Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

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Course Structure & Contents

for

M.Tech. Program in Computer Aided Design – Computer Aided Manufacturing

From 1st Semester - 4th Semester

Vision

The vision of the Department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after the holistic development of students and conducting need-based research and extension.

Post Graduate Attributes

The Post Graduate Attributes are the knowledge skills and attitudes which the students have at the time of post-graduation. These attributes are generic and are common to all engineering programs.

These Post Graduate Attributes identified by National Board of Accreditation, are as follows:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of engineering problems involving research.
2. **Problem analysis:** Identity, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for engineering problems involving research and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to research activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the research based engineeringsolutions in societal and environmental contexts, and demonstrate theknowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice to research problems.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader of a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

PEO1	To train students with in-depth and advanced knowledge to become professional and capable of identifying, analyzing and solving complex problems in the areas of CAD-CAM Engineering.
PEO2	To enable post graduates to carry out innovative and independent research work, disseminate the knowledge in Academia/Industry/Research organizations to develop systems and processes in the related field.
PEO3	To prepare the students to exhibit a high level of professionalism, integrity, effective communication skills and environmental and social responsibility.
PEO4	To provide an academic environment that gives adequate opportunity to the students to cultivate life-long independent learning ability for their successful professional career.

Program Outcomes

At the end of the program the student will be able to:

PO1	Acquire, demonstrate and apply advanced knowledge in the area of CAD-CAM engineering.
PO2	Identify problems in the field of CAD-CAM engineering, formulate them and solve by using advanced techniques.
PO3	Conduct independent research and generate new knowledge for the benefit of community, society Industry and country.
PO4	Apply various numerical methods, advanced software and engineering tools to model, analyze and solve manufacturing engineering problems.
PO5	Work effectively in interdisciplinary teams for solving real life problems in the related field.
PO6	Apply engineering and scientific principles for the effective management of manufacturing systems.
PO7	Effectively communicate through technical reports, presentations and scientific publications with the engineering community as well as society at large.
PO8	Demonstrate traits of management in handling engineering projects, related finance, and coordinate with workforce towards achieving goals.
PO9	Demonstrate high level of professional and intellectual integrity, ethics of research and scholarly standards.
PO10	Examine critically the outcomes of one's actions and make corrective measures subsequently.
PO11	Demonstrate the ability to work in team in the laboratory in achieving multidisciplinary tasks required for the project.
PO12	Engage in life-long reflective and independent learning with high level of enthusiasm and commitment.

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	No. of Lecture hours (per week)
T:	No. of Tutorial hours (per week)
P:	No. of Practical hours (per week)
C:	Total number of credits
BSH:	Basic Science and Humanity
BSC:	Basic Sciences Course
PCC:	Professional Core Course
OEC:	Open Elective Course
PEC:	Professional Elective Course
BHC:	Basic Humanity Course
ESC:	Engineering Science Course
HSMC:	Humanity Science and Management Course
NCC:	National Cadet Corps
NSS:	National Service Scheme

MASTER OF TECHNOLOGY
(Computer Aided Design – Computer Aided Manufacturing)

Syllabus effective from July 2018

Semester-I

Course Code	Type of Course	Name of the Course	Hours/Week			Credit	Examination Scheme				
							Theory		CA	PR/OR	Total
			L	T	P		TH	Test			
MDE11	PCC	Advanced Methods in Engineering Design Computer Aided Design	3	1	--	4	60	20	20	--	100
MCAAD12	PCC	Computer Aided Design	3	1	--	4	60	20	20	--	100
MCADM13	PCC	Computer Aided Manufacturing	3	1	--	4	60	20	20	--	100
MCADM14A	Elective I	Product Life Cycle Management	3	--	--	3	60	20	20	--	100
MCADM14B		Technology and Knowledge Management									
MCADM14C		Instrumentation and Automatic Control									
MCADM14D		Operation Research									

MCADM14E		Project Management									
MCADM15A	Elective II	Robust Design of Products/ Processes	3	--	--	3	60	20	20	--	100
ME-XX15B		Artificial Intelligence and Expert System in Automation									
MCADM15C		Digital Manufacturing									
MDE15D		Machine Tool Design									
MCADM15E		Enterprise Resource Planning									
MCADM15F		Reliability Engineering									
MCADM15G		Computer Integrated Manufacturing									
BSH16	HSMC	Communication Skills	2	--	--	2	--	--	25	25	50
MCADM17	PCC	Design Lab	--	--	3	2	--	--	25	25	50
		Total	**17**	**3**	**3**	**22**	**300**	**100**	**150**	**50**	**600**

Semester-II

Course Code	Type of Course	Name of the Course	Hours/Week			Credit	Examination Scheme				
							Theory		CA	PR/OR	Total
			L	T	P		TH	Test			
MDE21	PCC	Finite Element Method	3	1	--	4	60	20	20	--	100
MCADM22	PCC	Robotics	3	1	--	4	60	20	20	--	100
MCADM23A	Elective III	Customization of CAD/ CAM Software	3	--	--	3	60	20	20	--	100
MTE23B		Computational Fluid Dynamics									
MCADM23C		Flexible Manufacturing System									
MCADM23D		Design for 'X'									
ME-XX24A	Elective IV	Mechatronics	3	--	--	3	60	20	20	--	100
MCADM24B		Design For Mechanisms and Manipulators									
MME24C		Metrology and Computer Aided Inspection									
MOE25A	Elective V	Research Methodology	3	--	--	3	60	20	20	--	100
MOE25B		Design of Experiments									
MOE25C		Advanced Optimization Techniques									

MOE25D		Environmental Engineering and Pollution Control									
MOE25E		Soft Computing Techniques									
MOE25F		Manufacturing Automation									
MOE25G		Modeling and Simulation									
MCADM26	PCC	Seminar	--	--	4	2	--	--	50	50	100
MCADM27	PCC	Mini Project	--	--	4	2	--	--	50	50	100
		Total	**15**	**2**	**8**	**21**	**300**	**100**	**200**	**100**	**700**

Semester-III

Course Code	Type of Course	Name of the Course	Hours/Week			Credit	Examination Scheme				
							Theory		CA	PR/OR	Total
			L	T	P		TH	Test			
MMECH31	PCC	Project Management (Self Study Course)	--	--	--	2	--	--	50	50	100
		OR									
MMECH32		Intellectual Property Rights (Self Study Course)	--	--	--	2	--	--	50	50	100
MCADM33	PCC	Project Stage -I	---	--	--	10	--	--	50	50	100
Total			---	--	--	**12**	--	--	**100**	**100**	**200**

Semester-IV

Course Code	Type of Course	Name of the Course	Hours/Week			Credit	Examination Scheme				
							Theory		CA	PR/OR	Total
			L	T	P		TH	Test			
MCADM41	PCC	Project Stage -II	---	--	--	20	--	--	100	100	200
Total			---	--	--	**20**	--	--	**100**	**100**	**200**

Semester-I
Advanced Methods in Engineering Design

MDE11	Advanced Methods in Engineering Design	PCC	3-1-0	4 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites: Mechanics of Materials, Machine Design

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

DESIGN PHILOSOPHY: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability.

UNIT 2

PRODUCT DESIGN: Product strategies, value, planning and specification, concept generation, concept selection, concept testing.

UNIT 3

DESIGN FOR MANUFACTURING: Forging design, casting design, Design process for non-metallic parts, Plastics, Rubber, Ceramic, Wood and Glass parts like. Material selection in machine design.

UNIT 4

FAILURE THEORIES: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory, Fatigue mechanisms, Fatigue failure models, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles, Fatigue failure theories ,cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation.

UNIT 5

SURFACE FAILURES: Surface geometry, mating surfaces, oil film and their effects, design values and procedures, adhesive wear, abrasive wear, corrosion wear, surface fatigue, different contacts, dynamic contact stresses, surface fatigue failures, surface fatigue strength.

UNIT 6

ECONOMIC FACTORS INFLUENCING DESIGN: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design.

Texts/References:

1. Smith Seely, "Advanced Mechanics of Materials", John Willey & Sons Publications.
2. Timoshenko, "Strength of Materials"
3. Kocanda, "Fatigue Failure of Metal", Sijthoff and Noordhoff International Publications.
4. Frost N. E., "Metals Fatigue", Oxford University Press, London.
5. Benhan and Crawford, "Mechanics of Engineering Materials", John Willey & Sons Pub.
6. Spotts M. F., "Mechanical Design Analysis", PHI Publications, New Delhi.

Semester-I
Computer Aided Design

MCAAD12	Computer Aided Design	PCC	3-1-0	4 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1
INTRODUCTION: The design process, elements of CAD

UNIT 2
PRINCIPLES OF SOFTWARE DESIGN: Characteristics of good software, data structures, algorithm design, flow chart, coding, top-down programming, modular programming, structural coding, testing of the software.

UNIT 3
3D MODELING AND VIEWING: Coordinate systems, sketching and sketch planes; Modeling aids and tools; Layers, grids, clipping, arrays, editing.
Computer Graphics: Graphics display, transformations, visualizations, computer animation.

UNIT 4
CURVES MODELING: Analytical and synthetic curves, curve manipulations.
Surface Modeling: Surface representation and surface analysis, analytical and synthetic surfaces, surface manipulations, NURBS.
SOLID MODELING: Geometry and topology, solid entities, solid representation, fundamental of solid modeling, half spaces, boundary representation, constructive solid geometry, sweeps, solid manipulations.

UNIT 5
FEATURES: Feature entities, feature representation, three dimensional sketching, parametrics, relations, constraints, feature manipulation.

MASS PROPERTIES: Geometric and mass properties evaluation, assembly modeling, product data exchange

UNIT 6
OPTIMIZATION TECHNIQUE: Single variable optimization, multi-variable optimization, Johnson's method of optimum design, genetic algorithm.

