO-C	**A**	**A**	**H**	**A**	**A**	**A**	**H**	**A**	**A**	**A**
P0-D	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**H**
PO-E	**A**	**A**	**A**	**A**	**A**	**H**	**H**	**H**	**A**	**H**
PO-F	**H**	**H**	**A**	**A**	**H**	**A**	**A**	**H**	**H**	**A**
PO-G	**A**	**A**	**H**	**A**	**A**	**A**	**A**	**A**	**A**	**H**
PO-H	**A**	**A**	**H**	**H**	**A**	**A**	**H**	**A**	**A**	**A**
PO-I	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**

H- Highly Associated A- Associated Not – Not Associated

Mapping of Programme Educational Objective (PEOs) and Programme Outcomes (POs)

PEO / PO	PEO-01	PEO-02	PEO-03	PEO-04	PEO-05	PEO-06	PEO-07	PEO-08
PO-A	H	H	A	A	H	H	H	A
PO-B	A	A	A	H	H	A	A	A
PO-C	A	H	A	H	A	A	H	A
P0-D	A	H	A	A	A	A	H	A

PO-E	A	H	H	H	H	A	H	H
PO-F	H	A	A	A	H	H	A	A
PO-G	H	A	A	H	H	H	A	A
PO-H	A	H	H	A	A	A	H	H
PO-I	H	A	H	A	A	H	A	H

H- Highly Associated A- Associated Not – Not Associated

Duration of the programme: 2 Years/ 4 Semesters

Total credit: 67

CURRICULUM & SYLLABI

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CM3501	Principles of CIM	3	0	0	3
2.	CM3502	Computer Aided Design	3	0	0	3
3.	CM3503	Statistical and Optimization Technique	3	1	0	4
4.	CM35XX	Elective I (Core)	3	0	0	3
5.	CM35XX	Elective II (Core)	3	0	0	3
6.	CM35XX	Elective III (Core)	3	0	0	3
PRACTICAL						
7.	CM3571	CIM Laboratory - I	0	0	3	1
Total			**18**	**1**	**3**	**20**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CM3504	Mechatronics	3	0	0	3
2.	CM3505	Manufacturing System Simulation	3	0	0	3
3.	CM3506	Robotics	3	0	0	3
4.	CM3507	Computer Aided Manufacturing	3	0	0	3
5.	CM35XX	Elective IV (Core)	3	0	0	3
6	CM35XX	Elective V (Core)	3	0	0	3
PRACTICAL						
7.	CM3572	CIM Laboratory - II	0	0	3	1
Total			**18**	**0**	**3**	**19**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CM3508	Production and Operation Management	3	0	0	3
2.	CM35XX	Elective VI (Open Elective)	3	0	0	3
PRACTICAL						
3.	CM35P1	Project Work - Phase I	0	0	12	6
Total			**8**	**0**	**12**	**12**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CM35P2	Project Work - Phase II	0	0	32	16
Total			**0**	**0**	**32**	**16**

M.E. COMPUTER INTEGRATED MANUFACTURING

LIST OF ELECTIVES

CORE ELECTIVES

Sl.No	COURSE CODE	COURSE NAME	L	T	P	C
1.	CM35A1	Supply Chain Management	3	0	0	3
2.	CM35A2	Flexible Manufacturing System	3	0	0	3
3.	CM35A3	Applications of IT in Manufacturing Industries	3	0	0	3
4.	CM35A4	Automated Material Handling Systems	3	0	0	3
5.	CM35A5	Finite Element Analysis in Manufacturing	3	0	0	3
6.	CM35A6	Design for Manufacture and Assembly Systems	3	0	0	3
7.	CM35A7	Manufacturing Planning & Control	3	0	0	3
8.	CM35A8	Rapid Manufacturing	3	0	0	3
9.	CM35A9	Product Life Cycle Management	3	0	0	3
10.	CM35B1	Automated Inspection And Quality Management	3	0	0	3
11.	CM35B2	Concurrent Engineering	3	0	0	3

12.	CM35B3	Manufacturing Information Systems	3	0	0	3
13.	CM35B4	Materials And Processes for Automation	3	0	0	3
14.	CM35B5	Sensors, Actuation Devices and Control	3	0	0	3

OPEN ELECTIVES

Sl.No	COURSE CODE	COURSE NAME	L	T	P	C
1.	CM35B6	Artificial Intelligence & Expert System	3	0	0	3
2.	CM35B7	Machine Vision Systems and Image Processing	3	0	0	3
3.	CM35B8	Enterprise Computing	3	0	0	3
4.	GE35A1	Business Analytics	3	0	0	3
5.	GE35A2	Industrial Safety	3	0	0	3
6.	GE35A3	Operations Research	3	0	0	3
7.	GE35A4	Cost Management of Engineering Projects	3	0	0	3
8.	GE35A5	Composite Materials	3	0	0	3
9.	GE35A6	Waste to Energy	3	0	0	3

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CM3501	Principles of CIM	3	0	0	3
2.	CM3502	Computer Aided Design	3	0	0	3
3.	CM3503	Statistical and Optimization Technique	3	1	0	4
4.	CM35XX	Elective I (Core)	3	0	0	3
5.	CM35XX	Elective II (Core)	3	0	0	3
6.	CM35XX	Elective III (Core)	3	0	0	3
PRACTICAL						
7.	CM3571	CIM Laboratory - I	0	0	3	1
Total			**18**	**1**	**3**	**20**

CM3501	PRINCIPLES OF CIM	L	T	P	C
		3	0	0	3

AIM:

To enable the students to understand the basic principles of CIM and its elements

OBJECTIVES:

To familiarize

- The basic components of CIM and its hardware and software
- CAD/CAM and its integration with CIM
- Components of FMS and Agile manufacturing

Course Outcome		Cognitive Skill
CO-01	Students learn about the evolution of CIM and manufacturing system software.	R,U
CO-02	Students learn about process planning and ERP models.	R,U
CO-03	Students learn about networks, LAN and access techniques.	R,U
CO-04	Students learn about internetworking devices and the fundamentals of networking.	R,U
CO-05	Students learn rapid prototyping systems, virtual organization and CIM case studies.	R,U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	S	L	M	S
CO-02	S	S	S	M	M	S	L	M	M
CO-03	S	S	S	M	M	S	L	M	S
CO-04	S	S	S	M	M	S	L	M	M
CO-05	S	S	S	M	M	S	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I: INTRODUCTION TO CIM: 9

Evolution of CAD/CAM and CIM, scope of CIM, segments of generic CIM, computers and workstations, an overview of CIM software.

MANUFACTURING SYSTEM SOFTWARE: Production control–forecasting, master production schedule, MRP, capacity planning, shop floor control, inventory management, product routing, job costing, marketing applications.

UNIT II: PROCESS PLANNING & ERP MODELS: 9

PROCESS PLANNING: Approaches to process planning, CAPP- variant approach and generative approach, study of a typical process planning, system.

ERP MODULES: Materials, human resource, production, sales, marketing and finance, dynamic enterprise modeling.

UNIT III: NETWORKING: 9

NETWORKS: Computer networks, a perspective, goals, applications, switching techniques, circuit switching, message switching, packet switching, network components, existing network, ARPANET, concepts of network protocol, OSI reference model.

LAN & ACCESS TECHNIQUES: Topologies - star, ring, bus. Ethernet, transmission media, protocols, polling, contention, ALOHA, CSMA, CSMA/CD, token ring protocols, performance comparisons.

UNIT IV: INTERNETWORKING DEVICES: 9

INTERNETWORKING DEVICES: Principles, repeaters, bridges, routing with bridges, routers, brouters, gateways, hubs and switches, TCP/IP protocol structure, internet protocol, transmission protocol, applications.

FUNDAMENTALS OF NETWORKING: Networking concepts, LOSI, MAP, TOP, LAN and WAN, internet and related technologies, collaborative engineering.

UNIT V: RAPID PROTOTYPING SYSTEMS & VIRTUAL ORGANISATION: 9

RAPID PROTOTYPING SYSTEMS: Rapid prototyping techniques, software for rapid prototyping, process optimization.

VIRTUAL ORGANISATION: Paperless factory, introduction virtual reality and application, virtual prototyping and manufacturing instrumentation and measurement, virtual enterprises.

CIM CASE STUDIES: CIM implementation, integration, benefits of CIM.

TOTAL: 45 HOURS

REFERENCES

1. Kant Vajpayee. S., 'Principles of Computer Integrated Manufacturing', Prentice Hall of India, 1999
2. Radhakrishnan.P, Subramanyan. S, 'CAD/CAM/CIM', New Age International publishers, 1994
3. Daniel Hunt.V., 'Computer Integrated Manufacturing Hand Book', Chapman & Hall, 1989
4. Mikell P Groover, "Automation of Production Systems and Computer Integrated Manufacturing", Pearson Education, New Delhi, 2001.
5. Yorem Koren, 'Computer Control of Manufacturing System', McGraw Hill, 1986
6. Ranky Paul. G., 'Computer Integrated Manufacturing', Prentice Hall International, 1986.
7. Basandra S K and Jaiswal, "Local Area Networks", Galgotia Publications Pvt. Ltd, New Delhi, 2006.
8. Taylor E D, "Networking Handbook", Tata McGraw Hill Co. Ltd, New Delhi, 2004.

CM3502	COMPUTER AIDED DESIGN	L	T	P	C
		3	0	0	3

AIM:

To give clear idea about the role of computer aided design in manufacturing to students.

OBJECTIVES:

To introduce

- The role of computers in design and manufacture

- Both the hardware and software of CAD/CAM systems together with the practical discussion of their use in engineering
- Computer graphics for drafting and analysis
- Integration of CAD, Simulation, Manufacturing, Production planning and control

Course Outcome		Cognitive Skill
CO-01	To understand the hierarchy of computers in manufacturing.	U,A,An
CO-02	To understand the CAD/CAM Hardware/Software.	U,A,An
CO-03	To understand the two dimensional and three dimensional transformations.	U,A,An
CO-04	To understand the modeling and analysis.	U,A,An
CO-05	To understand the computer integrated design.	U,A,An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	L	L	M	S
CO-02	S	S	S	M	M	L	L	M	M
CO-03	S	S	S	M	M	L	L	M	S
CO-04	S	S	S	M	M	L	L	M	M
CO-05	S	S	S	M	M	L	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I: HIERARCHY OF COMPUTERS IN MANUFACTURING: 9

Introduction-Role of computers in design and manufacture. Design considerations in hierarchical network of computers-Levels of hierarchy - Local area networks - Network topologies - Manufacturing automation protocol. The planning function - Types of CAPP - retrieval and generative type CAPP - Programming & NC Machines - NC part programming - Punched tape and tape format - Manual and computer assisted part programming - Manual data input - NC programming using CAD/CAM - Computer automated part programming

UNIT II: CAD/CAM HARDWARE/SOFTWARE: 9

Types of computer Systems, Devices and their functioning (work stations, PC's, mouse, digitizer, display devices, key board. etc.) - CAD/CAM Software- Operating System-Graphics Standards - Basic Definitions, modes of graphics operations-User interface-Software Modules- Software Development.

UNIT III: TWO DIMENSIONAL AND THREE DIMENSIONAL TRANSFORMATIONS: 9

2D-representation and Transformation of points - Transformation lines - Rotation, Scaling, Translation, reflection and combined transformations - 3D Scaling - Rotation - Translation - Reflection. Windowing, View ports, Clipping

UNIT IV: MODELLING AND ANALYSIS: 9

3D-Modelling - Wire Frame, Surface and Solid Modeling - Solid Modeling Packages Finite element method - Fundamental of Finite element modeling - 2D & 3D Elements, Analysis of results.- Finite Element Analysis(FEA) - Introduction and Procedure - Introduction to FEA Packages

UNIT V: COMPUTER INTEGRATED DESIGN: 9

Design Phases - Standardization and Interchangeability of Machine Elements, Concurrent Engineering - meaning, scheme and design of concurrent engineering, design for assembly and modular construction - Concept of integration.

TOTAL: 45 HOURS

REFERENCES

1. Data base for CAD. Mustapha. I., 'Concurrent Engineering', New Age International Pvt. Ltd., 2002
2. Ibrahim Zeid, 'CAD/CAM, theory and practice', Tata McGraw Hill edition, 1998
3. Groover M.P., 'Automation, production systems and computer integrated manufacturing', Prentice- Hall of India Pvt. Ltd., 1996
4. David F Rogers and Alan Adams, 'Mathematical elements for computer graphics', McGraw Hill publishing Co. Int. Edition, 1990
5. William.M. Newman Robert. F. Sproull, 'Principles of interactive graphics', McGraw Hill publishing Co. Int. Edition, 1984.