Texts/References:

1. Zeid, I., "Mastering CAD/CAM", Tata McGraw Hill. 2007
2. Onwubiko, C., "Foundation of Computer Aided Design", West Publishing Company. 1989
3. Hsu, T. R. and Sinha, D. K., "Computer Aided Design: An Integrated Approach", West Publishing Company. 1991
4. Dimarogonas, A. D., "Computer Aided Machine Design", Prentice Hall. 1988
5. Mortenson, M. E., "Geometric Modeling", 3rd Ed., Industrial Press. 2006

Semester-I
Computer Aided Manufacturing

MCADM13	Computer Aided Manufacturing	PCC	3-1-0	4 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

INTRODUCTION OF AUTOMATION: Introduction, basic elements of an automated system, advanced automation functions, levels of automation

UNIT 2

NUMERICAL CONTROL: Basic components of an NC system, classification, merits and demerits, applications, the cost of NC/CNC, dimensioning systems, axes designation, NC motion control, interpolation, part programming formats, manual part programming, NC words, macro statements, application of NC to machine tools and other applications, NC coding systems (ISO and EIA), computer assisted part programming, APT statements, programming, NC part programming using CAD/CAM, manual data input (MDI), engineering analysis of NC positioning systems, open loop and closed loop positioning systems, precision in NC positioning

UNIT 3

COMPUTER NUMERICAL CONTROL (CNC) AND DNC: Features of CNC, the machine control unit for CNC, CNC software, direct numerical control, distributed numerical control

UNIT 4

GROUP TECHNOLOGY AND CELLULAR MANUFACTURING: Introduction to GT, benefits, part families, part classification and coding, product flow analysis, cellular manufacturing, adaptation consideration in GT, quantitative analysis in cellular manufacturing. Flexible Manufacturing Systems - Introduction to FMS, components, applications, benefits, FMS layout, FMS planning and implementation issues, quantitative analysis of FMS

UNIT 5

COMPUTER INTEGRATED MANUFACTURING (CIM): CAD, CAD/CAM, CIM, evolution of CIM, CIM hardware and software, nature and role of the elements of CIM system, development of CIM, the IBM concept of CIM, the Siemens concept of CIM, the CIM concept of Digital equipment corporation, Esprit CIM - OSA model, the NIST – AMRF Hierarchical model.

UNIT 6

MANUFACTURING SUPPORT SYSTEMS: CAPP, benefits, types, forward and backward planning implementation considerations, process planning systems, CAQC, CMM, JIT principles, the meaning of JIT, MRP–I and MRP-II

Texts/References:

1. Mikell P. Grover “Automation, Production Systems and Computer-Integrated Manufacturing”, Pearson Education, New Delhi.
2. P. Radhakrishnan & S. Subramanyan “CAD/CAM/CIM” Willey Eastern Limited New Delhi.

3. Mikell P. Grover and Enory W. Zimmers Jr. “CAD/CAM”, Pearson Education, New Delhi.
4. Hans B. Kief and J. Frederick Waters “CNC” Glencae Macmillan / McGraw Hill
5. Steve Krar and Arthar Gill “CNC Technology and Programming”, McGraw Hill Pub. Company, New Delhi.
6. Nicholas John M. “Competitive Manufacturing Management”, McGraw Hill International
7. P.N. Rao, N. K. Tewari “CAM” Tata Mc Graw Hill Pub. New Delhi.

Semester-I
Product Lifecycle Management

MCADM14A	Product Lifecycle Management	Elective I	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

INTRODUCTION: Background, overview, Need, Benefits, Concept of product Lifecycle, Components of PLM, Emergence of PLM, Why PLM is important, Customer Involvement.

UNIT 2

THE PRODUCT LIFECYCLE ENVIRONMENT: Product Data and Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Company's PLM Vision, The PLM Strategy.

UNIT 3

PRODUCT LIFECYCLE ACTIVITIES: Organizational Structure, Human Resources in the Product Lifecycle, Methods, Techniques, Interfaces, Information, Standards, Vendors of PLM Systems and Components, Examples of PLM in use.

UNIT 4

PDM BASICS: PDM Systems, Importance of PDM, Resolving Data Issues, A Multi-user, Multi-organization Environment, Multiple Data Definition, Justification of PDM, Reasons for implementing a PDM System.

Texts/References:

1. Product Lifecycle Management by Antti Saaksvuori and Anselmi Immonen, Springer; 1 edition (November 5, 2003).
2. Relevant recent technical articles, research papers, key note addresses, etc.

Semester-I
Technology and Knowledge Management

MCADM14B	Technology and Knowledge Management	Elective I	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define knowledge edge and classify drivers of knowledge management.
CO2	Study the process of conversion from information to knowledge.
CO3	Understand the different phases of knowledge management.
CO4	Study different strategies to achieve successful knowledge management system.

CO5	Explain infrastructural need and different layers for knowledge management.
CO6	Study the measuring process of knowledge growth and failure and creating the knowledge management blue print.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1			3					1
CO2	3	3	2	1			2					1
CO3	3	2	2	1			3					1
CO4	3	2	2				1					1
CO5	3	2	2	1			2					1

Course Contents:

UNIT I

INTRODUCTION: Knowledge & necessity of Knowledge, KM's value proposition, behind the buzz, assumptions about your company.

THE KNOWLEDGE EDGE: A common theme, intellectual capital, knowledge, market value, and prosperity, the 24 drivers of KM, knowledge centric drivers, technology drivers, organizational structure based, drivers, personnel focused drivers, process drivers, economic drivers, creating the knowledge edge.

UNIT 2

FROM INFORMATION TO KNOWLEDGE: From data to information to knowledge, from data to knowledge, classifying knowledge, the three fundamental steps, knowledge management systems and existing technology, taming the tiger's tail, business and knowledge.

UNIT 3

THE 10-STEP KNOWLEDGE MANAGEMENT ROAD MAP: The 10 step knowledge management road map, phase1: infrastructural evaluation, phase2: knowledge management system analysis, design, and development, phase3: deployment, phase4: matrices for performance evaluation.

UNIT 4

THE LEVERAGED INFRASTRUCTURE: The approach leverage, leverage, leverage, leveraging the internet, enabling technologies for the knowledge management, technology framework, knowledge server.

ALIGNING KNOWLEDGE MANAGEMENT AND BUSINESS STRATEGY: From strategic programming to strategic planning, codification or personalization, knowledge maps

to link knowledge to strategy, strategic imperatives for a successful km system, assessing focus.

UNIT 5

INFRASTRUCTURAL FOUNDATIONS: Technology components of the km architecture, the seven-layer km system architecture, foundation for the interface layer, the web or notes? Collaborative intelligence and filtering layer, audit knowledge.

KNOWLEDGE AUDIT AND ANALYSIS: Measuring knowledge growth, the knowledge audit team, choosing your company's k-spots, sources of expertise, team composition and selection criteria, team life span and sizing issues, the knowledge management project leader, the km team's project space, points of failure.

UNIT 6

CREATING KNOWLEDGE MANAGEMENT BLUEPRINT: Analyzing lost opportunities, the knowledge management architecture, components of a knowledge management system, designing integrative and interactive knowledge applications, interoperability considerations, performance and scalability, user interface design consideration, a network view of the km architecture, future-proofing the knowledge management system

Texts/References:

1. Amrit Tiwana, *The Knowledge Management Tool Kit*, Pearson Education Asia Pte. Ltd., 2000.
2. T.H.Davenport and Laurence, Prusak, *Working Knowledge: How Organizations Manage what they Know*, Harvard Business School Press, Boston, 1998.
3. I.Nonaka and H.Takeuchi, *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New York, 1995.
4. IGNOU, Technology Management, 6 booklets viz. Block I to VI, IGNOU Publication No. MS-94, 1997.
5. J.B.Quinn, *Intelligent Enterprise: A Knowledge and Service-Based Paradigm for Industry*, Free Press, New York, 1992.Betz Frederic, *Strategic Technology Management*, McGraw Hill, Inc., New York, 1993.

Semester-I
Instrumentation and Automatic Control

MCADM14C	Instrumentation and Automatic Control	Elective I	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Course Outcomes: At the end of the course, student should be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

PO's → CO's ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution, 2- Means medium contribution, 3- Maximum contribution

Course Contents

Unit 1
Introduction to measurements for scientific and engineering application need and goal. Broad category of methods for measuring field and derived quantities

Unit 2
Principles of measurement, parameter estimation, regression analysis, correlations, error estimation and data presentation, analysis of data

Unit 3
Measurement of field quantities, thermometry, heat flux measurement, measurement of force, pressure, flow rate, velocity, humidity, noise, vibration, measurement of the above by probe and non-instructive techniques

Unit 4
Measurement of derived quantities, torque, power, thermo physical properties, radiation and surface properties

Unit 5
Analytical methods and pollution monitoring, mass spectrometry, chromatography, spectroscopy

Unit 6
Basics of P, PI, PID controllers, pneumatic and hydraulic controllers, electronic controllers, applications to machine tools, furnaces, material handling etc

Texts/References

1. Doebelin E.O: Measurement Systems-Application and Design, McGraw Hill Publication Co.
2. Beckwith TG. N. Lewis Buck and Marangoni R.D: Mechanical Measurements, Narosa Publishing House, New Delhi
3. Liptak B.G. Instrument Engineers' Handbook
4. Bolton W, Mechatronics-Electronics Control Systems in Mechanical and Electrical Engg.
5. Modern Electronic Instrumentation and Measurement Technique by A.D. Helfrick and W.D. Cooper
6. Johnson C.D., Process Control Instrumentation
7. J. P. Holman: Experimental Methods for Engineers, McGraw Hill International Edition, Seventh Edition

Semester I
Operations Research

MCADM14D	Operations Research	Elective I	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Course Outcomes:

At the end of the course, student should be able to:

CO1	
CO2	

CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

PO's → CO's ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution, 2- Means medium contribution, 3- Maximum contribution

Course Contents:

Unit 1

Introduction: definition and scope of OR; Techniques and tools; Model formulation; general methods for solution; Classification of optimization problems; Optimization techniques.

Unit 2

Linear Optimization Models: Complex and revised simplex algorithms; Duality theorems, sensitivity analysis; Assignment, transportation and transshipment models; Traveling salesman problem as an assignment problem; Integer and parametric programming; Goal programming.

Unit 3

Game Problems: Mini-max criterion and optimal strategy; Two person zero sum game; Games by simplex dominance rules.

Unit 4

Waiting Line Problems: Classification of queuing situations; Kendall's notation, Poisson arrival with exponential or Erlang service time distribution; Finite and infinite queues; Optimal service rates; Application of queuing theory to industrial problems.

Unit 5

Dynamic Programming: Characteristic of dynamic programming problems (DPPs); Bellman's principle of optimality; Problems with finite number of stages; Use of simplex algorithm for solving DPPs.

Unit 6

Non-linear Programming: One dimensional minimization methods; Unconstrained optimization techniques; Optimization techniquescharacteristics of a constrained problem; Indirect methods; Search and gradient methods.

Texts/References:

1. Taha, H. A., "An Introduction to Operations Research", 6th Ed., Prentice Hall. 2006
2. Hillier, F. J. and Lieberman, G. J., "Introduction to Operations Research", 7th Ed., Holden Day.2001
3. Phillips, D. T, Ravindran, A. and Solberg, A. A., "Operations Research: Principles and Practice", 2nd Ed., John Wiley and Sons. 1986
4. Wagner, H. M., "Principles of OR with Applications to Managerial Decisions", 2nd Ed., Prentice Hall. 1975
5. Jensen, P. A, and Bard, J. F., "Operations Research Models and Methods", John Wiley and Sons. 2008

Semester I
Project Management

MCADM14E	Project Management	Elective I	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

INTRODUCTION TO PM: Projects in Contemporary Organization, Project Life Cycle

UNIT 2

PROJECT INITIATION: Strategic Management, Project Selection & Evaluation, Selection Criteria & Models, Risk Management, Portfolio Process, Project Proposals, Project manager: Demands on Project manager, selecting the Project Manager, Multicultural Communication, Project Organization: Organizational Concepts in PM, Selecting an Organizational Form,

UNIT 3

PROJECT PLANNING: Systems integration, WBS & Responsibility Charts, Interface Coordination, Conflict and Negotiation in PM: Nature of Negotiation, Conflict and Project Life Cycle

UNIT 4

PROJECT IMPLEMENTATION: Budgeting and Cost Estimation: Estimating Project Budgets, Improving Cost Estimation Process, Scheduling: Background, Network Techniques: PERT & CPM, Risk Analysis & Crystal Ball Simulation,

UNIT 5

RESOURCE ALLOCATION: CPM & Crashing a Project, Resource Allocation, Resource Loading & Leveling, Constrained Resource Scheduling, Multi-project Scheduling & Resource Allocation, Goldratt's Critical Chain, Monitoring & Information System, Planning-Monitoring-Controlling Cycle: Information Needs & Reporting Process, Earned Value Analysis, Computerized PMIS, Project Control: Need for Project Control, Three Types of Control Processes, Design of Control Systems, Control of Creative Activities, Control of Change & Scope.

UNIT 6

CREEP PROJECT TERMINATION: Project Auditing: System Goals & Project Audit, Audit Report, Project Audit Life Cycle, Project Termination, Varieties of Project Termination, Termination Process, Final Report, A Project History

Texts/References:

1. P. Gopalakrishnan and V. E. Rama Moorthy, Project Management, Macmillan India Ltd., New Delhi, 1993.

2. Prasanna Chandra, Projects: Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1980.

3. B. B. Goel, Project Management: Principles and Techniques, Deep & Deep Publications, New Delhi, 1986.

4. UNIDO Series on Project Management.

Semester-I
Robust Design of Products/Processes

MCADM15A	Robust Design of Products/Processes	Elective II	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

INTRODUCTION TO ROBUST DESIGN: Robustness Strategy & its primary tools: P-Diagram, Quality Measurement, Quality Loss Function, Signal to Noise (S/N) Ratios, Orthogonal Arrays, Steps in Robust Parameter Design. Robust design and Six-Sigma for Lean Enterprises.

UNIT 2

INTRODUCTION TO TAGUCHI'S EXPERIMENT DESIGN: Criteria for the Use of Experiment Design Methods: Applying Experiment Design Methods According To Situation; Problem Analysis and Empiric Parameter Reduction. Orthogonal Arrays, Graphical representation of factor combinations, linear graphs, Variance Analysis (ANOVA), Inner-Outer arrays Design.

UNIT 3

PARAMETER DESIGN ACCORDING TO TAGUCHI: Direct product design, indirect variance analysis, Product design with characteristic values, taking cost into account, Signal-to-noise ratio according to Taguchi.

UNIT 4

EXPERIMENT DESIGN ACCORDING TO SHAININ: Multi-variate charts, components search, paired comparisons; Determining decisive parameters (variable search), scatter plots, randomization of experiments, B versus C test, full factorial.

UNIT 5

RESPONSE SURFACE METHODOLOGY (RSM): Linear experiment designs, quadratic experiment designs.

Texts/References:

1. Optimizing Engineering Design - J. Krottmaier; McGraw Hill Ltd.
2. Taguchi Techniques for quality engineering - Philip J. Ross McGraw Hill Ltd.
3. Quality Control and Improvement– A. Mitra, Pearson Publications.
4. TQM and Taguchi Methods – Logothetis.

Semester-I

Artificial Intelligence & Expert System in Automation

ME-XX15B	Artificial Intelligence & Expert System in Automation	Elective II	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Know the expert system architecture
CO2	Select appropriate AI technique for a given problem
CO3	Develop neural network or fuzzy logic or genetic algorithm for a given situation
CO4	Understand the basics of machine learning
CO5	Apply the principles of machine learning and AI for practical applications.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit I: Expert system Architecture

Expert system Architecture, knowledge base, inference engine, expert system shell, applications.

Unit II: Fuzzy Logic

Fuzzy sets, membership functions, operation on fuzzy sets; fuzzy control system, Fuzzyfication, knowledge base, inference, defuzzification, application.

Unit III: Neural Network
Neuron structure, classification, artificial neural network, back propagation training and algorithm, neuro-fuzzy controllers, applications.

Unit IV: Genetic algorithms
Concepts, encoding and selection methods, genetic operators (crossover and Mutation), applications.

Unit V: Hybrid systems
Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

Unit VI: Artificial intelligence and machine learning:
Definition, knowledge representation techniques, problem solving, search techniques, game playing , knowledge and logic, learning methods, applications of AI.

Text Books / References:

1. Haykin "Neural Networks – A comprehensive Foundation" (Mc-millan)
2. J.M. Zureda "Introduction to artificial neural networks" (Jaico)
3. A Cichocki& R Unbehauen " Neural Networks for optimization and signal Processing" John Wiley
4. George J. Klin& Tina A Polgar "Fuzzy sets, uncertainty and Information"
5. BaertKosko "Neural network and fuzzy systems"
6. Peterson "Introduction to Artificial Intelligence and expert system (PHI)
7. Michell "Introduction to Genetic Algorithm" (PHI)
8. Vidyasagar M "Theory of learning and generalization" Springer
9. S. Rajasekaran, G.A. VijaylakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algotithm", PHI.
10. T.J. Ross: "Fuzzy Logic with Engineering Applications" Second Edition John Wiley India.

Semester-I
Digital Manufacturing

MCADM15C	Digital Manufacturing	Elective II	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

INTRODUCTION TO DIGITAL MANUFACTURING: A Brief History of Manufacturing, Digital Manufacturing Today, Digital Design, Digital Materials, Digital Fabrication, Digital Products, Technology Development, Applications Development, People and Business, The Digital Economy, Transition from Industrial Manufacturing

UNIT 2

PROCESS SIMULATION AND VALIDATION: Assembly and component manufacturing, process simulation and validation, Ergonomic/ human simulation, Robotic simulation and OLP

UNIT 3

PLANT DESIGN, SIMULATION & OPTIMIZATION**:** Station / work-cell layout design, Throughput simulation, Discrete event simulation, Optimization of material flow and logistic

UNIT 4
MANUFACTURING PROCESS SIMULATION SOLUTION CUSTOMIZATION**:** Functionality enhancements as extensions of OOTB software solution, Reports customization, User interface customization

UNIT 5
SPECIAL TOPICS: Informatics platform for designing and deploying e-manufacturing systems, framework for integrated design of Mechatronic systems, Collaborative supplier integration for product design and development. Reconfigurable manufacturing systems design, Virtual Reality based platform for collaborative product review and customization, managing collaborative process planning activities through extended enterprise, rapid product development, desktop assembly factories, Information sharing in digital manufacturing based on STEP and XML

Texts/References:

1. Collaborative Design and Planning for Digital Manufacturing, Springer, 2009

Semester-I
Machine Tool Design

MDE15D	Machine Tool Design	Elective II	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Course Outcomes: At the end of the course the student will be able to:

CO1	Study kinematics of various machine tools.
CO2	Understand principles of various machine tool feed and speed drives.
CO3	Design power screws, slideways and machine tool spindle with bearings.
CO4	Design structure and other auxiliary mechanism of machine tool.
CO5	Apply modular design aesthetics and ergonomics for machine tool.
CO6	Study acceptance test of machine tools and methods of machine tool condition.

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	3		1	2			1		1
CO2	2	2	1	2		1	1			1		1
CO3	2	1		2	2						1	1
CO4	2	1		2	2						1	1
CO5	2	2		1	2	2			2	2	1	1
CO6	2	2	1	2	2	1		1		1		1

Course Contents:

Unit 1
Introduction to metal cutting machine tools- criteria for the selection of operating capacity and design parameters, kinematics of machine tools.

Unit 2
Basic principles of machine tool design, estimation of drive power, machine tool drives, electrical, mechanical and fluid drives, stepped and step less speed arrangements and systems.

Unit 3
Design of machine tool spindles and bearings, design of power screws, design of slide ways, selective and pre-selective mechanisms.

Unit 4
Machine tool structures-beds, columns, tables and supports, stock feed mechanism, Measurement and control of machine tools, protective and safety devices, design of precision machine tools.

Unit 5
Micro-feeding mechanisms, concept of modular design and integration of SPM`s, Concepts of aesthetic and ergonomics applied to machine tools.

Unit 6
Acceptance tests standardization of machine tools, machine tool conditioning, latest trends in machine tool design, Introduction to CAD techniques.

Texts/References:

1. N. K.Mehta , Machine tool design, Tata Mcgraw-hill, New Delhi, 1989.
2. N.Acherkan, Machine tool design, Vol. 3 and 4, Mir publisher, Moscow, 1968.
3. A.Koenigsburger, Design principles of metal cutting machine tools, Pergamon press, 1964.
4. C.M.T.I. Machine tool design course notes, C.M.T.I. Bangalore.
5. G.Sen andA.Bhattacharya , Principles of machine tools, Vol. 2, NCB, Calcutta, 1973.

Semester-I

Computer-Integrated Manufacturing

MCADM15D	Computer-Integrated Manufacturing	Elective II	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

UNIT 1

INTRODUCTION: Fixed, Programmable and Flexible Automation, Classification of automated manufacturing systems based on product variety & production volume. Evolution of CIM, Segments of CIM - Computer aided Design, Computer Aided Manufacturing, Computer controlled business functions. Overview of CIM software.

UNIT 2

INTRODUCTION TO GROUP TECHNOLOGY: Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT, Part families , classification and coding, Machine cell design, PFA.