CM3503	STATISTICAL AND OPTIMISATION TECHNIQUES	L	T	P	C
		3	1	0	4

AIM:

To highlight the basic concepts and procedure for Optimization in Manufacturing systems

OBJECTIVE:

- Understand the need and origin of the optimization methods.
- Get a broad picture of the various applications of optimization methods used in engineering

Course Outcome		Cognitive Skill
CO-01	To understand the Basic Concepts and Multivariate Distributions	U,An
CO-02	To understand the Regression Analysis and Advanced Techniques	U,An
CO-03	To understand the Decision Making and Fuzzy Techniques	U,An
CO-04	To understand the Simulation and Linear Programming	U,An,E
CO-05	To understand the Metaheuristics and Optimization Techniques	U,An,E

- R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	L	L	M	S
CO-02	S	S	S	M	M	L	L	M	M
CO-03	S	S	S	M	M	L	L	M	S
CO-04	S	S	S	M	M	L	L	M	M
CO-05	S	S	S	M	M	L	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT-I : **9**

Basic concepts of multivariate distributions, Multinomial and multivariate normal distributions, Principal Component and Exploratory Factor Analysis, Cluster analysis, Hierarchial clustering, K-Means Clustering,Two step cluster, Non parametric tests.

UNIT-II: **9**

Multiple regression analysis, Discriminate and logistic regression, Multiple analysis of variance, Conjoint analysis, Economical correlation analysis, Structural equation modeling.

UNIT-III : **9**

Multicriteria decision making, AHP, ANP, TOPSIS, ELECTRE, Concepts of Fuzzy techniques, Fuzziness Vs Probability, Fuzzy associate memories. Introduction about Neural networks.

UNIT-IV: **9**

Techniques for generating random numbers, comparison & selection of simulation languages, Study any one simulation language, formulation of LPP.

UNIT-V: **9**

Meta heuristics, Genetic algorithm, simulated annealing, Ant colony optimization, Tabu search, particle swarm optimization. Neural network and fuzzy system.

L: 45 + T: 45, TOTAL: 60 HOURS

REFERENCES

1. Ross. S., "A first Course in Probability", Fifth Edition, Pearson Education, Delhi 2002.
2. Johnson. R. A., "Miller & Freund's Probability and Statistics for Engineers", Sixth Edition, Pearson Education, Delhi, 2000
3. Gupta S.C and Kapoor V.K "Fundamentals of Mathematical Statistics" Sultan Chand and Sons, NewDelhi.
4. Beveridge and Schechter, Optimization Theory and Practice, McGraw Hill, 1970.
5. Wayne.L.Winston, Operations research applications and algorithms, Thomson
6. learning,4th edition 2007.
7. Fred Glover, Manuel Laguna and Fred Laguna, "Tabu Search", Kluwer Academic Publishers, 1997.
8. Cihan H Dagli**,** "Artificial Neural Networks for Intelligent Manufacturing", Chapman and Hall, London, 1994, ISBN 0 412 48050.
9. Kalyanmoy Deb, "Optimization for engineering design", Prentice Hall India Pvt. Ltd., New Delhi, 2000.
10. David E Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley Pub Co., 1989.
11. Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", Prentice Hall of India, 2005.
12. Maurice Clerc, "Particle Swarm Optimization", ISTE, 2007

CM3571	CIM LABORATORY – I	L	T	P	C
		0	0	3	1

AIM:

To provide the student with the necessary ability to develop the basic 3Dpart design with assembling.

OBJECTIVES:

- To learn about the fundamentals of CAM systems.
- To learn about the use of Mastercam software.
- To learn about the integration of CAD and CAM software using neutral data format.

Course Outcome		Cognitive Skill
CO-01	Students can able to understand the basic 3D part design with assembling.	U,R
CO-02	Can obtain knowledge in Basic manufacturing of Part using design.	R, A
CO-03	Can generate a CNC program for a part design that can be determined.	A,E
CO-04	Students can understand the basic robot programming.	U,R
CO-05	Students will know about the PLC programming	U,R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	L	L	M	S
CO-02	S	S	S	M	M	L	L	M	M
CO-03	S	S	S	M	M	L	L	M	S
CO-04	S	S	S	M	M	L	L	M	M
CO-05	S	S	S	M	M	L	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

EXERCISES:

1. Sketching and Part modeling
2. Assembly
3. Generation of 2D Views
4. Creating programs to manufacture parts using Master CAM/Edge CAM
5. Manual part programming and Component manufacture in machining centre
6. Manual part programming and Component manufacture in CNC lathe
7. Creating part programme and simulation using HEIDENHAIN CNC simulator

8. Robot path planning using LEGO mind storm kit
9. Remote monitoring of CNC machines through ethernet
10. PLC programming-control of variable speed drive through PLC
11. Operating tools/ study of fixtures, CNC tooling, presetting

TOTAL: 45 HOURS

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CM3504	Mechatronics	3	0	0	3
2.	CM3505	Manufacturing System Simulation	3	0	0	3
3.	CM3506	Robotics	3	0	0	3
4.	CM3507	Computer Aided Manufacturing	3	0	0	3
5.	CM35XX	Elective IV (Core)	3	0	0	3
6	CM35XX	Elective V (Core)	3	0	0	3
PRACTICAL						
7.	CM3572	CIM Laboratory - II	0	0	3	1
Total			**18**	**0**	**3**	**19**

CM3504	MECHATRONICS	L	T	P	C
		3	0	0	3

AIM:

To expose the students to different types of Sensors used in manufacturing and fundamentals of condition monitoring

OBJECTIVE:

- Basics of sensors in manufacturing
- Different types of sensors in manufacturing
- Sensors in CNC machine tools
- Concepts of condition monitoring and identification

Course Outcome		Cognitive Skill
CO-01	Students will understand basics of mechatronics in manufacturing, sensors & transducer working	R, U
CO-02	Acquire basic knowledge on microprocessor and how to program	R, U, E
CO-03	Students will know the different hydraulic and pneumatic system	R, U
CO-04	Acquire basic knowledge of condition monitoring and online tool wear monitoring	R, U
CO-05	Students able to identify the technique of shop floor control, robot sensors, micro & nano sensors.	R, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	L	L	M	S
CO-02	S	S	S	M	M	L	L	M	S
CO-03	S	S	S	M	M	L	L	M	S
CO-04	S	S	S	M	M	L	L	M	S
CO-05	S	S	S	M	M	L	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I: INTRODUCTION: 9

Definition of mechatronics. Mechatronics in manufacturing, products and design. Review of fundamentals of electronics. Data conversion devices, sensors, transducers, signal processing devices, relays, contactors and timers.

UNIT II: MICROPROCESSORS AND PLCs: 9

Introduction-Architecture-Pin Configuration-Instruction set-Programming of Microprocessors using 8085 instructions-Interfacing input and output devices-Interfacing D/A converters and A/D converters-Applications- Temperature control-Stepper motor control-Traffic light controller. servo drives, PLCs.

UNIT III: HYDRAULIC AND PNEUMATIC SYSTEMS: 9

Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, transfer systems. Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems.

UNIT IV: CONDITION MONITORING: 9

Condition monitoring of Manufacturing systems- Principles, Sensors for monitoring force, Vibration and Noise, selection of sensors and monitoring techniques. Acoustic Emission: Principles of Acoustic emission sensors, Concepts of pattern recognition, applications of Acoustic emission, On line monitoring of tool wear using Acoustic emission.

UNIT V: IDENTIFICATION TECHNIQUE: 9

Automatic identification techniques for shop floor control, optical character and machine vision sensors, smart / intelligent sensors, integrated sensors, Robot sensors, Micro sensors, Nano sensors.

TOTAL: 45 HOURS

REFERENCES

1. Julian W. Gardner, 'Micro sensor MEMS and Smart Devices', John Wiley & Sons, 2001
2. Randy Frank, 'Understanding smart sensors', Artech House, USA, 1996
3. Sabrie Salomon, 'Sensors and control systems in manufacturing', McGraw Hill Int. Edition, 1994
4. W.Bolton, Mechatronics,Longman,Second Edition, 1999.
5. Michael B. Histand and David G.Alciatore, " Introduction to Mechatronics and Measurement Systems ", McGraw Hill International Editions, 1999.
6. HMT Ltd., " Mechatronics ", Tata McGraw Hill Publishing Co. Ltd., 1998.
7. Dan Necsulescu, "Mechatronics",Pearson Education Asia,2002(Indian reprint).

CM3505	MANUFACTURING SYSTEMS SIMULATION	L	T	P	C
		3	0	0	3

AIM:

To highlight the basic concepts and procedure for simulation of manufacturing systems

OBJECTIVE:

- Basics of simulation and its types
- Techniques for generation of random numbers
- Design and evaluation of simulation experiments
- Simulation languages
- Concepts and simulation of discrete events

Course Outcome		Cognitive Skill
CO-01	After successful completion of Manufacturing System Simulation course, the student will be able to: Characterize a system in terms of its essential elements, that is, its purpose, stakeholders, constraints, performance requirements, sub-systems, interconnections and environmental context.	R., A
CO-02	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.	An,A
CO-03	Apply the processes, procedures and techniques which are required for the successful execution of systems engineering methodology to resolve different types of complex problems faced by senior manager, at an earlier stage of system design.	An,A
CO-04	These problems may relate to system specification, requirements allocation, maintenance concepts, and critical issue resolution.	An,A
CO-05	Use common simulation software packages to construct and execute goal-driven system models.	An,A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	L	M	M	M
CO-02	S	S	S	M	M	L	M	M	M
CO-03	S	S	S	M	M	L	M	M	M
CO-04	S	S	S	M	M	L	M	M	M
CO-05	S	S	S	M	M	L	M	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I: INTRODUCTION: 9

Systems - discrete and continuous systems, general systems theory, models of systems- variety of modeling approach, concept of simulation, simulation as a decision making tool, types of simulation, Principle of computer modeling- Monte Carlo simulation, Nature of computer modeling, limitations of simulation, area of application.

UNIT II: RANDOM NUMBER GENERATION: 9

Techniques for generating random numbers- mid square method, mid product method, constant multiplier technique, additive congruential method, linear congruential method. Tests for random numbers- Kolmogorov-Smirnov test, the Chi-square test

UNIT III: DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS: 9

Problem formulation, data collection and reduction, time flow mechanism, key variables, logic flow charts, starting condition, run size, experimental design consideration, out put analysis, verification and validation of simulation models.

UNIT IV: SIMULATION LANGUAGES & DISCRETE EVENT SIMULATION: 9

Comparison and selection of simulation languages, study of any one simulation language, Concepts in discrete -event simulation, Programming for discrete event simulation in GPSS.

UNIT V: CASE STUDIES: 9

Development of simulation models using simulation language studied for systems like queuing systems, Production systems, Inventory systems, maintenance and replacement systems and Investment analysis.

TOTAL: 45 HOURS

REFERENCES

1. Jerry Banks and John S Carson, Barry L Nelson, David M Nicol, 'Discrete event system simulation', Prentice Hall, India, 2000
2. Khoshnevi. B., 'Discrete system simulation', McGraw Hill International edition, 1994

3. Ronald G Askin and Charles R Standridge, 'Modeling and analysis of manufacturing systems', John Wiley & Sons, 1993
4. Gordon G, 'System Simulation', Prentice Hall, India, 1991
5. Thomas J Schriber., 'Simulation using GPSS', John Wiley & Sons, 1991
6. Shannon, R.E., 'System Simulation - The art and science', Prentice Hall, India, 1975

CM3506	ROBOTICS	L	T	P	C
		3	0	0	3

AIM:

Develop the student's knowledge in various robot structures and their workspace to familiarize with latest innovations in the field of Robotics.

OBJECTIVES:

- To develop student's skills in performing spatial transformations associated with rigid body motions.
- To develop student's skills in perform kinematics analysis of robot systems.
- To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
- To provide the student with some knowledge and analysis skills associated with trajectory planning.
- To provide the student with some knowledge and skills associated with robot control.

Course Outcome		Cognitive Skill
CO-01	Familiarize with the basic concepts and fundamentals of Robotics.	R, U
CO-02	Demonstrate the various power transmission systems & drive mechanism controls and sensors.	R, U
CO-03	Describe the concepts of machine vision system and can gain knowledge in robot programming.	R, U
CO-04	Explain the robot manipulator kinematics and can discuss the transformations of manipulator.	R, U
CO-05	Discuss the economic and social aspects of robotics, robot cell design and application of robots.	R, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	N	N	M	S
CO-02	S	S	S	M	M	N	N	M	M
CO-03	S	S	S	M	M	N	N	M	S
CO-04	S	S	S	M	M	N	N	M	M
CO-05	S	S	S	M	M	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- FUNDAMENTAL CONCEPTS OF ROBOTICS: 9

History, present status and future trends, robotics and automation, laws of robotics, robot definition, robotics systems and robot anatomy, specification of robots. resolution, repeatability and accuracy of a manipulator.

UNIT II- ROBOT DRIVES SENSORS AND INTELLIGENT ROBOTS: 9

Power transmission systems and control robot drive mechanisms, hydraulic-electric-pneumatic drives, mechanical transmission method - rotary-to-rotary motion conversion, rotary-to-linear motion conversion, end effectors - types – gripping problem - remote-centered compliance devices - control of actuators in robotic mechanisms.