UNIT 3

INTRODUCTION TO FLEXIBLE MANUFACTURING SYSTEMS: Subsystems of FMS, Types of FMS layouts. Introduction to Automated inspection devices: Coordinate Measuring Machine (CMM), Inspection probes etc. Automated storage & retrieval systems.

UNIT 4

MANUFACTURING PROCESS PLANNING: Automated process planning: Retrieval & Generative Expert process planning, Introduction to process planning softwares. Manufacturing Production Planning: Aggregate Production planning, Master production schedule, Materials requirement planning, Capacity requirement planning, JIT Production system.

UNIT 5

MANUFACTURING SYSTEM CONTROL: Computerized statistical process control, Shop floor control, Shop floor data collection techniques, CAQC, Bill of materials. Business functions: Purchase orders receiving, Inventory management, financial control, Job costing, Sales & Marking applications.

Texts/References:

1. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall publication 1997.
2. P. Radhakrishnan, "CAD, CAM, CIM", New Age International Pvt. Ltd.
3. David Bedworth, Etal, "Computer Integrated Design and Manufacturing, McGraw Hill Book Co., 1991.
4. Mikell P. Groover and Zimmers E.W, "Computer Aided Design and Manufacturing", Prentice Hall Publication.

Semester-I

Enterprise Resource Planning

MCADM15E	Enterprise Resource Planning	Elective II	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

INTRODUCTION TO ERP: Introduction, Evolution of ERP, Reasons for growth of ERP, Advantages / disadvantages of ERP, Evaluation of ERP, Various Modules in ERP

UNIT 2

MODULES IN ERP: Finance and Controlling, Sales and Distribution, Materials Management, Production Planning and Control, Quality Management, Planet Maintenance, Human Resource

UNIT 3

BUSINESS PROCESSES: Order To Cash, Procure To Pay, Plan To Produce, Make To Stock, Make To Order and Assemble To Order, Difference in Discrete and Process industries Manufacturing Process Knowledge: Auto Industry, Hi Tech, FMCG, Pharma and Chemical

UNIT 4

ERP PROJECTS: Project types, Implementation methodology, Various steps in the project Implementation, Project Preparation, Business Blueprinting, As Is – To Be Study, Gap Analysis, Realization, Final Preparation, Go Live and Support, User Training, Issues during implementation

UNIT 5

ERP AND RELATED TECHNOLOGIES: Business Process Re – engineering, MIS, Executive Information System, Decision Support System ERP Market: ERP packages like SAP, BAAN, Oracle Apps, JD Edwards, Comparison Study, Evaluation and Selection

UNIT 6

FUTURE DIRECTIONS IN ERP: Current trends in ERP, Changes in the ERP Implementations, Faster implementation methodologies, Web enabling Integration of ERP with SCM, SRM, CRM and PLM, system architecture, landscape and licensing

Texts/References:

1. Alexis Leon, Enterprise Resource Planning
2. V.K. Garg & N.K. Venkitakrishnan, ERP Ware: ERP Implementation framework
3. V.K. Garg & N.K. Venkitakrishnan, ERP Concepts and Planning
4. APIC's material on ER

Semester-I
Reliability Engineering

MCADM15F	Reliability Engineering	Elective II	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

MODELING OF LIFE DISTRIBUTION FUNCTIONS: Quantification of reliability. Parameters of reliability: hazard rate and MTTF (for non-repairable items), failure rate and MTBF (for repairable items). Common failure patterns of systems and components; the bathtub curve for instantaneous failure rates. The memory less property of items with a constant failure rate. Two- and three-parameter Weibull models.

UNIT 2

FAILURE MECHANISMS: Stress-strength interference as a cause of failure. Approaches to minimize the chance of interference: safety margin, improving process capability, screening of items, and curtailment of load distribution.

UNIT 3

MODELLING OF SYSTEM RELIABILITY: Reliability block diagrams. Series and parallel configurations; use of the Bayesian approach. Use of redundancy to improve reliability. Active and standby redundancies.

UNIT 4

RELIABILITY DESIGN: Reliability programs. Reliability prediction in the preliminary design stage; the component count approach. Use of the component manufacturer‘s data and computer packages for reliability prediction. Simplification, derating, and use of redundancy. Fault tree analysis; failure modes, effects, and criticality analysis; development testing; failure reporting and corrective action systems; reliability growth models.

UNIT 5

ANALYSIS OF LIFE DATA: Non-parametric estimation of reliability functions. Parametric analysis of life data – probability plots of ungrouped and grouped data. Weibull analysis: parameter estimation, censored data, confidence limits, and Bq life. Hazard plots.

UNIT 6

RELIABILITY TESTING: Reliability validation tests, MIL-STD-781: the OC curve, discrimination ratio, producer‘s and consumer‘s risks. Failure truncation, time truncation, PRST. Confidence intervals for MTBF. Sudden death tests. Environmental testing. Accelerated tests.

Texts/References

1. Andrew K.S. Jardine and Albert H.C. Tsang, 2013, Maintenance, Replacement and Reliability: Theory and Applications, 2nd edition, CRC Press
2. O‘Connor, D.T., 2002, Practical Reliability Engineering, 4th edn, Wiley
3. Elsayed, Elsayed A, 2012, Reliability Engineering, 2nd edition, John Wiley

Semester-I

COMPUTER-INTEGRATED MANUFACTURING

MCADM15G	Computer-Integrated Manufacturing	Elective II	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

UNIT 1

INTRODUCTION: Fixed, Programmable and Flexible Automation, Classification of automated manufacturing systems based on product variety & production volume. Evolution of CIM, Segments of CIM - Computer aided Design, Computer Aided Manufacturing, Computer controlled business functions. Overview of CIM software.

UNIT 2

INTRODUCTION TO GROUP TECHNOLOGY: Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT, Part families , classification and coding, Machine cell design, PFA.

UNIT 3

INTRODUCTION TO FLEXIBLE MANUFACTURING SYSTEMS: Subsystems of FMS, Types of FMS layouts. Introduction to Automated inspection devices: Coordinate Measuring Machine (CMM), Inspection probes etc. Automated storage & retrieval systems.

UNIT 4

MANUFACTURING PROCESS PLANNING: Automated process planning: Retrieval & Generative Expert process planning, Introduction to process planning softwares. Manufacturing Production Planning: Aggregate Production planning, Master production schedule, Materials requirement planning, Capacity requirement planning, JIT Production system.

UNIT 5

MANUFACTURING SYSTEM CONTROL: Computerized statistical process control, Shop floor control, Shop floor data collection techniques, CAQC, Bill of materials. Business functions: Purchase orders receiving, Inventory management, financial control, Job costing, Sales & Marking applications.

Texts/References:

1. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall publication 1997.

2. P. Radhakrishnan, "CAD, CAM, CIM", New Age International Pvt. Ltd. **3.** David Bedworth, Etal, "Computer Integrated Design and Manufacturing, McGraw Hill Book Co., 1991.

4. Mikell P. Groover and Zimmers E.W, "Computer Aided Design and Manufacturing", Prentice Hall Publication.

Semester-I
Communication Skills

BHS16	Communication Skills	HSSC	2-0-0	2 Credits

Examination Scheme:

Theory

Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Students are found to be confident while using English
CO2	Engage in analysis of speeches or discourses and several articles
CO3	Identify and control anxiety while delivering speech
CO4	Write appropriate communications (Academic/Business)
CO5	Prepared to take the examinations like GRE/TOFEL/IELTS
CO6	Identify and control the tone while speaking
CO7	Develop the ability to plan and deliver the well-argued presentations

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1		2		2	1			2	3
CO2	2						1	2		1	2	3
CO3					1		1	2			2	3
CO4	2		1		1		3	1	2	1	2	3
CO5	1											1
CO6					2		2	2			2	3
CO7			2	1	2	2	3	3	1	1	3	3

Course Contents:

UNIT 1:
COMMUNICATION AND COMMUNICATION PROCESSES: Introduction to Communication, Forms and functions of Communication, Barriers to Communication and overcoming them, Verbal and Non-verbal Communication, Ways of Effective Communication.

UNIT 2:
ORAL COMMUNICATION: Use of Language in Spoken Communication, Features of Good Communication, Principles and Practice of Group Discussion, Public Speaking (Addressing Small Groups and Making Presentation), Interview Techniques, Appropriate Use of Non-verbal Communication, Presentation Skills, Telephonic Etiquettes, Extempore, Elocution, Describing Experiences and Events.

UNIT 3:
STUDY OF SOUNDS IN ENGLISH: Introduction to phonetics, Study of Speech Organs, Study of Phonemic Script, Articulation of Different Sounds in English, Stress Mark.

UNIT 4:
ENGLISH GRAMMAR: Grammar: Forms of Tenses, Articles, Prepositions, Use of Auxiliaries and Modal Auxiliaries, Synonyms and Antonyms, Common Errors, Sentence Formation and Sentence Structures, Use of Appropriate Diction.

UNIT 5:
WRITING SKILLS: Features of Good Language, Difference between Technical Style and Literary Style, Writing Emails, Formal and Informal English, Business Writing, Advertisements, Essay Writing, (Technical, Social, and Cultural Topics), Technical Reports: Report Writing: Format, Structure and Types, Writing Memorandum, Circulars, Notices, Agenda and Minutes, Technical Manuals, Brochures
Letter Writing: Types, Parts, Layouts, Letters and Applications, Use of Different Expressions and Style, Writing Job Application Letter and Resume.

UNIT 6:
READING SKILLS & LISTENING SKILLS:
READING**:** Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning, Fast Reading, Strategies for Reading, Comprehension.
LISTENING**:** Importance of Listening, Types of Listening, Barriers to Listening.

Texts/Reference:

1. Mohd. Ashraf Rizvi, Communications Skills for Engineers, Tata McGraw Hill
2. Sanjay Kumar, Pushp Lata, Communication Skills, Oxford University Press, 2016
3. Meenakshi Raman, Sangeeta Sharma, Communication Skills, Oxford University Press, 2017
4. Teri Kwal Gamble, Michael Gamble, Communication Works, Tata McGraw Hill Education, 2010

Semester I

Design Lab

MCADM17	Design Lab	PCC	0-0-3	2 Credits

Examination Scheme:

Practical

Internal Assessment: 25 Marks	External Exam: 25 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Note: Minimum 10 experiments to be performed

1. Design of mechatronic system for mechanical application
2. Demonstration of process control such as temp, level, flow, etc control using PID controller
3. Static analysis of any mechanical component using ANSYS, LSDyna etc. software
4. Dynamic anlysis of any mechanical component
5. Design and modelling of mechanical component using commercial software
6. Stress Analysis of composite shaft

7. Optimization techniques using MATLAB
8. Cutting force determination using force dynamometer in CNC Milling operation
9. Cutting force determination using force dynamometer in CNC Turning operation
10. Experimental study in micromachining using photo chemical machining
11. Study of EDM/Wire EDM for metal machining.
12. Metal casting simulation using PROCAST.
13. Sequencing of cylinders using pneumatic trainer kit.
14. Modeling of component and determination of mass properties.
15. Inspection of an engineering component using CMM.
16. Simulation of robot.

Semester-II

Finite Element Methods

MDE21	Finite Element Methods	PCC	3-1-0	4 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand the basics principle of FE method
CO2	Identify mathematical model for solution of common problems
CO3	Solve structural, thermal problem using FE in 1D Case
CO4	Derive element stiffness matrix by different methods
CO5	Understand the formulation for 2D and 3D case
CO6	Recognize need for and engage in lifelong learning

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2	3	3	1		1							1
CO3	2	2	1	2	2				2			1
CO4	3								2			
CO5	3	2										
CO6			1									3

Course Contents:

Unit 1

1-D PROBLEMS: Introduction to structural analysis and FEM, Introduction to approximate solutions and FEM, summary of linear elastic mechanics.

Unit 2

1-D PROBLEMS: Principles of linear elastic mechanics, principles of virtual displacements and minimum potential energy, Rayleigh Ritz method, exact v/s approximate solution, beam elements.

Unit 3

2-D PROBLEMS: Plane stress and plane strain conditions, triangular elements, constant strain triangle, linear strain triangle, Boundary conditions, body forces and stress recovery, quadrilateral elements.

Unit 4

2-D PROBLEMS: Lagrange and Serendipity shape functions, isoparametric formulation, numerical integration, modeling with isoparametric elements, requirements for convergence, patch test, nonconforming elements, reduced integration.

Unit 5

3-D PROBLEMS: Axisymmetric solids, governing equations, axisymmetric elements and their applications, mixed formulations, bending of flat plates (Kirchhoff Theory), continuity requirements and boundary conditions.

Unit 6

3-D PROBLEMS: Discrete Kirchhoff's elements, thick plate elements, plate bending applications, shells as assemblage of flat plates, finite element formulation for dynamic problems, mass properties, introduction to elastic stability for frames and plates.

Texts / References:

1. R. D. Cook, Concepts and Applications of Finite Element Analysis, John Wiley and Sons, second edition, 1981.
2. C.S. Krishnamurti, Finite element method, Tata Mc-Graw Hill Publication.
3. K.J. Bathe, Finite Element Method and Procedures, Prentice hall, 1996.
4. Tirupathi, R., and Chandrupatla,Finite Elements in Engineering, PHI Publication, New Delhi.
5. Bruce Irons and SoharabAhmed,Techniques of Finite Elements, John Wiley and Sons, New York.
6. K.J. Bathe, Finite Element Method, Prentice Hall, 1987.
7. O.P., Gupta, Finite and Boundary Element Methods in Engineering, Oxford and IBH.

Semester-II
Robotics

MCADM22	Robotics	PCC	3-1-0	4 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Study the manipulators and its kinematics.
CO2	Classify the actuators and study their characteristics.
CO3	Understand the motions of robots and its control.
CO4	Determination of the solution to inverse kinematics and trajectory planning in robot movements.
CO5	Acquire the knowledge of sensors used in robots.
CO6	Write a program for robot motion and control.

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2			1								
CO2	2			1								1
CO3	2			1								
CO4	2			1						2		
CO5	2			1								1
CO6	2			1								

Course Contents:

UNIT 1
INTRODUCTION: Review, forward and inverse kinematics, dynamics, Robots with Flexible Elements: Robots with Flexible Joints, Robots with Flexible Links

UNIT 2

PARALLEL MECHANISMS AND ROBOTS: Definitions, Type of Synthesis of Parallel Mechanisms, Kinematics, Velocity and Accuracy Analysis, Singularity Analysis, Workspace Analysis, Static Analysis and Static Balancing, Dynamic Analysis, Design

UNIT 3

MOBILE ROBOTS: Wheeled mobile robots: mobile robot kinematics, Mobility of Wheeled Robots, State-Space Models of Wheeled Mobile Robots, Wheeled Robot Structures, sensors for mobile robots, planning and navigation Legged robots: Analysis of Cyclic Walking, Control of Biped Robots Using Forward Dynamics, Biped Robots in the ZMP Scheme, Multilegged Robots, Performance Indices

UNIT 4

COOPERATIVE MANIPULATORS: Kinematics and Statics, Cooperative Task Space, Dynamics and Load Distribution, Task-Space Analysis,

UNIT 5

CONTROL OF MANIPULATORS: Manipulator control problem; Linear and nonlinear control schemes; PID control scheme; Force control.

UNIT 6

IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS: Acquisition of images, digital images, image processing techniques, noise reduction, edge detection, image analysis, object recognition by features, application of vision systems

Texts / References:

1. K. S. Fu, R. C. Gonzalez, C. S. G. Lee, Robotics, McGraw Hill New york, 1987.
2. Y. Koren, Robotics for Engineers, McGraw Hill, 1985.
3. J. J. Craig, Robotics, Addison-Wesley, 1986.

Semester-II
Customization of CAD/CAM Software

MCADM23A	Customization of CAD/CAM Software	Elective III	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

INTRODUCTION TO CUSTOMIZATION: Customization, Application Programming Interface (API), macros, scripts

UNIT 2

TOOLS FOR CUSTOMIZATION**:** Object Oriented Programming (OOP), OLE interfaces in CAD/CAM software; Use of General programming interfaces like VB, VBS, VC++, OpenGL programming and System dependent programming interfaces like Visual LISP (AutoCAD), GRIP (Unigraphics), Pro-Programming (Pro/Engineer)

UNIT 3

COMPUTER-BASED SYSTEM ENGINEERING: System Engineering process, Software product development life cycle, software processes, software development project management, software prototyping.

UNIT 4

RAPID DEVELOPMENT: Core issues in rapid development, rapid development languages, lifecycle planning and customer oriented development.

UNIT 5

SOLID MODELING ALGORITHMS: Euler operations, basic solid modeling algorithms

UNIT 6

AUTOMATED SOLID MODELING USING CUSTOMIZATION: Creating 2D, 3D and solid entities through API, Editing 2D, 3D and solid entities through API, Design and development of user interfaces - icons, menus, dialog boxes, Integrating databases with CAD; creating BOM or part lists, Automated Assembly modelling through customization, Automated drafting and dimensioning using customization, Creating Automated Animations using API and animation software.

Texts/References:

1. Rapid development; Steve McConnel, Microsoft Press
2. Software Engineering; Ian Sommerville, Pearson Education
3. Computer graphics; Foley, van Dam, et al, Pearson Education
4. OpenGL Programming guide; Mason Woo, et al;
5. Advanced AutoCAD; George Omura
6. Customizing AutoCAD; Sham Tickoo, Thomson learning
7. Solid Modeling; Martti Mantilya; Computer Science Press
8. Solid Works API using VB and C++; Custom Programming Unlimited LLC
9. GRIP programming manuals for Unigraphics (Vol. 1 and 2)
10. User Function Programming manuals for Unigraphics (Vol. 1, 2, 3)

Semester-II
Computational Fluid Dynamics

MTE23B	Computational Fluid Dynamics	Elective-III	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Course Objectives:

1. To Understand the concept of fluid dynamics, CFD techniques, convergence criteria
2. To familiarize the students about the implementation of CFD in fluid mechanics and heat transfer problems
3. To understand the use of software based on CFD

Course Outcomes:

At the end of the course, student will be able to:

CO1	Identify applications of finite volume and finite element methods to solve Navier-Stokes equations.
CO2	Evaluate solution of aerodynamic flows. Appraise & compare current CFD software. Simplify flow problems and solve them exactly.
CO3	Design and setup flow problem properly within CFD context, performing solid using CAD package and producing grids via meshing tool.
CO4	Interpret both flow physics and mathematical properties of governing Navier-Stokes equations and define proper boundary conditions for solution.
CO5	Use CFD software to model relevant engineering flow problems. Analyse the CFD results. Compare with available data, and discuss the findings.

Mapping of COs with POs:

POs → Cos↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2	1		2	3	1	1						
CO3	2	1	1	2	1		1					
CO4	1			1	1	1						
CO5			2	2	2	1				2		1

Course Contents

UNIT I
Introduction to CFD

Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations

UNIT II
Governing Equations
Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.

UNIT III
Finite Volume Method
Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach.

UNIT IV
Geometry Modeling and Grid Generation
Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance.

UNIT V
Methodology of CFDHT
Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation.

UNIT VI
Solution of Navier-Stokes Equations for Incompressible Flows
Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non Staggered Grid System of N-S Equations for Incompressible Flows.

Reference Books:

1. J. D. Anderson, Computational Fluid Dynamics-The Basics with Applications, Mcgraw Hill.
2. An Introduction to Computational Fluid Flow: The Finite Volume Method, by H.K. Versteeg and W. Malalasekera, Prentice Hall
3. Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication
4. Muralidhar K. and Sundararajan T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi1995.
5. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, T & F.
6. An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.

Semester-II

Flexible Manufacturing Systems

MCADM23C	Flexible Manufacturing Systems	Elective III	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks

End Term: 60 Marks	

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Detailed Syllabus:

Unit I: Introduction
FMS definition and classification of manufacturing systems, automated production cycle, Need of flexibility, Concept of flexibility, Types of flexibilities and its measurement.

Unit II: Economic Analysis
Why FMS, Factors responsible for the growth of FMS, FMS types and applications, Economic justification for FMS.

Unit III: FMS Equipment
Functional requirements for FMS equipments, FMS processing and QA equipment, e.g., turning and machining centers, Co-ordinate measuring machines, Cleaning and deburring machines, FMS system support equipment, Automated material handling and storage equipment, cutting tool and tool management, Work holding considerations, Fixture considerations in FMS environment.

Unit IV: Group Technology
GT concepts, Advantages of GT, Part family formation-coding and classification systems; Part-machine group analysis, Methods for cell formation, Use of different algorithms, mathematical programming and graph theoretic model approach for part grouping, Cellular Vs FMS production.