Sensors And Intelligent Robots: Sensory devices - non-optical-position sensors - optical position sensors - velocity sensors - proximity sensors: - contact and non-contact type - touch and slip sensors - force and torque sensors - AI and robotics.

UNIT III- COMPUTER VISION AND CONSIDERATIONS FOR ROBOTIC SYSTEMS: 9

Robot vision systems - imaging components - image representation - hardware aspects - picture coding - object recognition and categorization - visual inspection - software considerations - applications - commercial - robotic vision systems.

Computer Considerations For Robotic Systems: Computer architecture for robots, hardware, computational elements in robotic applications - robot programming - sample programs - path planning - robot's computer system.

UNIT IV- TRANSFORMATIONS AND KINEMATICS: 9

Homogeneous co-ordinates - co-ordinate reference frames - homogeneous transformations for the manipulator - the forward and inverse problem of manipulator kinematics - motion generation - manipulator dynamics - Jacobian in terms of D.H. matrices controller architecture.

UNIT V- ROBOT CELL DESIGN AND CONTROL: 9

Specifications of commercial robots - robot design and process specifications - motor selection in the design of robotic joint - robot cell layouts - economic and social aspects of robotics.

Applications Of Robots: Capabilities of robots - robotics applications - obstacle avoidance - robotics in India - the future of robotics.

TOTAL: 45 HOURS

REFERENCES

1. Richard D Klafter, Thomas A Chmielewski and Michael Negin "Robotic Engineering - An Integrated Approach" - Eastern Economy Edition - Prentice Hall Pvt. Ltd., 2005.
2. Fu KS, Gomaler R C and Lee C S G., "Robotics: Control Sensing, Vision, Intelligence", McGraw Hill Book Co., 1987.
3. Shuman Y No, "Handbook of Industrial Robotics", John Wiley and Sons, New York, 1985.
4. Deb K.S "Robotics Technology and Flexible Automation", Tata McGraw Hill Book Co., 2004.

CM3507	COMPUTER AIDED MANUFACTURING	L	T	P	C
		3	0	0	3

AIM:

To provide the student with the necessary ability to develop the planning methods for component machining

OBJECTIVES:

- To learn about the fundamentals of CAM systems
- To learn about the use of Mastercam software
- To learn about the integration of CAD and CAM software using neutral data format

Course Outcome		Cognitive Skill
CO-01	Understand the basics of different Manufacturing systems	R, U
CO-02	Understand the fundamentals of CNC machines	R, U
CO-03	Understand the constructional features of CNC machines	R, U
CO-04	Able to do part programming in CNC machines	A, E
CO-05	Understand the concepts of Production Planning and Control	R, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	N	N	S	M
CO-02	S	S	S	M	M	N	N	S	M
CO-03	S	S	S	M	M	N	N	S	M
CO-04	S	S	S	M	M	N	N	S	M
CO-05	S	S	S	M	M	N	N	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- CAD / CAM INTERFACE: 8

Current trends in Manufacturing Engineering - Part families - Classification and Coding - Production flow Analysis - Machine Cell Design FMS workstations -Analysis methods - Design for Manufacturing and Assembly - Concurrent Engineering - Rapid prototyping - Introduction to CAD / CAM software packages.

UNIT II- FUNDAMENTALS OF CNC MACHINES: 10

CNC Technology - Functions of CNC Control in Machine Tools - Classification of CNC systems - Contouring System - Interpolators, open loop and closed loop CNC systems - CNC Controllers, Hardware features - Direct Numerical Control (DNC Systems).

UNIT III- CONSTRUCTIONAL FEATURES OF CNC MACHINES: 10

Design considerations of CNC machines for improving machining accuracy-Structural members-Slide ways - Sides linear bearings - Ball screws - Spindle drives and feed drives - work holding devices and tool holding devices -Automatic Tool changers. Feedback devices

CNC MACHINE OPERATING SYSTEM: Fanuc operating system – flow chart of automatic operation – general precautions, siemens operating system – Sinumerik – Hinumerik, Heidnhain operation system – list of operating switches. Principles of Operation-Machining Centres - Tooling for CNC machines.

4 Part Programming for CNC Machines

UNIT IV- PART PROGRAMMING OF A CNC LATHE: 10

Process planning, tooling, preset and qualified tools, typical tools for turning and machining centres. Axes definition, machine and work piece datum, turret datum, absolute and incremental programming, tape codes - ISO and EIA codes, G and M functions, tool offset information, soft jaws, tool nose radius compensation, long turning cycle, facing cycle, constant cutting velocity, threading cycle, peck drilling cycle, part programming examples.

MANUAL PART PROGRAMMING OF A MACHINING CENTRE: Co-ordinate systems, cutter diameter compensation, fixed cycles- drilling cycle, tapping cycle, boring cycle, fineboring cycle, back boring cycle, area clearance programs, macros, parametric programming, part programming examples. CAD/CAM based NC part programming, features of typical CAM packages.

UNIT V- PRODUCTION PLANNING AND CONTROL: 7

Computer Integrated Production Planning System - Materials Requirement Planning - Computer Processes Interface - Process Monitoring - Supervisory Computer Control – Computer Monitory - Types & Strategies

TOTAL: 45 HOURS

REFERENCES

1. Jonathan, S.C. and Tony Shiue, F.C. – Mastercam Version 9 Mill and Solids, Scholar International Publishing, Ann Arbor, 2003, ISBN 1-886552-16-9
2. Radhakrishnan P, "Computer Numerical Control, (CNC) Machines", Newness – Butterworth and Co. Publisher Ltd., 1992.
3. Binit Kumar Jha, "CNC Programming Made Easy", Vikas Publishing House Pvt Ltd., 2005.
4. Gilla and Krars, "CNC and Programming", McGraw-Hill Publishing Company, 1990. Mike Mattson, "CNC Programming Principles and Application", Vikas Publishing House Pvt Ltd., 2002.
5. David Gibbs, "An Introduction to CNC Machining", English Language Book Society / Cassell. 1988.

CM3572	CIM LABORATORY – II	L	T	P	C
		0	0	3	1

AIM:

To train the students to work in different operating systems

OBJECTIVES:

Study the end of this course the student will be able to programme in PLC, Robot, Matlab environment and they can also inspect mechanical components using VMS and CMM.

Course Outcome		Cognitive Skill
CO-01	At the end of this course the student will be able to Programme in PLC, Robot, MATLAB environment and they can also inspect mechanical components using VMS and CMM	A, An, E
CO-02	Programmable Logic Control (PLC) using PLC software Keyence ladder builder and working of PLC trainer kit. Robot Programming.	A, An, E
CO-03	Matlab Programming. (Matrix manipulations, plotting of functions and data, implementation of algorithms and creation of user interfaces).	A, An, E
CO-04	Inspection of mechanical components using Video Measuring System (VMS).	A, An, E
CO-05	Dimensional and Geometric measurements using Digital Height Gauge and Coordinate Measuring Machine (CMM).	A, An, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	N	N	M	L
CO-02	S	S	S	M	M	N	N	M	L
CO-03	S	S	S	M	M	N	N	M	L
CO-04	S	S	S	M	M	N	N	M	L
CO-05	S	S	S	M	M	N	N	M	L

S- Strong, M- Medium, L-Low, N- Not Relevant

List of Experiments

- Measurement of cutting forces,
- Measurement of surface roughness & tool wear,
- Measurement of chip thickness ratio and temperature in machining.
- Determination of the mill modulus of a laboratory rolling mill.
- Measurement of hardness.
- Hydraulic and pneumatic systems.
- Sensors and transducers.

- PID controller.
- Study of robots.
- Design of simple electronic circuits.
- Microprocessors and PLCs for manufacturing applications.

TOTAL: 45 HOURS

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CM3508	Production and Operation Management	3	0	0	3
2.	CMXXXX	Elective VI (Open Elective)	3	0	0	3
PRACTICAL						
3.	CM35P1	Project Work - Phase I	0	0	12	6
Total			**8**	**0**	**12**	**12**

CM3508	PRODUCTION AND OPERATION MANAGEMENT	L	T	P	C
		3	0	0	3

AIM:

Meet customer needs: Ensure that products and services meet customer requirements, including quality, quantity, and delivery time.

OBJECTIVES

To expose the students about the concepts of production and operation administration

OUTCOMES:

Course Outcome		Cognitive Skill
CO-01	Understand the role of Planning in achieving organizational competitiveness.	A, An, E
CO-02	Understand the fundamentals of inventory analysis and control	A, An, E
CO-03	Understand the concept of project planning and management	A, An, E
CO-04	Understand the role of modern production management tool	A, An, E
CO-05	Understand the fundamentals of optimized production technology	A, An, E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	N	N	M	L
CO-02	S	S	S	M	M	N	N	M	L
CO-03	S	S	S	M	M	N	N	M	L
CO-04	S	S	S	M	M	N	N	M	L
CO-05	S	S	S	M	M	N	N	M	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I -PRODUCTION SYSTEMS **9**

Types of production systems, Productivity, Strategic management - Product Design and Analysis: New product development, Process Planning and Design, Value analysis and Value Engineering, Standardization, Simplification - Capacity Planning and Investment Decisions - Forecasting and facility location and layout - Aggregate Planning and Master Production Scheduling - Nature of aggregate planning, Methods of aggregate planning, Development of MPS.

UNIT II - INVENTORY ANALYSIS AND CONTROL **9**

Definitions, ABC inventory systems, Inventory modals, EOQ models for purchased and manufactured parts, lot sizing techniques - Scheduling and Controlling: Objectives in scheduling, Major steps involved, Information systems linkages in production planning and control.

UNIT III - PROJECT PLANNING AND MANAGEMENT **9**

Phases of project planning, Evolution of network planning techniques - Critical Path Method (CPM) and Project Evolution and Review Technique (PERT), Crashing of project network, Project scheduling with constrained resources - RLT & RAT, Graphical Evolution and Review Technique (GERT), Project monitoring, Line balance

UNIT IV - MODERN PRODUCTION MANAGEMENT TOOLS **9**

Elements of lean production, MRP Vs JIT, cycle time, takt time, KANBAN, SMED, OEE, 5S, theory of constraints – drum, buffer and rope, Agile manufacturing.

UNIT V - OPTIMIZED PRODUCTION TECHNOLOGY **9**

Factors affecting quality and Quality control activities in product cycle and ISO 9000 series - Scope and Benefits.

TOTAL: 45 HOURS

REFERENCE BOOKS

1. Chary S N, “Production and Operations Management”, Third Edition, Tata McGraw Hill

Publishing Company Limited, 2004.
2. Mukhopadhyay S K, “Production Planning and Control – Text and Cases”, Prentice Hall of India Private Limited, 2004.
3. Baker K, “Introduction to Sequencing and Scheduling”, John Wiley and Sons, 2004.
4. Norman Gaither and Greg Frazier, “Operations Management”, Thomson Asia Private Limited, 2002.
5. Elwood S Buffa, Rakesh K Sarin, “Modern Production and Operations Management”, John Wiley & Sons Inc, 2002.
6. Richard B Chase, Nicholas J Aquilano and F Robert Jacobs, “Production and Operations Management – Manufacturing and Services, Eight Edition, Tata McGraw Hill Inc, 2000.
7. Bedworth D D, "Integrated Production Control Systems Management, Analysis, Design", John Wiley & Sons, 1987.
8. Johnson L A and D C Montgomery, “Operations Research in Production Planning, Scheduling, and Inventory Control”, John Wiley & Sons, 1974.

CM35P1	PROJECT WORK PHASE I	L	T	P	C
		0	0	12	6

OBJECTIVES: • To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.

• To develop the methodology to solve the identified problem.

• To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of Computer Integrated Manufacturing. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

• At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	CM35P2	Project Work - Phase II	0	0	32	16
Total			**0**	**0**	**32**	**16**

CM35P2	PROJECT WORK PHASE II	L	T	P	C
		0	**0**	**32**	**16**

OBJECTIVES:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

OUTCOME:

- On completion of the project work students will be in a position to take up any challenging practical problems in the field of Computer Integrated Manufacturing and find better solutions to it.

LIST OF ELECTIVES

CORE ELECTIVES

Sl.No	COURSE CODE	COURSE NAME	L	T	P	C
1.	CM35A1	Supply Chain Management	3	0	0	3
2.	CM35A2	Flexible Manufacturing System	3	0	0	3
3.	CM35A3	Applications of IT in Manufacturing Industries	3	0	0	3
4.	CM35A4	Automated Material Handling Systems	3	0	0	3
5.	CM35A5	Finite Element Analysis in Manufacturing	3	0	0	3
6.	CM35A6	Design for Manufacture and Assembly Systems	3	0	0	3
7.	CM35A7	Manufacturing Planning & Control	3	0	0	3
8.	CM35A8	Rapid Manufacturing	3	0	0	3
9.	CM35A9	Product Life Cycle Management	3	0	0	3
10.	CM35B1	Automated Inspection And Quality Management	3	0	0	3
11.	CM35B2	Concurrent Engineering	3	0	0	3
12.	CM35B3	Manufacturing Information Systems	3	0	0	3
13.	CM35B4	Materials And Processes for Automation	3	0	0	3
14.	CM35B5	Sensors, Actuation Devices and Control	3	0	0	3

ELECTIVES

CORE ELECTIVES

CM35A1	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

AIM:

To obtain the recent trends in supply chain management

OBJECTIVES:

- Inventory reduction along the value chain,
- Reduction of warehousing costs,
- Safeguarding the just-in-time supply,
- Acceleration of cash-to-cash cycles,

- Improvement of delivery reliability,
- Reduction of throughput times.