Unit V: Plant layout, FMS and GT layouts

FMS design problems: Part assignment, Machine selection, Storage system selection, Selection of pallets and fixtures, Selection of computer hardware and software, designing for layout integration of machine storage, Material handling System and computer system,

Unit VI: Communication networks

FMS planning problems: Strategic planning, Part type selection, Machine grouping, production ratio and resource allocation, Machine loading problems. Operational & Control problems: Part scheduling, Machines robots & AGVS, Process monitoring & control. FMS Implementation: Objectives, acceptance testing, Performance goals and expectation maintenance concerns.

Books:

1. Automation, Production System & Computer Integrated Manufacturing Groover Englewood
2. Design and Operation of SMS Rankey IFS
3. Flexible Manufacturing System Wernecks Spring-Verlag
4. FMS in Practice Bonctto Northox Ford
5. Flexible Manufacturing Cells and systems W.W. Luggen Prentice Hall India
6. Performance Modelling of Automated Manufacturing Vishwanathan & NaraharPrentice Hall India.

Semester-II
Design for 'X'

MCADM23B	Design for 'X'	Elective III	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution 2- Means medium contribution 3- Maximum contribution

Course Contents:

UNIT 1

INTRODUCTION: Need, evolution, fundamentals and usages of DFX, Performance characteristics and tool kits for DFX, Development and Implementation of DFX tools.

UNIT 2

DESIGN FOR MANUFACTURING, ASSEMBLY AND DISASSEMBLY: Principles, approaches, Product and component DFMA, the B & d Experience, Evaluations for DFMA.

UNIT 3

DESIGN FOR ASSORTED TECHNICAL REQUIREMENTS/PROCESSES: Material storage and distribution, Dimensional control, Heat treatment, Coating, Casting, Plastic processes like wise.

UNIT 4

DESIGN FOR LIFE CYCLE: Approaches to product development, Inspectability, Serviceability. Design for Reliability, Quality: Approaches, QFD, Evaluations and Procedures.

UNIT 5

DESIGN FOR COMPETITIVENESS: Modularity, Technical Merit, Optimization of Product Life cycle and allied.

Texts/References:

1. Design for X: Concurrent engineering approach, Edited by G. H. Haung, Chapman & Hall, 1996.

2. Industrial assembly, S. Y. Nof. W. E. Wihelm and H. J. Warnecke, Chapman & Hall, 1996
3. Assembly automation and product design, Geoffrey Boothroyd, Marcel Dekker, Inc,
4. Design for manufacturing: a structured approach, Corrado Poli, Butterworth Heinemann
5. Process section from Design to Manufacturing, Swift and Booker, Butterworth Heinemann
6. Design for Manufacturability Handbook, James Barilla, Mc Graw Hill
7. Design for manufacturing and concurrent engineering, David M. Anderson, CIM press, V 2004

Semester II
Mechatronics

ME-XX24A	Mechatronics	Elective IV	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define sensor, transducer and understand the applications of different sensors and transducers
CO2	Explain the signal conditioning and data representation techniques
CO3	Design pneumatic and hydraulic circuits for a given application
CO4	Write a PLC program using Ladder logic for a given application
CO5	Understand applications of microprocessor and micro controller
CO6	Analyze PI, PD and PID controllers for a given application

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	3	2				2	1		1

CO2	3	2			3	3	2				1	3
CO3	1	1		3	3	2	1		3		1	3
CO4	3	3	1	1	3		1	1	1			
CO5	3			1	3	2	3					2
CO6		3	3		3	3	1	1	3			2

Course Contents:

Unit 1

Introduction to Mechatronic systems, elements, advantages and practical examples of Mechatronic systems.

Sensors and Transducers:

Various types of sensors and transducers used in Mechatronic system such as pressure sensors, temperature sensors, velocity sensors, Acceleration sensors, proximity sensors, position sensors, force sensors, Optical encoders, Capacitive level sensor, tactile sensors, Selection of sensors.

Unit 2

Signal Conditioning and Data Representation: Types of electronic signals, need for signal processing, Operational amplifiers: Types, classification and applications, Opto-isolators, Protection devices, Analogue to Digital and Digital to Analog Converters, Interfacing devices, Electro-magnetic Relays, Data representation systems, Displays, seven segment displays, LCD displays, Printers, Data loggers, Data Acquisition Cards/Systems

Unit 3

Electrical Drives: Types of Electrical Motors, AC and DC motors, DC servomotors, Stepper motors, linear motors, etc.

Pneumatics and Hydraulics

Components of Pneumatic systems, actuators, direction control valves, pneumatic air preparation, FRL unit, methods of actuation of valves, Sequencing of Pneumatic cylinders using Cascade and shift register methods. Electro-pneumatic valves, Electro- pneumatic circuits using single and double solenoid methods. Hydraulic cylinders, design of cylinder, Design of Piston and piston rod, Valves, poppet valve, house pipes and design of tubing, Meter-in and Meter-out circuits.

Unit 4

Microprocessor and Microcontroller

8085 microprocessor, architecture, various types of registers and their functions in 8085μP, Instruction sets, interfacing, applications.8081 microcontroller, architecture, Instruction sets, various pins and their functions interfacing, applications.

Programmable Logic Controller

Introduction, Architecture, Types of inputs/outputs, Specifications, guidelines for Selection of PLCs, Programming: Ladder logic and FBD

Unit 5

Control Systems

Open and closed loop system; block diagram manipulation/reduction, Transfer function, modeling of Mechanical Systems using spring, Dashpot and Masse quivalence.

Unit 6

Stability of Systems

On/Off controller, Proportional Control, Integral control, Derivative Control; PI, PD and PID Controllers, Introduction to control using state variable system models, Bode Plots and stability criteria.

Texts / References:

1. HMT Limited, Mechatronics, Tata McGraw-Hill, 1998.
2. Bolton, W., Mechatronics; Electronic Control Systemin Mechanical Engineering, PearsonEducationAsia,1999.
3. Raven, Automatic Control Engineering, McGraw Hill, NewYork,1986

Semester-II
Design for Mechanisms and Manipulators

MCADM24B	Design for Mechanisms and Manipulators	Elective IV	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites: None

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit I: Kinematics
Mobility analysis, Degree of Freedom (DOF), Mixed Mobility, Total, Partial and Fractional DOF, Closed and Open Chain Systems, Application of D-H representation for 1) Kinematic parameter tables for standard robot structures.

Unit II: Link coordinate diagram and arm matrix
Link coordinate diagram and arm matrix of SCARA, Alpha II, PUMA articulated robot, standard robot, polar frame, structure robot, Enter transform solution, Arm matrix of standard Robots, Polar frame, structure robots

Unit III: Structural Analysis and Synthesis of mechanisms
Structural Analysis and Synthesis of mechanisms, Alternative design solutions; Coding, evaluation and selection of optimum mechanism. Type synthesis, number synthesis and design of mechanisms. Indexes of merit; Graphical, Algebraic and Optimization techniques, Matrix methods of design and analysis; Design of function, Path and Motion Generators; Structural and Mechanical error; Design and Analysis using software.

Unit IV: Manipulators
Classifications, actuation and transmission systems; Coordinate Transformation – DH notations, Inverse and Forward kinematics, Manipulator dynamics from Lagrangian and Newtonian point of view.

Unit V: Dynamic Analysis of manipulator
Forces in Manipulator, manipulate Dynamics, selecting of robots for Robot Application Reliability of Robotic & Automation systems and their evaluation.

Unit VI: Gripper Design
Linkage activated grippers: kinematic and dynamic design, other principles of gripping like, magnetic grippers, adhesive grippers, internally expanding grippers, mandrels, etc. their static and dynamic analysis.

Text Books / References:

1. Andeen, G.B., “Robort Design Hand Book”, SRI International, McGraw Hill,
2. Craig, J.J., “Introduction to Robotics”, Mechanics and Control, Addison Wesley
3. Spong, M., and Vidyasagar, M. “Robot Dynamics and Control”, John Wiley, NY, 1989.

4. Venkataraman. S.T., and liberall. T., “Dextrous Robot Hands”, S
5. AppuKuttan, “Robotics”, I.K. International Publishing house

Semester-II
Metrology and Computer Aided Inspection

MME24C	Metrology and Computer Aided Inspection	Elective IV	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Explain high precision measurement requirements of industry and select instruments for high precision.
CO2	Using various measuring standards and instruments for different applications.
CO3	Calibrate basic metrology instruments used in machine shop, and Identify techniques to minimize the errors in measurement.
CO4	Employing limits and design gauges
CO5	Explain the different instruments used for linear and angular measurements, surface finish and form features of a component
CO6	Identify the advanced measurement principles with ease and operate sophisticated measurement machines.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1			2	2						1
CO2	2	1	3	1	1	1						
CO3	2	2		3								2
CO4	2	2	2		3							2
CO5		1	1		1							1
CO6						3						2

Course Contents:

Unit I

Metrological concepts, Abbe's principle, need for high precision measurements, problems associated with high precision measurements.

Unit II

Standards for length measurement, shop floor standards and their calibration, light interference, method of coincidence.

Unit III

Slip gauge calibration, measurement errors, various tolerances, and their specifications, gauging principles.

Unit IV

Selective assembly, comparators, angular measurements, principles and instruments, gear and thread measurements.

Unit V

Surface and form metrology, computer aided metrology, principles and interfacing, software metrology, laser metrology, CMM, types, probes used applications.

Unit VI

Non-contact CMM using electro-optical sensors for dimensional metrology, non-contact sensors for surface finish measurements, image processing and its applications in metrology.

Texts / References:

1. D.J.Whitehouse, *Handbook of Surface Metrology*, Inst. of Physics Bristol and Philadelphia, 1994.
2. R.K.Jain, *Engineering Metrology*, Khanna Publishers, 2000.
3. Galleyer and Shotbolt, *Metrology for Engineers*, ELBS, 1998

Semester-II
Research Methodology

MOE25A	Research Methodology	OEC	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Course Outcomes: At the end of the course, student should be able to

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

PO's → CO's ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution, 2- Means medium contribution, 3- Maximum contribution

Course Contents:

Unit 1

Research Concepts – concepts – meaning – objectives – motivation. Types of research – descriptive research – conceptual research – theoretical research – applied research – experimental research.

Unit 2

Research process – Criteria for good research – Problems encountered by Indian researchers. Formulation of Research Task – Literature Review – Importance & Methods – Sources – Quantification of Cause Effect Relations – Discussions– Field Study – Critical Analysis of Facts Generated

Unit 3

Hypothetical proposals for future development and testing, selection of Research task.