Course Outcome		Cognitive Skill
CO-01	Ability to solve theoretical and practical professional problems with the use of research methods and procedures	R, U
CO-02	Understand the role and meaning of theoretical knowledge to solve concrete projects in supply chain	R, U
CO-03	The application of knowledge in the field of supply chain management in practice and ability to deal with selected issues	R, U
CO-04	Basic knowledge for creating and implementing strategies in supply chains	R, U
CO-05	Understand the importance of strategic assessments on which management decisions for entering the new partnership in supply chain.	R, U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	L	L	M	M
CO-02	S	S	S	M	M	L	L	M	M
CO-03	S	S	S	M	M	L	L	M	M
CO-04	S	S	S	M	M	L	L	M	M
CO-05	S	S	S	M	M	L	L	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT – I INTRODUCTION & SUPPLY CHAIN NETWORK DESIGN: 9

INTRODUCTION: Definition, house of supply chain – customer satisfaction, integration, coordination - decision phases in a supply chain, objectives of SCM, examples of supply chains, supply chain drivers, supply chain performance measures.

SUPPLY CHAIN NETWORK DESIGN: Data collection – data aggregation, transportation modes and rates, mileage estimation, warehouse costs, warehouse capacity, potential warehouse locations, service level requirements and future demand. Network design in the supply chain –

factors influencing the network design, framework for network design decisions, models for facility location and capacity allocation – capacitated plant location model

UNIT – II INVENTORY MANAGEMENT: 9

Single warehouse inventory model - cycle inventory – economies of scale to exploit fixed costs, quantity discounts, short term discounting, multi-echelon inventory, example problems. managing uncertainty – safety inventory in the supply chain –safety level estimation, impact of supply uncertainty, impact of aggregation, impact of replenishment policies, managing safety inventory in multi echelon supply chain, managing safety inventory in practice – product availability – optimal level, affecting factors, supply chain contracts – risk pooling – examples. value of information – Bullwhip effect, information and supply chain technology.

UNIT III - DISTRIBUTION STRATEGIES DISTRIBUTION NETWORK DESIGN AND STRATEGIES: 9

Role of distribution in supply chain – distribution network design – factors influencing distribution network design. push strategy – pull strategy – Kanban replenishment systems, types, implementation, and push–pull strategy – demand driven strategy – impact of internet on supply chain strategy. distribution networks in practice – direct shipment, cross docking, warehousing, transshipment.

UNIT IV - STRATEGIC ALLIANCE, CUSTOMER VALUE AND GLOBAL SUPPLY CHAINS: 9

STRATEGIC ALLIANCE: Framework for srategic alliance - 3PL and 4PL – retailer-supplier partnerships – distribution integration – procurement and outsourcing – benefits, make/buy decisions, E-Procurement, supplier relationship management – supplier scoring and assessment, supplier selection and contracts – E-Business and the supply chain. design for logistics – supplier integration into new product development – mass customization.

CUSTOMER VALUE AND GLOBAL SUPPLY CHAINS: Customer value – dimensions, strategic pricing, customer value measures, information technology and customer value – customer relationship management. global supply chains – introduction, driving factors, risks and advantages, issues, regional differences in logistics.

UNIT V - INFORMATION TECHNOLOGY FOR SCM, E-BUSINESS AND THE SUPPLY CHAIN: 9

INFORMATION TECHNOLOGY FOR SCM: Goals – standardization – infrastructure – interface devices, communications, databases, system architecture – system components – integrating the supply chain information technology - DSS for supply chain management.

E-BUSINESS AND THE SUPPLY CHAIN: Value of information, bullwhip effect, information and supply chain technology, customer relationship management, supplier relationship management.

TOTAL: 45 HOURS

REFERENCES

1. Simchi – Levi Davi, Kaminsky Philip and Simchi-Levi Edith, “Designing and Managing the Supply Chain”, TMH Publishing Company Ltd, New Delhi, 2003.
2. Chopra S and Meindl P, “Supply Chain Management: Strategy, Planning, and Operation”, Second edition, Prentice Hall India Pvt. Ltd, New Delhi, 2005.

3. Robert B Handfield, And Ernest L Nichols, “Introduction To Supply Chain Management”, Prentice Hall, Inc, New Delhi, 1999.
4. Sahay B S, “Supply Chain Management”, Macmillan Company, 2000
5. David Brunt, And David Taylor, “Manufacturing Operations And Supply Chain Management : The Lean Approach”, Vikas Publishing House , New Delhi, 2001
6. Hartmud Stadler, And Christoph Kilger, “Supply Chain Management And Advanced Planning: Concepts, Models, Software”, Springer-Verlag, 2000
7. David F Ross,” Introduction To E-Supply Chain Management”, CRC Press, 2003.

CM35A2	FLEXIBLE MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

AIM:

To introduce the basics and components of FMS to the learners

OBJECTIVES:

- Basic concepts and components of FMS
- Automated material handling systems used in FMS
- FMS control using computers
- Software used in FMS & scheduling of FMS

Course Outcome		Cognitive Skill
CO-01	Study about FMS and its implementation in various industries	R, U
CO-02	Gain the knowledge about various types automated material handling system and storage system	R, U
CO-03	To understand and implements the different modelling tools and its applications.	U, A
CO-04	Able to implements distributed numerical control in industries	R, U
CO-05	To understand the various scheduling methods and loading methods of FMS	R, U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	L	L	M	S
CO-02	S	S	S	M	M	L	L	M	M
CO-03	S	S	S	M	M	L	L	M	S
CO-04	S	S	S	M	M	L	L	M	M
CO-05	S	S	S	M	M	L	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I – INTRODUCTION: 9

Definition of an FMS - types and configurations concepts - types of flexibility and performance measures. Functions of FMS host computer - FMS host and area controller function distribution.

DEVELOPMENT AND IMPLEMENTATION OF AN FMS: Planning phases - integration - system configuration - FMS layouts - simulation - FMS project development steps. Project management - equipment development - host system development - planning - hardware and software development.

UNIT II - AUTOMATED MATERIAL HANDLING AND STORAGE: 9

Functions- types – analysis of material handling equipments, Design of conveyor & AGV systems. Storage system performance- AS/RS – carousel storage system – WIP storage system – interfacing handling storage with manufacturing.

UNIT III - MODELLING AND ANALYSIS: 9

Types of analysis: queuing- single server, multiple servers, queue disciplines, markovian queing models. Simulation and petrinet modelling techniques.

UNIT IV- CONCEPTS OF DISTRIBUTED NUMERICAL CONTROL: 9

DNC system – communication between DNC computer & machine control unit – hierarchical processing of data in DNC system – features of DNC systems. Programmable Controllers: Control system architecture – elements of programmable controllers: languages, control system flowchart, comparison of programming methods.

Introduction to micro controllers Applications

UNIT V- SCHEDULING AND LOADING OF FMS: 9

Introduction, scheduling of operations on a single machine –2 machine flow shop scheduling – 2 machine job shop scheduling, 3 machine flow shop scheduling – scheduling ‘n’ machines – scheduling rules – loading problems – tool management of FMS, material handling system schedule, Knowledge based scheduling in FMC FMS Relationale: Economic and technological

justification for FMS – as GT, JIT- operation and evaluation – personnel and infra structural aspects – typical case studies – future prospects.

TOTAL: 45 HOURS

REFERENCES

1. Parrish D.J, "Flexible manufacturing", Butter Worth – Heinemann Ltd, Oxford, 1993.
2. Groover M.P. "Automation, Production system and computer Integrated manufacturing", Prentice Hall India (P) Ltd, 1989.
3. Kusiak A "Intelligent Manufacturing Systems", Prentice Hall, Englewood Clitts, NJ,
4. 1990.
5. Considine D M. and Considine G.D, "Standard Handbook of Industrial Automation", Chapman and Hall, London, 1986.
6. Viswanadham N and Narahari Y, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India (P) Ltd. 1992.
7. Ranky P G, " The Design and Operation of FMS", IFS Pub. UK,1988.
8. Viswanadham N and Narahari Y, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India Pvt. Ltd, 2005.

CM35A3	APPLICATIONS OF IT IN MANUFACTURING INDUSTRIES	L	T	P	C
		3	0	0	3

AIM:

To highlight different applications of computers in manufacturing

OBJECTIVES:

- Basics of production and operations management
- Forecasting, Facility location and layout
- MPS and inventory control, scheduling and controlling project management
- Modern production management tools

OUTCOMES:

Course Outcome		Cognitive Skill
CO-01	TO understand the Basics of production and operations management	R, U
CO-02	TO understand the Forecasting, Facility location and layout	R, U
CO-03	TO understand the MPS and inventory control, scheduling and controlling project management	R, U
CO-04	TO understand the Modern production management tools	R, U
CO-05	To understand the ERP packages	R, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	N	N	M	S
CO-02	S	S	S	M	M	N	N	M	S
CO-03	S	S	S	M	M	N	N	M	S
CO-04	S	S	S	M	M	N	N	M	S
CO-05	S	S	S	M	M	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I - PRODUCT DEVELOPEMNT AND ISSUES: 9

INTRODUCTION: Role of Internet and information technology in manufacturing, present market constraints, extended enterprises, B2C and B2B, PLM and PDM

PRODUCT DEVELOPEMNT AND ISSUES: Product lifecycle, sequential engineering Vs concurrent engineering, concurrent engineering and information technology, global product and product complexity, product development and its relevance.

UNIT II - MANUFACTURING MODELS: 9

Engineer to order, make to order, assemble to order, made to stock, and configure to order.

AUTOMATED PROCESS PLANNING: Process planning, structure of process planning software, Information requirements for process planning, operation to a typical computer aided process planning software group technology

UNIT III - INTRODUCTION TO ERP SYSTEMS: 9

ERP an overview – enterprise an overview – ERP as integrated management information system – evolution of ERP – benefits of ERP – ERP vs. traditional information systems – advantages of ERP – MRP ii model and organizational processes.

BUSINESS PROCESS REENGINEERING: Need and challenges – management concerns about BPR – BPR to build business – model for ERP – basic constituents of ERP – selection criteria for ERP – packages – procurement process for ERP package – features of various modules of ERP.

UNIT IV - OVERVIEW OF ERP PACKAGES: 9

SAP-R/3 – SAP B1 – MFG/PRO – IFS/AVALON – ORACLE. Comparison between different ERP packages. Survey of Indian ERP packages regarding their coverage, performance and cost – top management concerns and ERP systems – extended ERP (ERP II)/advanced planning systems.

UNIT V- COLLABORATIVE ENGINEERING: 9

Faster design throughput, web based design, changing design approaches, engineering change management, product configuration management, extended enterprises, enterprise wide product visualization, enterprise application integration for PLM.

TOTAL: 45 HOURS

REFERENCES

1. Alexis Leon, "ERP Demystified", Tata McGraw-Hill Publishing Company Limited, Eleventh Reprint, 2003.
2. Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning-Concepts and Practice", Second Edition, Prentice Hall of India Private Limited, 2003.
3. David L OLSON, "Managerial Issues of Enterprise Resource Planning Systems", Tata McGraw Hill Edition, 2004.
4. Rahul V Altekar, "Enterprise Wide Resource Planning – Theory and Practice", Prentice Hall of India, New Delhi, 2004.
5. Prasad, "Concurrent Engineering fundamentals: Integrated product Development", Prentice Hall, 1996.

CM35A6	AUTOMATED MATERIAL HANDLING SYSTEMS	L	T	P	C
		3	0	0	3

AIM:

This subject is expected to imbibe knowledge on materials handling system which are essential for industries ranging from heavy works to semiconductor devices manufacturing.

OBJECTIVE:

This course is practically oriented for the needs of industry. Students are to master materials handling systems for flow, transport and assembly operations in production

OUTCOMES:

Course Outcome		Cognitive Skill
CO-01	To understand the basic principle of material handling and plant layout	R, U
CO-02	To understand the basic principle of mechanical assembly	R, U
CO-03	To understand the basic principle of material transport system	R, U
CO-04	To understand the basic principle of automated storage system	R, U
CO-05	To understand the basic principle of robotics	R, U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	N	N	M	S
CO-02	S	M	S	M	M	N	N	M	M
CO-03	S	M	S	M	M	N	N	M	S
CO-04	S	M	S	M	M	N	N	M	M
CO-05	S	M	S	M	M	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- PLANT LAYOUT AND MATERIAL HANDLING PRINCIPLE: 9

Plant Layout: Need for layout planning, Layout objectives and Determinants, Types of Layout, Computer Aided Plant Layout Planning: CRAFT, ALDEP, and CORELAP. Material Handling objective, benefits of better handling, relationship between layout and material handling, principles of Material Handling, Unit load concept, Material Handling Types, Equipment selection and Applications.