Unit 4

Mathematical modelling and simulation – Concepts of modelling – Classification of mathematical models – Modelling with – Ordinary differential equations – Difference equations – Partial differential equations – Graphs – Simulation – Process of formulation of model based on simulation.

Unit 5

Interpretation and report writing – Techniques of interpretation – Precautions in interpretation – Significance of report writing – Different steps in report writing – Layout of research report – Mechanics of writing research report – Layout and format – Style of writing – Typing – References – Tables – Figures – Conclusion – Appendices.

Texts/References

1. J.W Bames, Statistical Analysis for Engineers and Scientists, McGraw Hill, N.York
2. Schank Fr., Theories of Engineering Experiments, Tata McGraw Hill Publication.
3. C. R. Kothari, Research Methodology, New Age Publishers.
4. Willktnsion K. L, Bhandarkar P. L, Formulation of Hypothesis, Himalaya Publication.

Semester-II
Design of Experiments

MOE25B	Design of Experiments	OEC	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites: None

Course Outcomes: At the end of the course the student will be able to:

CO1	Define Taguchi, factorial experiments, variability, orthogonal array, quality loss.
CO2	Plan and design the experimental investigations efficiently and effectively.
CO3	Understand strategy in planning and conducting experiments.
CO4	Evaluate variability in the experimental data using ANOVA.
CO5	Practice statistical software to achieve robust design of experiments.

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1		1	1	1	1	1		1	1	1
CO2	3	2	1	3	2	1	2	1	1	2	1	1
CO3	3	2	1	3	2	1	2	1	1	2	1	1
CO4	3	3	1	3	2	1	2	1	1	2	1	1
CO5	2	3	1	2	3	2	2	1	1	2	1	1

Course Contents:

Unit 1

Introduction: Modern quality control, quality in engineering design, history of quality engineering.

The Taguchi Approach to quality: Definition of quality, loss function, off-line and on-line quality control, Taguchi`s quality philosophy.

Unit 2

Full Factorial Designs: Experimentation as learning process, traditional scientific experiments, three factor design, replicating experiments, factor interactions, normal plots of

estimated effects, mechanical plating experiments, two factor design, four factor design, Taguchi design and western design.

Unit 3

Fractional Factorial Design: Fractional factorial design based on eight run experiments, folding over an eight run experimental design, Fractional factorial design in sixteen run, folding over an sixteen run experimental design, blocking two level designs, other two level designs.

Unit 4

Evaluating Variability: Necessity to analyze variability, measures of variability, the normal distribution, using two level designs to minimize variability, signal-to-noise ratio, minimizing variability and optimizing averages.

Taguchi Inner and Arrays: Noise factors, experimental designs for control and noise factors, examples.

Unit 5

Experimental Design for Factors at Three and Four level: Necessity to use more than two level, factors at four levels, factors at three levels. Analysis of Variance in Engineering Design: Hypothesis testing concepts, using estimated effects as test statistics, analysis of variance for two level designs, when to use analysis of variance.

Unit 6

Computer Software for Experimental Design: Role of computer software in experimental design, summery of statistical packages, example of use of software packages. Using Experiments to improve Processes: Engineering design and quality improvement, steps to implementing use of engineering design.

Texts/References:

1. D.C. Montgomery, Design and Analysis of Experiments, 5th Edition, John Wiley and Sons, NewYork, 2004.
2. R.H. Lochner and J.E. Matar, Designing for Quality: An Introduction to the Best of Taguchi and Western Methods of Statistical Experimental Design, Chapman and Hall, London, 1983.

Semester-II
Advanced Optimization Techniques

MOE25C	Advanced Optimization Techniques	OEC	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Prerequisite: None
Course Outcomes: At the end of the course the student will be able to:

CO1	Enables to acquire mathematical methods and apply in engineering disciplines.
CO2	Apply methods of optimization to solve a linear, non-linear programming problem by various methods
CO3	Optimize engineering problem of nonlinear-programming with/without constraints, by using this techniques
CO4	Use of dynamic programming problem in controlling in industrial managements.
CO5	Simulate Thermal engineering system problem. Understand integer programming and stochastic programming to evaluate advanced optimization techniques.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1						1		1		1
CO2	2	1	1					1				
CO3		2							1			
CO4	1				2	1				2		1
CO5			1	2	1	1	2		1	2		1

Course Contents:

Unit 1
SINGLE VARIABLE NON-LINEAR UNCONSTRAINED OPTIMITION: One dimensional Optimization methods, Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods- quadratic & cubic interpolation methods.

Unit 2
MULTI VARIABLE NON-LINEAR UNCONSTRAINED OPTIMIZATION: Direct search method –Univariant Method – pattern search methods – Powell's – Hook – Jeeves, Rosenbrock search methods – gradient methods, gradient of function, steepest decent method, Fletcher reeves method.
Variable metric method.

Unit 3

GEOMETRIC PROGRAMMING: Polynomials – arithmetic – geometric inequality – unconstrained G.P– constrained G.P

DYNAMIC PROGRAMMING: Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

Unit 4

LINEAR PROGRAMMING: Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints.

Simulation: Introduction – Types – Steps – application – inventory – queuing – thermal system.

Unit 5

INTEGER PROGRAMMING: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.

STOCHASTIC PROGRAMMING: Basic concepts of probability theory, random variables Distributions – mean, variance, Correlation, co variance, joint probability distribution stochastic linear, dynamic programming.

TEXTS/REFERENCES:

1. Optimization theory & Applications/ S.S Rao/ New Age International
2. Introductory to operation research/Kasan & Kumar/Springar
3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ Narosa Publications.
4. Operation Research/H.A. Taha/TMH
5. Optimization in operations research/R.L Rardin
6. Optimization Techniques/Benugundu & Chandraputla/Person Asia
7. Optimization Techniques /Benugundu & Chandraputla / Pearson Asia

Semester-II
Environmental Engineering and Pollution Control

MOE25D	Environmental Engineering and Pollution Control	OEC	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Course Objectives:

1. To Understand the need of pollution control, its impact, control
2. To familiarize the students about the pollution control techniques
3. To carry out the real life problem

Course Outcomes:
At the end of the program the student will be able to:

CO1	Identify effects of industrialization on environmental pollution in various field.
CO2	Describe photochemical smog, acid Rain, Greenhouse effect, ozone depletion, global warming.
CO3	Suggest pollution control techniques for vehicles, refrigeration, industries, chemical and power plant.
CO4	Do Case study on any industry and analyze carbon exertion rate, water pollution, soil pollution etc.
CO5	Design pollution control devices for vehicle, analyze and find out replacement CFC refrigerant with HC refrigerant.

Mapping of COs with POs:

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2										
CO2	2											1
CO3				1			2	1				1
CO4	2					2			1			
CO5						1						2

Course Content
Unit I

Impact of industrialization and modernization - pollution and pollutants. Air pollution and its effects - air pollution - sources - pollutants – organic and inorganic pollutants - gaseous pollutants– nitrogen oxides - particulate pollutants - effect of pollutants on plants – animals and human beings.

Unit II

photochemical oxidants - photochemical smog – acid Rain - Green house effect - ozone depletion - global warming -Environmental pollution techniques for air pollution - monitoring and Control measures of air pollution - dust control equipment - Electrostatic precipitators and scrubbers.

Unit III

Water pollution and its effects structure - water pollution - sources -Pollutants - industrial effluents - domestic wastes - agrochemicals -Heavy metals - effect of pollutants on plants - animals and human beings Bod - eutrophication - waste water treatment - indicator orgnisms -Oxidation pond - water pollution analysis and monitoring – drinking Water standards. Soil pollution and its effects - soil pollution - sources - solid waste Disposal and their effects - pesticides - types and effect of pollutants on Plants - animals and human beings - biomagnification - fertilizers and its Effect of pollutants on plants - animals and human beings –

UNIT IV

soil pollution Control measures - soil microbes and function - biofertilizer. Noise pollution and its effects - noise pollution - sources – noise Exposure level and standards - impacts - noise control and abatement Measures.

Unit V

Marine pollution - sources and control of marine pollution – criteria Employed for disposal of pollutants in marine system – coastal Management. Radioactive pollution and its impacts - radioactive - sources - effect of Pollutants of plants - animals and human beings - prevention and control Measures of radioactive pollution.

Unit VI

Assessment and control of pollution - environmental standards - Assessment of pollution effects due to air - water - soil and radioactive Pollution - biotechnology in pollution control - microbial role in Pollution control - biomonitoring and bioremediation - pollution control Legislations for air - water - land etc. Biotechnology in pollution control - bioremediation (organic and Inorganic pollutants) - bioleaching and biomineralization.

Text/References

1. Environmental Pollution Analysis:Khopkar.
2. Environmental Science – A study of Inter relationships, E. D. Enger, B. E. Smith, 5th ed., W C B publication.
3. Environmental Pollution Control Engineering: C. S. Rao
4. Bruce Rittman, Perry L. McCarty. Environmental Biotechnology: Principles and Applications, 2nd Edition, McGraw-Hill, 2000.
5. J.N.B. Bell (2002) Air Pollution and Plant Life, 2nd Edition, John Wiley and Sons, New Delhi.

Semester II
Soft Computing Techniques

MOE25E	Soft Computing Techniques	OEC	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Course Outcomes: At the end of the course, student should be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

PO's → CO's ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Note: 1- Means least contribution, 2- Means medium contribution, 3- Maximum contribution

Course Contents:

Unit 1
INTRODUCTION

Soft Computing: Introduction of soft computing, Evolutionary Algorithms vs. Convectional optimization techniques, various types of soft computing techniques, applications of soft computing.

Artificial Intelligence: Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various

types of control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and non-monotonic reasoning, forward Reasoning, backward reasoning.

Unit 2

OPTIMIZATION CONCEPTS

Objective functions, constraints, Search space, local optima, global optima, fitness functions, search techniques, etc.

Unit 3

NEURAL NETWORKS

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models – important technologies – applications.

McCulloch-Pitts neuron – linear separability – hebb network – supervised learning network: perceptron networks – adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative autoassociative memory network & iterative associative memory network – unsupervised learning networks: Kohonenself organizing feature maps, LVQ – CP networks, ART network.

Unit 4

FUZZY LOGIC

Fuzzy logic: Introduction – crisp sets- fuzzy sets – crisp relations and fuzzy relations: cartesian product of relation – classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets.

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy arithmetic – extension principle – fuzzy measures – measures of fuzziness -fuzzy integrals – fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

Unit 5

GENETIC ALGORITHM

Genetic algorithm- Introduction – biological background – traditional optimization and search techniques – Genetic basic concepts.