UNIT II- MECHANIZED ASSEMBLY: 9

Principles and operating characteristics of part feeders such as vibratory bowl feeder, Reciprocating tube hopper feeder, Centrifugal hopper feeder, Center board hopper feeder, Orientation of parts : In bowl and out bowl tooling, different types of Escapement, Transfer Systems and Indexing Mechanism.

UNIT III- MATERIAL TRANSPORT SYSTEM: 9

Industrial trucks: non powered and powered industrial trucks, AGVS : Types, Vehicle guidance technology, traffic and safety, Monorail and other rail guided vehicles, types of cranes, hoists and elevators, Belt conveyors, Slat conveyors, Gravity conveyors, Apron, escalators, pneumatic conveyors, screw conveyors, vibrating conveyor, Analysis of material transportsystem.

UNIT IV- AUTOMATED STORAGE SYSTEM: 9

Storage and warehouse planning and design; computerized warehouse planning Need, Factors and Indicators for consideration in warehouse automation; which function, When and How to automate; Levels and Means of Mechanizations.

Automated Storage system, AS/RS System, Carousel storage system, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing. interfacing handling storage with manufacturing. Automatic data collection, bar code technology, Radio Frequency Identification.

UNIT V- ROBOTICS: 9

Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace,

Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots. Rotation matrices, Euler angle and RPY representation, Homogeneous transformation matrices, Denavit- Hartenberg notation, representation of absolute position and orientation in terms of joint parameters, direct kinematics

TOTAL: 45 HOURS

REFERENCE

1. Jon R. Immer, "Material Handling", Mc-Graw Hill Company, 1950
2. Sharma, S. C., "Materials Management and Materials Handling " Khanna Publishers.,2004.
3. Dr.K.C.Arora, Vikas . V.Shinde,"Aspects of Materials Handling", Laxmi publishers, 2007.
4. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008
5. K.H.E. Kroemer, Karl Kroemer,"Ergonomics Design for Materials Handling systems",CRC Press, 1997.
6. Raymond A.Kulwiec, "Materials handling – Handbook", A Wiley – Inderscience publication" 1984.
7. Apple, J. M.," Plant Layout and material handling system design", John Wiley & Sons, 1995.
8. Francis, L. R. and White J. A., "Facility Layout and Location: An analytical approach", Prentice Hall, Englewood Cliffs, N.J, 1998
9. Alexandrov, M. P.," Material Handling Equipment", MIR Publishers, Moscow, 1981.
   Rudenko. N," Material Handling Equipment", MIR Publishers, 1981
   Tompkins, J. and White, J. A., "Facilities Planning", John Wiley & Sons, 2000.

CM35A5	FINITE ELEMENTS ANALYSIS IN MANUFACTURING	L	T	P	C
		3	0	0	3

AIM:

To present the basics of finite element analysis and its applications in Manufacturing to the students in a structured way.

OBJECTIVES:

Fundamentals of finite element method with emphasize on the underlying theory and implementation issues, analyze and design systems of relevance to mechanical engineers.

Course Outcome		Cognitive Skill
CO-01	To understand the Introduction of FEA	R,U
CO-02	To understand the Static Analysis of Structures	U, An
CO-03	To understand the Dynamic Analysis of Structures	U, An
CO-04	To understand the Analysis of Production Processes	U, An
CO-05	To understand the Computer Implementation	U, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	N	N	M	M
CO-02	S	M	S	M	M	N	N	M	M
CO-03	S	M	S	M	M	N	N	M	M
CO-04	S	M	S	M	M	N	N	M	M
CO-05	S	M	S	M	M	N	N	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I – INTRODUCTION: 9

Variational formulation - general field problems in engineering- modeling - discrete and continuous models – characteristics - the relevance and place of finite element method, boundary and initial value problems - gradients and divergence theories – functional - varitional calculus - varitional formulation of B.V.P- The method of weighted residuals-the Ritz-Galerkin relaxation.

UNIT II - STATIC ANALYSIS OF STRUCTURES: 9

General procedure of FEM - discretization of the problem - geometric approximations- symmetry- size and number of elements. element shape and distortion, location of nodes, formulation of element stiffness matrices by potential energy approach - 1D spar and beam elements - 2D triangular and quadrilateral elements- axisymmetric triangular elements- shape function for 3D tetrahedron element- isoparametric formulation. Treatment of boundary condition. Galerkin‟s residual method and its application to a one dimensional bar.

UNIT III - DYNAMIC ANALYSIS OF STRUCTURES: 9

Dynamic analysis-equations of motions-mass matrices-lumped and mass matrices-free vibration analysis-natural frequencies of longitudinal introduction to Eigen buckling analysis-application and examples.

UNIT IV - ANALYSIS OF PRODUCTION PROCESSES: 9

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

UNIT V - COMPUTER IMPLEMENTATION: 9

Pre Processing, Mesh generation, element connecting, boundary conditions, input of material and processing characteristics - Solution and post processing - Overview of application packages such as ANSYS and DEFORM - Development of code for one dimensional analysis and validation.

TOTAL: 45 HOURS

REFERENCES

1. Rao S S, "The Finite Element Method in Engineering", Elsevier, 2005.
2. K.J. Bathe, ' Finite Element Procedures in Engineering Analysis", Prentice hall, Engle Wood chiffs, 1981.
3. C.S. Desai and J.P. Abel. " Introduction to Finite Element Method" Affiliated East West Press, 1972.
4. Belakuntu, "Finite Element Methods in Engineering", PHI, 2002
5. Logan D L, "A First Course in the Finite Element Method", Third Edition, Thomson Learning, 2007.
6. Gupta O P, "Finite and Boundary Element Methods in Engineering", Oxford and IBH Publishing Co. Pvt. Ltd, 1999.
7. Rajasekaran S, "Finite Element Analysis in Engineering Design", S Chand, 2008.
8. Seshu P, "A Text Book on Finite Element Analysis", Prentice Hall of India, New Delhi, 2007.
9. Cook R D, Malkus D S and Plesha M E, "Concepts and Applications of Finite Element Analysis", Fourth Edition, John Wiley and Sons, New Delhi, 2003.

CM35A6	DESIGN FOR MANUFACTURING AND ASSEMBLY SYSTEMS	L	T	P	C
		3	0	0	3

AIM:

To facilitate the students to understand the design for manufacture and assembly

OBJECTIVES:

- Understand constraints of manufacturing processes that limit design possibilities with respect to cycle time, material handling, and other factory costs.

- Apply quantitative methods to assess DFA between different designs.
- Apply principles of DFA to increase manufacturing efficiency in assembly processes.
- Distinguish poor practices from robust design practices for discussed processes.
- Prepare project or report to illustrate applied DFM principles per an example from industry.

Course Outcome		Cognitive Skill
CO-01	To Understand about Embodiment Design	R, U
CO-02	To Understand about Tolerance Analysis	R, U
CO-03	To Understand about Datum Systems	R, U
CO-04	To Understand about True Position Theory	R, U
CO-05	To Understand about Tolerance Charting Techniques	R, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	N	N	S	S
CO-02	S	M	S	M	M	N	N	S	S
CO-03	S	M	S	M	M	N	N	S	S
CO-04	S	M	S	M	M	N	N	S	S
CO-05	S	M	S	M	M	N	N	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- EMBODIMENT DESIGN: 9

Steps, Basic rules, principles, guidelines, design for ease of assembly, Design for standards, design for maintenance, Recycling, minimum risk, Evaluating embodiment design, Design for minimum cost, DFM approach and Processes, DFM Guidelines, DFMEA, PFMEA.

UNIT II- TOLERANCE ANALYSIS: 9

Process capability, mean, variance, skewness, kurtosis, process capability metrics, Cp, Cpk cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process Cumulative effect of tolerances-sure fit law, normal law and truncated normal law.

Selective Assembly: - Interchangeable part manufacture and selective assembly, deciding the number of groups- Model-I Group tolerances of mating parts equal; Model II total and group tolerances of shaft equal. Control of axial play- introducing secondary machining, operations laminated shims, examples.

UNIT III- DATUM SYSTEMS: 9

Degrees of freedom, grouped datum systems- different types, two and three mutually perpendicular grouped datum planes; grouped datum system with spigot and recess, pin and hole; grouped datum system with spigot and recess pair and tongue- slot pair – computation of translational and rotational accuracy, geometric analysis and applications.

UNIT IV- TRUE POSITION THEORY: 9

Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples. Form Design Of Castings And Weldments: Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols.

UNIT V- TOLERANCE CHARTING TECHNIQUES: 9

Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples. Design features to facilitate machining: Datum features- functional and manufacturing. Components design machining considerations, redesign for manufacture, examples.

Case Studies:- Redesign to suit manufacture of typical drive - system example, design of Experiments. Value analysis and design rules to minimize cost of a product. Computer Aided DFMA, Poke Yoke principles.

TOTAL: 45 PERIODS

REFERENCES

1. Harry Peck, “Designing for Manufacture”, Pitman Publications, 1983.
2. Matousek, “Engineering Design- A Systematic Approach” Blackie & Son Ltd., London.
3. Spots. M. F. “Dimensioning and Tolerance for Quantity production”, Prentice Hall Inc.
4. Oliver R. Wade, “Tolerance Control in Design & Manufacturing”, Industrial Press Inc. New York 1967.

CM35A7	MANUFACTURING PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

AIM:

To emphasis the importance of planning and control of different activities in manufacturing.

OBJECTIVES:

- Fundamental concepts of Production control
- Concepts of Forecasting and Product planning
- Concepts of inventory control, Scheduling and dispatching

Course Outcome		Cognitive Skill
CO-01	To Understand about PPC	R, U
CO-02	To Understand about Forecasting	R, U
CO-03	To Understand about Product Planning	R, U
CO-04	To Understand about Inventory Control	R, U
CO-05	To Understand about Scheduling And Dispatching	R, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	L	N	M	S
CO-02	S	S	S	M	M	L	N	M	M
CO-03	S	S	S	M	M	L	N	M	S
CO-04	S	S	S	M	M	L	N	M	M
CO-05	S	S	S	M	M	L	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I - INTRODUCTION TO PPC: 9

Objectives and benefits of production control, function of production control. Types of production: Job, batch and continuous production. Product development and design, marketing aspect, functional products, operational aspects, durability and dependability, standardization, simplification and specialization. Break even analysis, economics of a new design.

UNIT II – FORECASTING : 9

Sales forecasting: Need and its use, making the forecast, market share, sales trend analysis, forecasting in seasonal demand, use of indicators and correlation analysis, effects of forecast on production orders, accuracy of forecasts.

UNIT III - PRODUCT PLANNING: 9

Extending the original product information, value analysis, problems created by lack of product planning. Process planning and routing, prerequisite information needed for process planning, steps in process planning. Product data management (PDM), Enterprise application integration. (EAI)

UNIT IV- INVENTORY CONTROL: 9

Material and tool control: Physical control, record keeping, two-bin material control system, the super market concept, procurement and control of tools, inventory control, determination of economic order quantity and economic lot size, ABC analysis, reorder point and lead time. MRP I &II Introduction to JIT and KANBAN.

UNIT V- SCHEDULING AND DISPATCHING: 9

Loading and scheduling information rearranging for loading and scheduling: Master scheduling, perceptual loading, order scheduling devices. Dispatching: Progress reporting and expediting.

TOTAL: 45 HOURS

REFERENCES

1. Samuel Eilon, "Elements of production planning and control", Macmillan and co., 1971.
2. Jain K .C and Aggarwal L .N, "Production planning control and Industrial Management", Khanna Publishers, 1997.
3. Buffa E .S, "Morden Production management", Eastern Pvt Ltd., 1983.

CM35A8	RAPID MANUFACTURING	L	T	P	C
		3	0	0	3

AIM:

To study the rapid prototyping techniques and its applications.

OBJECTIVES:

- To develop student's skills in perform kinematics analysis of robot systems.
- To provide the student with knowledge of the singularity issues associated with the operation of robotic systems
- To provide the student with some knowledge and analysis skills associated with trajectory planning.