Genetic algorithm and search space – general genetic algorithm – operators – Generational cycle – stopping condition – constraints – classification genetic programming – multilevel optimization – real life problem- advances in GA.

Unit 6

HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS

Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of

multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

Texts/References

1. J. S. R. Jang, C.T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", PHI /Pearson Education 2004.
2. S. N. Sivanandam and S. N. Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.
3. S. Rajasekaran and G. A. VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
4. George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" Prentice Hall, 1997.
5. David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education India, 2013.
6. James A. Freeman, David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
7. Simon Haykin, "Neural Networks Comprehensive Foundation" Second Edition, Pearson Education, 2005.

Semester II

Manufacturing Automation

MOE25F	Manufacturing Automation	OEC	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

UNIT 1

Product cycle, manufacturing functions, types of automation, degree of automation, technical, economic and human factors in automation.

UNIT 2

Technologies- mechanical, electrical, hydraulic, pneumatic, electronic, hybrid systems, comparative evaluation.

UNIT 3
Development of small automation systems using mechanical devices, synthesis of hydraulic circuits.

UNIT 4
Circuit optimization techniques, illustrative examples of the above types of systems.

UNIT 5
Industrial logic control systems logic diagramming, programmable controllers.

UNIT 6
Applications, designing for automation, cost-benefit analysis.

Texts/References:

1. A.N.Gavrilov, *Automation and Mechanization of Production Processes in Instrument Industry*, Pergaman Press, Oxford, 1967.
2. G.Pippengerm, *Industrial Hydraulics*, MGH, New York, 1979.
3. F.Kay , *Pneumatics for Industry*, The Machining Publishing Co., London,1969.
4. Ray, *Robots and Manufacturing Assembly*, Marcel Dekker, New York, 1982.

Semester-II
Modeling and Simulation

MOE25G	Modeling and Simulation	OEC	3-0-0	3 Credits

Examination Scheme:

Theory	
Mid Term: 20 Marks	Internal Assessment: 20 Marks
End Term: 60 Marks	

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define simulation, its limitations and applications.
CO2	Apply simulation to queuing and inventory situations.
CO3	Acquire knowledge to generate the random numbers for simulation models.
CO4	Analyze the data and verify model of simulation.
CO5	Learn software's and programming languages for developing simulation model.
CO6	Discuss case studies in manufacturing simulation.

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											1
CO2	2			1								
CO3	2	2	1	2								1
CO4	2	2	1	2						2	1	
CO5	2	2	2	3						1		2
CO6	2						2			1		

Course Contents:

Unit 1
Introduction to systems and modeling – discrete and continuous system - Limitations of simulation, areas of application - Monte Carlo Simulation.

Unit 2
Discrete event simulation and their applications in queueing and inventory problems.

Unit 3
Random number generation and their techniques - tests for random numbers. Random variable generation.

Unit 4
Analysis of simulation data. - Input modeling – verification and validation of simulation models – output analysis for a single model.

Unit 5
Simulation languages and packages - FORTRAN, C, C++, GPSS, SIMAN V, MODSIM III, ARENA, QUEST, VMAP - Introduction to GPSS – Case studies.

Unit 6
Simulation of manufacturing and material handling system, Caste studies.

Texts/References:

1. Jerry Banks and John S, Carson II “Discrete Event System Simulation”, Prentice Hall, 1984.
2. Geoffrey Gordon., “System Simulation”, Prentice Hall, 1978.
3. Francis Neelamkovil, “Computer Simulation and Modelling”, John Willey and sons,1987.

Semester II
Seminar

MCADM26	Seminar	PCC	0-4-0	2 Credits

Examination Scheme:

Internal Assessment: 25 Marks	External Exam: 25 Marks

Pre-Requisites: Previously studied course subjects.

Course Outcomes: At the end of the course the student will be able to:

CO1	Identify and compare technical and practical issues related to the area of course specialization
CO2	Outline annotated bibliography of research demonstrating scholarly skills.
CO3	Prepare a well-organized report employing elements of technical writing and critical thinking.
CO4	Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1		1	2		2	2	2	1	2
CO2		2				2		1	2	1		1
CO3						1	1	2	2	2		2
CO4	1	2	1	1		1	1	1	2	1		1

Objective:
To assess the debating capability of the student to present a technical topic. Also, to impart training to a student to face audience and present ideas and thus creating self-esteem, self-confidence and courage that are essential for an engineer.

Individual students are required to choose a topic of their interest from CAD-CAM related topics preferably from outside the M. Tech syllabus or an extension of syllabus and give a seminar on that topic for about 30 minutes. The Seminar can also be a case study from a Computer Aided Analysis design organization. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students.

Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Semester-II
Mini Project

MCADM27	Mini Project	PCC	0-0-4	2 Credits

Examination Scheme:

Practical	
Internal Assessment: 25 Marks	External Exam: 25 Marks

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Identify methods and materials to carry out experiments/develop code.
CO2	Reorganize the procedures with a concern for society, environment and ethics.
CO3	Analyze and discuss the results to draw valid conclusions.
CO4	Prepare a report as per recommended format and defend the work
CO5	Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.

Mapping of course outcomes with program outcomes

Program Outcomes→ / Course Outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1		2	2	1	1	2	2	1	2
CO2	1	1	2	2			2	2	1	2	1	2
CO3	2	2		3					2	2		1
CO4				2				2	2	3		1
CO5		1		2	2			2	2	3		1

Objectives:
To train students in identification, analysis, finding solutions and execution of live engineering and managerial problems. It is also aimed to enhance the capabilities of the students for group activities.

Individual students are required to choose a topic of their interest. The subject content of the mini project shall be from emerging / thrust areas, topics of current relevance having research aspects or shall be based on industrial visits. Students can also choose live problems from manufacturing organizations as their mini project. At the end of the semester, the students should submit a report duly authenticated by the respective guide, to the head of the department.
Mini Project will have internal marks 50 and Semester-end examination marks 50.

Internal marks will be awarded by respective guides as per the stipulations given below.
Attendance, regularity of student (20 marks)
Individual evaluation through viva voce / test (30 marks)
Total (50 marks)

Semester end examination will be conducted by a committee consisting of three faculty members. The students are required to bring the report completed in all respects duly authenticated by the respective guide and head of the department, before the committee. Students individually will present their work before the committee. The committee will evaluate the students individually and marks shall be awarded as follows.
Report = 25 marks
Concept/knowledge in the topic = 15 marks
Presentation = 10 marks
Total marks = 50 marks

Semester-III
Project Management

MMECH31	Project Management	PCC	0-0-0	2 Credits

Continuous Assessment 50 Marks	PR/OR 50 Marks	Total 100 Marks

Pre-Requisites: None
Course Outcomes: At the end of the course the student will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit-1

- Introduction to Project management**:** Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization. Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks.

Unit-2

- Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Leveling and Resource Allocation. Time Cost Trade off: Crashing Heuristic.

Unit-3

- Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management. Post-Project Analysis.

TEXT BOOKS/REFERENCES:

1. Shtub,BardandGloberson,ProjectManagement:Engineering,Technology,andImplementation,Prentice Hall, India
2. Lock, Gower, Project Management Handbook.

Intellectual Property Rights

MMECH32	Intellectual Property Rights	PCC	0-0-0	2 Credits

Continuous Assessment 50 Marks	PR/OR 50 Marks	Total 100 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course the student will be able to:

CO1	Enumerate and demonstrate fundamental terms such as copy-rights ,Patents ,Trademarks etc.,
CO2	Interpret and follow Laws of copy-rights, Patents, Trademarks and various IP registration Processes to register own project research.
CO3	exhibit the enhance capability to do economic analysis of IP rights, technology and innovation related policy issues and firms' commercial strategies.
CO4	Develop awareness at all levels (research and innovation) of society to develop patentable technologies.
CO5	Apply trade mark law, copy right law, patent law and also carry out intellectual property audits
CO6	Manage and safeguard the intellectual property and protect it against unauthorized use

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1					1		1			
CO2	1		2				1		2			2
CO3						1		1				
CO4						1			1			
CO5			1						1			1
CO6												

Course Contents:

Unit-1

- Introduction to IPR; Overview & Importance; IPR in India and IPR abroad; Patents ;their definition; granting; infringement ;searching & filing; Utility Models an introduction;

Unit-2

- Copyrights ; their definition; granting; infringement ;searching & filing, distinction between related and copy rights; Trademarks ,role in commerce ,importance , protection, registration; domain names;

Unit-3

- Industrial Designs ; Design Patents; scope; protection; filing infringement; difference between Designs & Patents' Geographical indications , international protection; Plant

varieties; breeder's rights, protection; biotechnology& research and rights managements; licensing, commercialization; ; legal issues, enforcement ;Case studies in IPR.

TEXT BOOKS/REFERENCES:

1. Prabuddha Ganguli, IPR: Unleashing the Knowledge Economy, published by Tata McGraw Hill 2001.

Semester III
Project Stage-I

MCAMD33	Project Stage-I	PCC	0-0-0	10 Credits

Examination Scheme:

Internal Assessment: 50 Marks	External Exam: 50 Marks

Course Outcomes:

At the end of the course, student should be able to:

CO1	Identify problems and to plan methodologies to solve problems.
CO2	Carry out exhaustive literature review, study &evaluate collected literature critically and identify the gaps based on the review.
CO3	Select the specific problem for the study as a project
CO4	Demonstrate technical writing while preparing project report and present it to evaluation committee to demonstrate presentation skills acquired.

PO's → CO's↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Note: 1- Means least contribution, 2- Means medium contribution, 3- Maximum contribution

Course Contents:

Project (stage-I) should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

Semester IV

Project Stage-II

MCADM41	Project Stage-II	PCC	0-0-0	20 Credits

Examination Scheme:

Internal Assessment: 100 Marks	External Exam: 100 Marks

Course Outcomes:

At the end of the course, student should be able to:

CO1	Solve identified technical problem using acquired knowledge and skill.
CO2	Use latest equipment, instruments, software tools, infrastructure and learning resources available to solve the identified project problem. Procure resources, if required.
CO3	Interpret theoretical/experimental findings using available tools
CO4	Compare the results obtained with results of similar studies
CO5	Draw conclusions based on the results.

Mapping of COs with POs:

PO's → CO's↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Note: 1- Means least contribution, 2- Means medium contribution, 3- Maximum contribution

Course Contents

Project stage-II should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and Faculty Advisor. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.