Course Outcome		Cognitive Skill
CO-01	Able to describe about product development, conceptual design and classification of rapid prototyping systems.	R,U,A
CO-02	Able to explain about the different rapid prototyping methods and data file preparation process.	R,U,A
CO-03	Able to demonstrate Laminated Object Manufacturing, Solid Ground Curing & printer description.	R,U,A
CO-04	Able to explain the various rapid tooling systems & software for RP techniques. Identifying ideal materials for RP.	R,U,A
CO-05	Able to discuss the errors influencing part build orientation & allied process of surface generation.	R,U,A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	N	N	M	S
CO-02	S	M	S	M	M	N	N	M	S
CO-03	S	M	S	M	M	N	N	M	S
CO-04	S	M	S	M	M	N	N	M	S
CO-05	S	M	S	M	M	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- INTRODUCTION: 9

Need for the compression in product development, history of RP systems, survey of applications, growth of RP industry, classification of RP systems. **Fused Deposition Modeling:** Principle, process parameters, path generation, applications

UNIT II- SELECTIVE LASER SINTERING & STEREOLITHOGRAPHY SYSTEMS: 9

Types of machines, principles of operation, process parameters, data preparation for SLS, applications.

STEREOLITHOGRAPHY SYSTEMS: Principle, process parameters, process details, data preparation, data files and machine details, applications.

UNIT III- LAMINATED OBJECT MANUFACTURING: 9

Principle of operation, LOM materials, process details, applications., **Solid Ground Curing:** Principle of operation, machine details, applications., **Concept Modelers:** Principle, Thermo jet printer, Sander's model market, 3-D printer, Genisys Xs printer, JP system 5, object quadra system.

UNIT IV- RAPID TOOLING & SOFTWARE FOR RP: 9

Indirect rapid tooling - silicone rubber tooling, aluminum filled epoxy tooling, spray metal tooling, cast Kirksite, 3D Keltool, etc., direct rapid tooling - direct AIM, quick cast process, copper polyamide, rapid tool, DMILS, prometal, sand casting tooling, laminate tooling, soft tooling Vs hard tooling.

Software for RP: STL files, overview of solid view, magics, mimics, magics communicator, etc., internet based software's, collaboration tools.

UNIT V- RAPID MANUFACTURING PROCESS OPTIMIZATION: 9

Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation.

Allied Processes: Vacuum casting, surface digitizing, and surface generation from point cloud, surface modification, data transfer to solid models.

TOTAL: 45 HOURS

REFERENCES

1. Terry Wohlers, "Wohlers Report 2001", Wohlers Associates, 2008.
2. Pham D T and Dimov S S, "Rapid Manufacturing", Verlag, 2001.
3. Paul F Jacobs, "Stereo lithography and other RP&M Technologies", SME, 1996.
4. FDM Maxum User Guide.
5. FDM 1650 User Guide.
6. Sinterstation 2500 plus System User Guide.
7. MK-Technology Gmbh. System User Guide

CM35A9	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

AIM:

To study the life cycle management techniques and its applications

OBJECTIVES:

- A product lifecycle, including drugs, is the success outcome of stages from the product's birth until its final withdrawal from the market.
- This time interval a number of factors are involved that can dramatically alter the conditions of access, utilization, pricing, and sales..

Course Outcome		Cognitive Skill
CO-01	To Understand about Concept of Product Life Cycle	R, U
CO-02	To Understand about Product Development Process & Methodologies	R, U
CO-03	To Understand about Product Modelling and Analysis	U, An
CO-04	To Understand about Product Data Management	R, U
CO-05	To Understand about recent advances	R, U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	L	S	M	M	L	L	M	M
CO-02	S	L	S	M	M	L	L	M	M
CO-03	S	L	S	M	M	L	L	M	S
CO-04	S	L	S	M	M	L	L	M	M
CO-05	S	L	S	M	M	L	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- MOTIVATION AND INTRODUCTION: 9

Background, Overview, Need, Benefits, Concept of Product Life Cycle. Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement Product Data and Product Workflow, Company's PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection.

UNIT II- PRODUCT DEVELOPMENT PROCESS & METHODOLOGIES: 9

Integrated Product development process - Conceive – Specification, Concept design, Design - Detailed design, Validation and analysis (simulation), Tool design, Realize – Plan manufacturing , Manufacture, Build/Assemble , Test (quality check) , Service - Sell and Deliver , Use , Maintain and Support, Dispose. Bottom-up design, Top-down design, Front loading design workflow, Design in context, Modular design. Concurrent engineering - work structuring and team Deployment - Product and process systemization - problem, identification and solving methodologies. Product Reliability, Mortality Curve. Design for Manufacturing, Design for Assembly. Design for Six Sigma.

UNIT III- PRODUCT MODELLING AND ANALYSIS: 9

Product Modeling - Definition of concepts – Fundamental issues - Role of Process chains and product models -Types of product models – model standardization efforts-types of process chains - Industrial demands, Design for manufacturing - machining - casting and metal forming - Optimum design - Design for assembly and disassembly – probabilistic design concepts - FMEA - QFD - Taguchi Method for design of experiments -Design for product life cycle. Estimation of Manufacturing costs, Reducing the component costs and assembly costs, Minimize system complexity

UNIT IV- PRODUCT DATA MANAGEMENT: 8

Product Data Management– An Introduction to Concepts, Benefits and Terminology, CIM Data. PDM functions, definition and architectures of PDM systems, product data interchange, portal integration, PDM acquisition and implementation

UNIT V- RECENT ADVANCES: 9

Intelligent Information Systems - Knowledge based product and process models - Applications of soft computing in product development process -Advanced database design for integrated manufacturing, PDM/PLM software.

TOTAL: 45 HOURS

REFERENCES

1. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007.
2. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.
3. John Stark, "Product Lifecycle Management: 21 century paradigm for Product Realisation", Springer Publisher, 2005.
4. Leon Alexis, "Enterprise Resource Planning ", Tata McGraw Hill, 2002.
5. Kevin N Otto and Kristin L Wood, "Product Design", Pearson, 2001.
6. David Ferris and Larry Whipple, "Building an Intelligent E-Business", Premier Press, 2001.
7. Damer Amer, "The E-business Revolution", Prentice Hall, 2000.
8. Faisal Hoque and David Orchard, "e-Enterprise: Business Models, Architecture and Components (Breakthroughs in Application Development)", Cambridge University Press, 2000.

CM35B1	AUTOMATED INSPECTION AND QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

AIM:

To study the principles of Non Destructive Testing machines & inspection

OBJECTIVES:

- For understanding the principle of Dimensional metrology and applying principles, techniques and devices used for quality control in modern Industrial environment.
- Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.
- To study the principle of Non Destructive Testing Machines

Course Outcome		Cognitive Skill
CO-01	To Understand about General Concepts of Measurements	U, A
CO-02	To Understand about Advanced Inspection System	U, A
CO-03	To Understand about Quality in Manufacturing Engineering	U, A
CO-04	To Understand about Quality in Design Engineering	U, A
CO-05	To Understand about Quality Management System and Continuous Improvement	U, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	M	M	M	M
CO-02	S	S	S	M	M	M	M	M	M
CO-03	S	S	S	M	M	M	M	M	M
CO-04	S	S	S	M	M	M	M	M	M
CO-05	S	S	S	M	M	M	M	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- GENERAL CONCEPTS OF MEASUREMENTS: 9

Variables and measurement signals, the three stages of generalized measurement system, mechanical, matching, frequency response, error analysis and classification, sources of error, transducers, displacement and velocity transducers, potentiometer, LVDT, variable reluctance transducers, capacitive transducers, tachometer, strain gauges - strain gauge bridges, measurement of torque on rotating shaft. Acceleration and Vibration Measuring Instruments, Pressure Measurement

UNIT II- ADVANCED INSPECTION SYSTEM: 9

Smart Cameras, systems on line inspections, features. Machine vision systems, CMM – (ELGI). Surface roughness measurement using laser, ultrasonic automatic thickness gauging, automatic material sorter, automatic radiographic (x-ray), optical sensor to check the inspection.

UNIT III - QUALITY IN MANUFACTURING ENGINEERING: 9

Importance of manufacturing planning for quality – initial planning for quality – concept of controllability: self controls – defining quality responsibilities on the factory flow – self inspection – automated manufacturing – overall review of manufacturing planning – process quality audits – quality and production floor culture.

UNIT IV- QUALITY IN DESIGN ENGINEERING: 9

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

UNIT V- QUALITY MANAGEMENT SYSTEM AND CONITNOUS IMPROVEMENT: 9

Need for quality management system – design of quality management system - quality management system requirements – ISO 9001 and other management systems and models - improvements made to quality management systems.

Basic quality engineering tools and techniques - statistical process control - techniques for process design and improvement - Taguchi methods for process improvement - six sigma - the 'DRIVE' framework for continuous improvement

TOTAL: 45 HOURS

REFERENCES

1. Oakland J S, "Total Quality Management - Text with Cases", Butterworth – Heinemann – An Imprint of Elseiver, First Indian Print, 2005.
2. Juran J M and Gryna F M, "Quality Planning and Analysis", Tata McGraw Hill Edition, 1995. Beckwith T G and Buck N L, "Mechanical Measurements" Addition Wesley Publishing Company Limited, 1995.
3. Bryan G T, "Control Systems for Technicians", The English Universities Press Limited, 1971.
4. Eugene L Grant and Richard S Leavenworth, "Statistical Quality Control", Tata McGraw Hill, Publishing Company Limited, New Delhi, Second Edition, 2002.
5. Johannes Ledolter and Claude W Burrill, "Statistical Quality Control", John Wiley and Sons, Inc.,
6. Jain R K, "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 1984.
7. Rangan, Mani and Sharma, "Instrumentation", Tata McGraw Hill Publications, New Delhi, 1985.
8. Nagrath I J and Gopal M, "Control Systems Engineering", Wiley Eastern Limited, 1995.

CM35B2	CONCURRENT ENGINEERING	L	T	P	C
		3	0	0	3

AIM:

To study the principles of concurrent engineering and how it can be applied.

OBJECTIVES:

- Basics of concurrent engineering
- Tools and methodologies available in CE
- Various approaches to CE
- Other related aspects of CE

Course Outcome		Cognitive Skill
CO-01	The graduates shall have the ability to understand the importance of product design in leveraging both manufacturing cost and product lifecycle cost.	A,E
CO-02	The graduates shall have the ability to plan and implement a product development program.	A,E
CO-03	The graduates shall have the ability to participate in multi-discipline Integrated Product Development teams	A,E
CO-04	The graduates shall have the ability to both write effective documents and deliver effective oral presentations.	A,E
CO-05	The graduates shall have the ability to benchmark competitive products and develop best industry practices.	A,E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	N	N	M	M
CO-02	S	M	S	M	M	N	N	M	M
CO-03	S	M	S	M	M	N	N	M	M
CO-04	S	M	S	M	M	N	N	M	M
CO-05	S	M	S	M	M	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I – INTRODUCTION: **9**

Extensive definition of CE - CE design methodologies - Organizing for CE - CE tool box Collaborative product development

UNIT II - USE OF INFORMATION TECHNOLOGY: 9

IT support - Solid modeling - Product data management - Collaborative product commerce – Artificial Intelligence - Expert systems - Software hardware co-design

UNIT III - DESIGN STAGE: 9

Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design - Automated analysis idealization control – Concurrent engineering in optimal structural design - Real time constraints

UNIT IV - MANUFACTURING CONCEPTS AND ANALYSIS: 9

Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative physical approach - An intelligent design for manufacturing system - JIT system - low inventory - modular -Modeling and reasoning for computer based assembly planning - Design of Automated manufacturing.

UNIT V - PROJECT MANAGEMENT: 9

Life Cycle semi realization - design for economics - evaluation of design for manufacturing cost – concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy - plan for Project Management on new product development – bottleneck technology development

TOTAL: 45 HOURS

REFERENCES

1. Anderson MM and Hein, L. Berlin, "Integrated Product Development", Springer Verlog, 1987.
2. Cleetus, J, "Design for Concurrent Engineering", Concurrent Engg. Research Centre,Morgantown, WV, 1992.
3. Andrew Kusaik, "Concurrent Engineering: Automation Tools and Technology",Wiley, John and Sons Inc., 1992.
4. Prasad, "Concurrent Engineering Fundamentals: Integrated Product Development",Prentice Hall, 1996.
5. Sammy G Sinha, "Successful Implementation of Concurrent Product and Process", Wiley, John and Sons Inc., 1998.

CM35B3	MANUFACTURING INFORMATION SYSTEMS	L	T	P	C
		3	0	0	3

AIM:

To highlight the concepts and elements of Manufacturing Information Systems

OBJECTIVES:

To familiarize

- Study of MRP, MRP II with role of production organization
- Concepts of database
- Designing of database
- Models in manufacturing
- Computerized manufacturing information system with practical application

Course Outcome		Cognitive Skill
CO-01	The graduates shall have the ability to understand the importance of the Evolution of order policies.	U,E
CO-02	The graduates shall have the ability to plan and implement a product data modeling for a database.	U,E
CO-03	The graduates shall have the ability Relationship among entities	U,E
CO-04	The graduates shall have the ability to Inventory and process flow	U,E
CO-05	The graduates shall have the ability to Parts oriented production information system	U,E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	N	N	M	M
CO-02	S	M	S	M	M	N	N	M	M
CO-03	S	M	S	M	M	N	N	M	M
CO-04	S	M	S	M	M	N	N	M	M
CO-05	S	M	S	M	M	N	N	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- MRP: **9**

The Evolution of order policies- From MRP to MRP II- Operations control- The role of production organization

UNIT II- DATA MODELING: **9**

Data modeling for a Database- Records and files- Abstraction and Data integration- Three level architecture for DBMS- Components of DBMS- Advantages and disadvantages of DBMS.

UNIT III- ENTITY RELATIONSHIP: 9

Relationship among entities- ER diagram- Data Models- Relational, Network, Hierarchical - Relational Model - Concepts, principles, keys, Relational operations-Functional Dependency- Normalization- Query languages.

UNIT IV- PRODUCT AND ITS STRUCTURE: 9

The product and its structure- Inventory and process flow- Shop floor control- Data structure and procedure- Various model - The order scheduling module- Input/Output analysis module- Stock status database- Complete IOM database

UNIT V- PRODUCTION INFORMATION SYSTEM: 9

Parts oriented production information system – concepts and structure – Computerized production scheduling, online production control systems; Computer based production management system, computerized manufacturing information system – case study

TOTAL: 45 HOURS

REFERENCES

1. Date. C.J, 'An Introduction to Database systems', Narosa Publishing House, 1997
2. Bipin C.Desai, 'An Introduction to Database systems', West Publishing Company, 1996
3. Kerr. R, 'Knowledge Based Manufacturing Management', Addison-Wesley, 1991
4. Luca G. Sartori, 'Manufacturing Information Systems', Addison-Wesley Publishing Company, 1988 Orlicky. G, 'Material.

CM35B4	MATERIALS AND PROCESSES FOR AUTOMATION	L	T	P	C
		3	0	0	3

AIM:

To highlight the materials used in manufacturing and their behavior under service

OBJECTIVES:

To familiarize

- Selection of materials and their applications with case studies
- Fundamentals of modern metallic materials and non metallic materials

OUTCOMES:

Course Outcome		Cognitive Skill
CO-01	To Understand about Piezoelectric Materials	U
CO-02	To Understand about Shape Memory Alloys	U
CO-03	To Understand about Composite Materials	U
CO-04	To Understand about Micro-Electro-Mechanical (MEMS) Systems and Materials for High Temperature Applications	U
CO-05	To Understand about Powder Metallurgy	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	N	N	M	M
CO-02	S	M	S	M	M	N	N	M	M
CO-03	S	M	S	M	M	N	N	M	M
CO-04	S	M	S	M	M	N	N	M	M
CO-05	S	M	S	M	M	N	N	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT - I PIEZOELECTRIC MATERIALS: 9

Introduction of advanced materials and its manufacturing processes for engineering applications. Piezoelectric materials (PZT): piezoelectric effect, Di-electric hysteresis, piezoelectric constants, piezoelectric charge constants, dynamic behaviour of PZT transducers, piezoelectric materials and manufacturing techniques (stability, poling and depolarisation).

UNIT - II SHAPE MEMORY ALLOYS: 9

Shape memory alloys (SMA): Shape memory effect and the metallurgical phenomenon of SMA, Temperature assisted shape memory effect, Visco-elastic behaviour, magnetic shape memory effect. Various shape memory alloys. Manufacturing technology of SMAs. Electro rheological (ER) and magneto-rheological (MR) materials: Characteristics of ER and EM fluids. ER and EM materials.

UNIT - III COMPOSITE MATERIALS: 9

Composite materials: Design and manufacturing of polymer matrix, metal matrix and ceramic matrix composites. Various forms and type of reinforcements, fillers and additives. Design of composites for structural, wear resistance and high temperature applications.

UNIT – IV MICRO-ELECTRO-MECHANICAL (MEMS) SYSTEMS AND MATERIALS FOR HIGH TEMPERATURE APPLICATIONS: 9

Micro-electro-mechanical (MEMS) systems. Introduction, characteristics of silicon wafers and other materials for MEMS applications. Various manufacturing techniques of MEMS components Materials for high temperature applications: Ni-Cr alloys, ODS materials, Ni base and Co based super alloys, carbon-carbon composites. Diffusion bond coating of high temperature materials.

UNIT - V POWDER METALLURGY: 9

Powder metallurgy: Introduction and feature of powder metallurgy processes. Advanced solidification techniques: directional solidification, single crystal growth and levitation melting.

TOTAL: 45 HOURS

REFERENCES

1. Filnn. R.A. and Trojan. P.K., 'Engineering Materials and their Applications', (4th Edition), Jai co, 1999
2. 'Powder Metallurgy', Metals Hand Book, Vol. 7, ASM, USA, 1994
3. Lubin. G. Ed., 'Hand Book of composites', Van Nestrand, Rcishahole, USA, 1994
4. George. E. Dieter, 'Mechanical Metallurgy', McGraw Hill, 1988
5. www.astm.org/labs/pages/131350.htm
6. Gandhi, M.V. and Thompson, B.S., Smart materials and Structures, Chapman and Hall, 1992.
7. Otsuka, K. and Wayman, C. M., Shape memory materials, C.U.P, 1998.
8. Taylor, W., Pizoelectricity, George Gorden and Breach Sc. Pub., 1985.
9. Mallick, P.K., Fiber Reinforced Composites Materials, Manufacturing and Design. Marcel Dekker Inc, New York, 1993.

CM35B5	SENSORS, ACTUATION DEVICES AND CONTROL	L	T	P	C
		3	0	0	3

AIM:

To expose the students to different types of Sensors, Actuation Devices and Control in manufacturing

OBJECTIVES:

- Basics of sensors in manufacturing
- Different types of sensors in manufacturing
- Different types of actuators and controllers in manufacturing

Course Outcome		Cognitive Skill
CO-01	To understand concepts of sensors in automation.	R, U
CO-02	To understand the actuators and control valves**.**	R, U
CO-03	To acquire proficiency in microprocessors & microcontrollers.	R, U
CO-04	To understand about controllers for industrial automation.	R, U
CO-05	To understand about human machine interface (hmi) and supervisory control and data acquisition (scada) systems.	R, U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	L	L	M	S
CO-02	S	M	S	M	M	L	L	M	S
CO-03	S	M	S	M	M	L	L	M	S
CO-04	S	M	S	M	M	L	L	M	S
CO-05	S	M	S	M	M	L	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I – SENSORS IN AUTOMATION: 9

Digital Sensors: Photo electric – Inductive, capacitive – Application profile of digital sensor and analysis of different applications – Fiber optic sensors – Laser sensors – Intelligent sensors – Networking of sensors for manufacturing automation – sensors for diagnostics and analysis, machine vision sensors, smart / intelligent sensors, integrated sensors, Robot sensors, Micro sensors, Nano sensors, . Selection of sensors for different applications.

UNIT II – ACTUATORS AND CONTROL VALVES : 9

Magneto strictive actuators, Memory-metal actuators, Shape memory alloys, Pneumatic, hydraulic and electrical actuators and their working principles, control valves – directions, pressure and flow, proportional valves, servo valves, Design of fluid power circuits – cascade, KV-map and step counter method, Analysis of hydraulic circuits.

UNIT III – MICROPROCESSORS & MICROCONTROLLERS: 9

Microprocessors - introduction, 8085 architecture, types of memory, machine cycles and timing diagram, addressing modes, instruction set, development of simple programs. 8051 microcontroller architecture, registers, addressing modes, interrupts, port structure, timer blocks and applications- stepper motor speed control

UNIT IV - CONTROLLERS FOR INDUSTRIAL AUTOMATION: 9

Programmable Logic Controllers - Evolution – Architecture – Scanning principle – different types of I/O modules – Interfacing real world devices with PLC – Communication possibilities – Software development: Features, different methodologies and strategies adopted for logic development.

UNIT V - HUMAN MACHINE INTERFACE (HMI) AND SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS: 9

Need for HMI – Hardware based HMI panels – PC based HMI systems – SCADA: different functionalities-Creating user screens – Trend graphs and data acquisition systems – Alarm and event logging – Archiving – User administration – Benefits of implementing SCADA systems – Case studies of SCADA implementation.

TOTAL: 45 HOURS

REFERENCES

1. Jon Stenerson, "Fundamentals of Programmable Logic Controllers, Sensors and Communication", Prentice Hall, 2004.
2. Dick Caro, "Automation Network Selection– The Instrumentation Systems and Automation Society", 2004.
3. David Bailey and Edwin Wright, "Practical SCADA for Industry", Newness Publishers, 2003.
4. John W Webb and Ronald A Reis, "Programmable Logic Controllers" Prentice Hall Publication, 2002.
5. Edwin H Zimmerman, "Getting Factory Automation Right (the First Time)", Manufacturing Engineers, 2001.
6. Richard L Shell and Ernest L Hall, "Hand Book of Industrial Automation" Marcel Dekker, Inc., 2000.
7. Frank D Petruzella, "Programmable Logic Controllers", McGraw Hill Publication, 1997.
8. Sabrie Soloman "Sensors and Control System in Manufacturing", McGraw Hill Publications, 1994.
9. Peter G Vanderspek, "Planning for Factory Automation: A Management Guide to World Class Manufacturing" McGraw Hill Companies, 1992.
10. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International, India, 2000.
11. Kenneth J Ayala, "8051 Microcontroller, Architecture, Programming and Applications" Penram International, India, 1996.
12. Anthony Espisito, "Fluid Power with Application", Prentice Hall, New Jersey, 2003.

OPEN ELECTIVES

Sl.No	COURSE CODE	COURSE NAME	L	T	P	C
1.	CM35B6	Artificial Intelligence & Expert System	3	0	0	3
2.	CM35B7	Machine Vision Systems and Image Processing	3	0	0	3
3.	CM35B8	Enterprise Computing	3	0	0	3
4.	GE35A1	Business Analytics	3	0	0	3
5.	GE35A2	Industrial Safety	3	0	0	3
6.	GE35A3	Operations Research	3	0	0	3
7.	GE35A4	Cost Management of Engineering Projects	3	0	0	3
8.	GE35A5	Composite Materials	3	0	0	3
9.	GE35A6	Waste to Energy	3	0	0	3

OPEN ELECTIVES

CM35B6	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	L	T	P	C
		3	0	0	3

AIM:

To expose the fundamentals of AI and Expert systems and its applications

OBJECTIVES:

- Fundamental concept of AI and expert system in manufacturing
- Concepts of fuzzy logic, AI programming languages and applications of OOP
- Speech and vision recognition systems for knowledge acquisition for the use of AI and expert system in manufacturing

Course Outcome		Cognitive Skill
CO-01	To understand about AI	R, U
CO-02	To understand about Cognitive Psychology	R, U
CO-03	To understand about Knowledge Engineering	R, U
CO-04	To understand about Visual Perception	R, U
CO-05	To understand about Expert Systems	R, U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	L	L	M	M
CO-02	S	M	S	M	M	L	L	M	M
CO-03	S	M	S	M	M	L	L	M	S
CO-04	S	M	S	M	M	L	L	M	M
CO-05	S	M	S	M	M	L	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I – INTRODUCTION: **9**

Intelligence - Definition, types, cognitive aspect approach: measuring intelligence - early efforts, IQ and AI; aspects of Intelligence - learning, problem solving, creativity, behaviour and biology. Artificial Intelligence: Historical background: applications of AI; objections and myths. AI Languages: Introduction to PROLOG & LISP

UNIT II - COGNITIVE PSYCHOLOGY: **9**

The mind - information and cybernetics components for thought, modes of perception - visual, auditory and other systems; memory mechanisms, problem solving –planning, search, the GPS systems; types of learning – rote parameters, method and concept; Game playing, reasoning

UNIT III - KNOWLEDGE ENGINEERING: **9**

Introduction - role of knowledge engineer, knowledge representation - psychology, production rules, logic and programming. Common sense and fuzzy logic; semantic networks learning systems.

UNIT IV - VISUAL PERCEPTION: **9**

Introduction - biology of vision, computational aspects; Towards Artificial vision - picture procession identifying real objects; vision programs; factory vision system. Robotics: AI impact; Robot sensors; factory robots; personal robots; robots tomorrow.

UNIT V - EXPERT SYSTEMS: **9**

Introduction, knowledge acquisition for Expert systems, features of Expert systems- System structure, Inference Engines, uncertainties, memory mechanisms, range of applications, actual expert systems - VP expert - Assignment - Development of a simple expert system.

TOTAL: 45 HOURS

REFERENCES

1. Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India, 1997
2. Charnaik, E., and McDermott, D., Introduction to Artificial Intelligence, Addison Wesley, 1985
3. Dan, W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall of India 1992.
4. Winston, P.H., Artificial Intelligence, Addison Wesley, 1990

CM35B7	MACHINE VISION SYSTEMS AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3

AIM:

To study the MV techniques and its applications

OBJECTIVES:

To treat the 2D systems as an extension of 1D system design and discuss techniques specific to 2D systems.

Course Outcome		Cognitive Skill
CO-01	To understand about MV System	R,U
CO-02	To understand about Image Processing Fundamentals	R,U
CO-03	To understand about Image Operations And Analysis	R,U, An
CO-04	To understand about Machine Vision	R,U
CO-05	To understand about Applications Of Mission Vision System	R,U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	L	N	M	M
CO-02	S	M	S	M	M	L	N	M	M
CO-03	S	M	S	M	M	L	N	M	M
CO-04	S	M	S	M	M	L	N	M	M
CO-05	S	M	S	M	M	L	N	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- INTRODUCTION: 9

Image representation, binary, gray and color images, digital image fundamentals, basics of image processing, imaging requirements, human vision and machine vision.

UNIT II - IMAGE PROCESSING FUNDAMENTALS: 9

Image sampling and quantization, image enhancement, gray level transformations, histogram processing, sharpening and smoothing, spatial and frequency domain filters, restoration, segmentation, edge and line detection, thresholding, representation.

UNIT III - IMAGE OPERATIONS AND ANALYSIS: 9

Study of various image operations, 2D and 3D measurements, image information, feature extraction, image based knowledge interpretation, template matching.

UNIT IV- MACHINE VISION: 9

Image sensing and acquisition, types of cameras for machine vision, their principles, different lighting system, Lens equation, Resolution of image, Depth of field, Volume of vision, laser vision system, elements of vision system and their functions, software's for image processing.

UNIT V- APPLICATIONS: **9**

General application in various fields, factory automation and machine vision, dimensional measurement, identification of flaws and defects, pattern recognition applications, sorting and counting, study of surface finish, tool wear measurement, robot application, safety monitoring.

TOTAL: 45 HOURS

REFERENCES

1. Tinku Acharya and Ajoy K Ray, "Image Processing – Principles and Applications", John Wiley and Sons Publication, 2005.
2. Rafael G Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education, 2002.
3. Linda G Shapriro and George C Stockman, "Computer Vision", Prentice Hall, 2001.
4. John C Russ, "The Image Processing Handbook", 3rd Edition, CRC Press, 1999.
5. Davies E R, "Machine Vision – Theory, Algorithms, Practicalities", Academic Press, 1997.
6. Ramesh Jain, Rangachar Kasturi and Brain G Schunck, "Machine Vision", McGraw Hill, 1995.
7. Robert R Schalkoff, "Digital Image Processing and Computer

CM35B8	ENTERPRISE COMPUTING	L	T	P	C
		3	0	0	3

AIM:

To study the Enterprise Computing techniques and its applications

OBJECTIVES:

- To provide knowledge on multi-tier enterprise architecture, enterprise database connectivity and distributed enterprise communications such as RMI, CORBA, DCOM.
- To provide knowledge for building scalable, secure, web enabled, and distributed enterprise systems with enterprise technologies and the Java 2 Platform Enterprise Edition (J2EE).

Course Outcome		Cognitive Skill
CO-01	To understand the multi-tier and distributed enterprise architecture and to apply concepts such as object oriented and components for software development for enterprises.	R, U,A
CO-02	To acquire knowledge on the basis of java database connectivity, interfaces and drivers and use it to design enterprise systems.	R, U,A
CO-03	To practice enterprise technologies and tools by conducting experiments.	R, U,A
CO-04	To study and use distributed enterprise communication technologies such as RMI, CORBA, and DCOM	R, U,A
CO-05	To provide high assurance for the multi-tier enterprise applications through providing various services such as naming, directory, trading, activation, messaging, transaction and security services.	R, U,A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	L	M	S	S
CO-02	S	M	S	M	M	L	M	S	S
CO-03	S	M	S	M	M	L	M	S	S
CO-04	S	M	S	M	M	L	M	S	S
CO-05	S	M	S	M	M	L	M	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- ENTERPRISE FOUNDATIONS: 9

Enterprise Architectural overview - object oriented software development for enterprise - Component Based software development for enterprise. Java Enterprise System. Enterprise Data - Basis of JDBC, Drivers, Connection, Statement, Result Set, Advanced JDBC features.

UNIT II- DISTRIBUTED ENTERPRISE COMMUNICATIONS ENABLING: 9

Distributed Enterprise Communications Basis - RMI Communication - CORBA communication - DCOM Communication. – Software Development for RMI Communication

UNIT III- SERVICES FOR DISTRIBUTED ENTERPRISE SYSTEMS: 9

Naming Services, Directory and Trading services, Activation Services, Message Services, Transaction Services, Security Services and High assurance Enterprise applications.

UNIT IV- ENTERPRISE WEB ENABLING: 9

Web Browsers and Web Servers in Enterprise. Web Programming, XML. Java Servlets - Java Server pages, JavaServer Faces, JSTL, Struts.

UNIT V- MULTITIER ENTERPRISE COMPUTING: 9

Introduction to Java Beans, Advantages of Java Beans, BDK Introspection, Using Bound properties, Bean Info Interface, Constrained properties Persistence, Customizes, Java Beans API, Enterprise Java Beans, Stateless Session Beans, Stateful Session Beans, Message Driven Beans, Entity, Accessing EJB in web services.

TOTAL: 45 HOURS

REFERENCES

1. Bill Burke and Richard Monson Haefel, "Enterprise Java Beans 3.0" O'Reily, 2006.
2. Raghu R Kodali, Jonathan R Wetherbee and Peter Zadrozny, "Beginning EJB 3 Application Development", Apress, 2006.
3. Dave Crane, Eric Pascarello and Darren Jame, "Ajax in Action", Manning, 2006.
4. Eric Jendrock, Jennifer Ball, Debbie Carson, Ian Evans, Scott Fordin and Kim Haase, "The Java EE 5 Tutorial", Addison Wesley, 2006.
5. Kito D Mann, "JavaServer Faces in Action", Manning, 2005.
6. Dustin R Callaway, "Inside Servlets" - Addison Wesley, 2001.
7. Jason Hunter, "Java Servlet Programming", O' Reily & Associates Inc., 2001.
8. Paul J Perrone, Venkata S R Krishna R and Chayanti, "Building Java Enterprise Systems with J2EE", Techmedia, 2000.
9. George Reese, "Database programming, with JDBC and Java", O'Reily, 2000.

GE35A1	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

AIM:

To understand the basic concepts of Business Analytics and other operational techniques.

OBJECTIVES:

- To make students understandable about the Regression Analysis, Business analytics, forecasting and decision analysis.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the concepts of Business Analytics.	R, U, An
CO-02	Can understand the factors of Trendiness and Regression analysis.	R, U, An
CO-03	Students can understand about organization structures of business analytics.	R, U, An
CO-04	One can understand the concepts of Forecasting Techniques.	R, U, An
CO-05	Can understand the Decision analysis.	R, U, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	L	L	S	S
CO-02	S	M	S	M	M	L	L	S	S
CO-03	S	M	S	M	M	L	L	S	S
CO-04	S	M	S	M	M	L	L	S	S
CO-05	S	M	S	M	M	L	L	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- BUSINESS ANALYTICS: 9

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

UNIT II- TRENDINESS AND REGRESSION ANALYSIS: 9

Modeling Relationships and Trends in Data, simple Linear Regression.

Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT III- ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS: 9

Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.

UNIT IV- FORECASTING TECHNIQUES: 9

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V- DECISION ANALYSIS: 9

Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TOTAL: 45 HOURS

REFERENCES

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

GE35A2	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

AIM:

To understand the basic Industrial Safety and Fault diagnosis.

OBJECTIVES:

- To make students understandable about the Industrial safety, Maintenance and fault tracing.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the concepts of Industrial Safety.	U, A
CO-02	Can understand the fundamentals of Maintenance Engineering.	U, A
CO-03	Students can understand the ways to prevent from wear and corrosion.	U, A
CO-04	One can understand the concepts of fault tracing.	U, A
CO-05	Can understand the functions of periodic and preventive maintenance.	U, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	L	N	M	S
CO-02	S	M	S	M	M	L	N	M	S
CO-03	S	M	S	M	M	L	N	M	S
CO-04	S	M	S	M	M	L	N	M	S
CO-05	S	M	S	M	M	L	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- INDUSTRIAL SAFETY: 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, leanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II- FUNDAMENTALS OF MAINTENANCE ENGINEERING: 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III- WEAR AND CORROSION AND THEIR PREVENTION: 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV- FAULT TRACING: 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Anyone machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V- PERIODIC AND PREVENTIVE MAINTENANCE: 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine

tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

TOTAL: 45 HOURS

REFERENCES

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

GE35A3	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

AIM:

To understand the concepts behind Operations Research.

OBJECTIVES:

- To make students understandable about the optimization techniques

Course Outcome		Cognitive Skill
CO-01	Ability to understand the concepts of Optimization Techniques.	U, An
CO-02	Can understand the fundamentals of LPP formulation.	U, An
CO-03	Students can understand the Non-Linear Programming.	U, An
CO-04	One can understand the concepts Scheduling and Sequencing.	U, An
CO-05	Can understand the functions of Competitive models	U, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	L	N	L	L
CO-02	S	M	S	M	M	L	N	L	L
CO-03	S	M	S	M	M	L	N	L	L
CO-04	S	M	S	M	M	L	N	L	L
CO-05	S	M	S	M	M	L	N	L	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- OPTIMIZATION TECHNIQUES: 9

Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II- LPP FORMULATION: 9

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT III- NONLINEAR PROGRAMMING: 9

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV- SCHEDULING AND SEQUENCING: 9

Single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V- COMPETITIVE MODELS: 9

Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

TOTAL: 45 HOURS

REFERENCES

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

GE35A4	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

AIM:
To understand the concepts of Cost management of Engineering Projects.

OBJECTIVES:

- To make students understandable about the cost concepts in decision making and profit planning.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the strategic cost management.	R, A
CO-02	Can understand the fundamentals of cost concepts in decision making.	R, A
CO-03	Students can understand the process involved in project execution.	R, A
CO-04	One can understand the concepts of cost behavior and profit planning.	R, A
CO-05	Can understand the functions of quantitative techniques.	R, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	M	S	M	M	N	N	M	S
CO-02	S	M	S	M	M	N	N	M	M
CO-03	S	M	S	M	M	N	N	M	S
CO-04	S	M	S	M	M	N	N	M	M
CO-05	S	M	S	M	M	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I - STRATEGIC COST MANAGEMENT: **9**

Introduction and Overview of the Strategic Cost Management Process.

UNIT II- COST CONCEPTS IN DECISION MAKING: 9

Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT III- PROJECT: 9

Meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

UNIT IV- COST BEHAVIOR AND PROFIT PLANNING: 9

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V- QUANTITATIVE TECHNIQUES: 9

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TOTAL: 45 HOURS

REFERENCES

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of CostAccounting A. H. Wheeler Publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

GE35A5	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

AIM:

To understand the characterization and properties of composite materials.

OBJECTIVES:

- To make students understandable about the material characteristics, processing and classifications of composite materials.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the functional requirements of composite materials.	R,U,E
CO-02	Can understand the properties and applications of reinforcements.	R,U,E
CO-03	Students can understand the process involved in metal matrix composite fabrication.	R,U,E
CO-04	One can understand the concepts of polymer matrix composites fabrication.	R,U,E
CO-05	Can understand the physical characteristics of composite materials.	R,U,E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	S	S	M	M	L	N	M	L
CO-02	S	S	S	M	M	L	N	M	L
CO-03	S	S	S	M	M	L	N	M	L
CO-04	S	S	S	M	M	L	N	M	L
CO-05	S	S	S	M	M	L	N	M	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- INTRODUCTION: 9

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II- REINFORCEMENTS: 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT III- MANUFACTURING OF METAL MATRIX COMPOSITES: 9

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT IV-MANUFACTURING OF POLYMER MATRIX COMPOSITES: 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression molding – Reaction injection moulding. Properties and applications.

UNIT V- STRENGTH: 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygro thermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 HOURS

TEXT BOOKS

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

GE35A6	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

AIM:

To understand the basic properties of Bio Materials and its process

OBJECTIVES:

- To make students understandable about the gasification process, bio materials and its design considerations.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the process of obtaining Energy from waste substances.	R, U
CO-02	Can understand manufacturing of pyrolytic oils and gases, yields and applications.	R, U
CO-03	Students can understand kinetic consideration in gasifier operation.	R, U
CO-04	One can understand the Design, construction and operation of Bio Mass chamber.	R, U
CO-05	Can understand the basic Properties of biogas	R, U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I
CO-01	S	L	S	M	L	L	L	M	L
CO-02	S	L	S	M	L	L	L	M	L
CO-03	S	L	S	M	L	L	L	M	L
CO-04	S	L	S	M	L	L	L	M	L
CO-05	S	L	S	M	L	L	L	M	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I- INTRODUCTION TO ENERGY FROM WASTE: 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT II- BIO MASS PYROLYSIS: PYROLYSIS: 9

Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III- BIO MASS GASIFICATION: 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV- BIO MASS COMBUSTION: 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V- BIO GAS: 9

Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 HOURS

REFERENCES

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.