Rashtreeya Sikshana Samithi Trust

R.V. College of Engineering

(Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)

Department of Mechanical Engineering

Master of Technology (M. Tech.) in

Computer Integrated Manufacturing

Scheme and Syllabus of Autonomous System w.e.f 2016

R.V. College of Engineering, Bengaluru – 59

(Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)

Department of Mechanical Engineering

Vision:

Quality education in Design, Materials, Thermal and Manufacturing with emphasis on research, sustainable technologies and entrepreneurship for societal symbiosis.

Mission:

- Imparting knowledge in basic and applied areas of Mechanical Engineering.
- Providing state-of-the-art laboratories and infrastructure for academics and research in the areas of design, materials, thermal engineering and manufacturing.
- Facilitating faculty development through continuous improvement programs.
- Promoting research, education and training in materials, design, manufacturing, Thermal Engineering and other multidisciplinary areas.
- Strengthening collaboration with industries, research organizations and institutes for internship, joint research and consultancy.
- Imbibing social and ethical values in students, staff and faculty through personality development programs

Program Educational Objectives (PEO)

The Graduates of M. Tech. in Computer Integrated Manufacturing Program will be prepared for:

PEO 1. Practicing design and implementation of computer integrated manufacturing systems through the application of the fundamental knowledge and skills of Mechanical Engineering

PEO 2. Enhancing their skills through training, independent inquiry, and professional development

PEO 3. Working independently as well as collaboratively, while demonstrating the professional and ethical responsibilities of the engineering profession.

PEO 4. Pursuing higher studies at Doctoral level in multidisciplinary areas of Automation

Program Outcomes (PO)

M. Tech. in Computer Integrated Manufacturing Graduates will be able to:

PO 1. **Engineering Knowledge**: Apply knowledge of manufacturing engineering and management principles to design and evaluate automated manufacturing systems.

PO 2. **Problem Analysis**: Analyze problems of manufacturing and industrial systems to formulate the design requirements for CIM systems.

PO 3. **Design/Development of Solutions**: Design, implement, and evaluate advanced manufacturing systems and processes, with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

PO 4. **Modern Tool Usage**: Design, conduct and analyze experiments using domain knowledge and concepts of design of experiments to arrive at valid conclusions.

PO 5. **The Engineer and Society**: Use state of the art engineering tools and techniques for design and operation of advanced manufacturing systems.

PO 6. **Environment and Sustainability**: Develop manufacturing systems using the knowledge of contemporary issues.

PO 7. **Ethics**: Apply professional, ethical, legal, security and social issues in the design of manufacturing systems.

PO 8. **Individual and Teamwork**: Function effectively, individually and in teams, on diverse and multidisciplinary environments to accomplish common goals.

PO 9. **Communication**: Communicate effectively with diversified groups to motivate and exhibit leadership qualities in the management of an enterprise.

PO 10. **Project Management and Finance**: Apply the principles of project management for effective execution of manufacturing projects.

PO 11. **Life-long Learning**: Pursue life-long learning as a means of enhancing the knowledge and skills.

Program: M.Tech in Computer Integrated Manufacturing

Program Specific Criteria (PSC):

Lead Society: Society of Manufacturing Engineers

These program criteria apply to engineering programs that include "manufacturing" or similar modifiers in their titles.

The program must prepare graduates to have proficiency in automation and manufacturing processes: ability to design manufacturing processes that result in products that meet specific automation and other related requirements. Process, assembly and product engineering: ability to design, tooling and analyse the environment necessary for their manufacture. Manufacturing competitiveness: ability to create competitive advantage through manufacturing planning, strategy, quality, and control. Manufacturing systems design: ability to analyze, synthesize, and control manufacturing operations using statistical methods. Manufacturing laboratory or facility experience: ability to measure manufacturing process variables and develop technical inferences about the process.

The faculty members of the program possess in-depth understanding and expertise in their areas of specialization with a commitment to periodically update their knowledge in respective domains.

Program Specific Outcomes (PSO)

M. Tech. in Computer Integrated Manufacturing Graduates will be able to:

PSO1. Design subsystems of Computer Integrated Manufacturing systems by integrating automation with mechanical systems in manufacturing, assembly and testing

PSO2. Develop advanced tools for evaluating performance of automated systems and for data automation with respect to materials, machines and other resources.

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Department of Mechanical Engineering

M. Tech. in Computer Integrated Manufacturing

FIRST SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Self Study S**	
1	16MEM11P	Project Management	IM	3	1	0	0	4
2	16MAT12B	Probability & Statistics for Engineers	MA	4	0	0	0	4
3	16MCM13	Computer Control of Manufacturing Systems (Theory & Practice)	ME	4	0	1	0	5
4	16MCM14	Computer Aided Design	ME	4	0	0	1	5
5	16MCM15X	Elective 1	ME	4	0	0	0	4
6	16HSS16	Professional Skill Development	ME	0	0	2	0	2
		Total		**19**	**1**	**3**	**1**	**24**

Elective 1			
16MCM151	Digital Manufacturing	16MCM152	Hydraulic and Pneumatic Systems

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Department of Mechanical Engineering

M. Tech. in Computer Integrated Manufacturing

SECOND SEMESTER

Sl. No	Course Code	Course Title	BoS	CREDIT ALLOCATION				Total Credits
				Lecture L	Tutorial T	Practical P	Self Study S	
1	16MEM21R	Research Methodology	IM	3	1	0	0	4
2	16MCM22	Mechatronic Systems (Theory & Practice)	ME	4	0	1	0	5
3	16MCM23X	Elective 2	ME	4	0	0	0	4
4	16MCM24X	Elective 3	ME	4	0	0	0	4
5	16MCM25X	Elective 4	ME	4	0	0	0	4
6	16MCM26	Minor Project	ME	0	0	5	0	5
		Total		**19**	**1**	**6**	**0**	**26**

Elective - 2			
16MCM231 / 16MTE231	Non Traditional Machining and Testing	16MPD232/16MCM232	Design of Machine Tools
Elective - 3			
16MCM241/16MTE241	Tooling for Manufacture in Automation	16MMD242/16MCM242	Industrial Robotics
Elective - 4			
16MCM251	Automation and Production Systems	16MCM252	Computer Aided Process Planning

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Department of Mechanical Engineering

M. Tech. in Computer Integrated Manufacturing

THIRD SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Self Study S**	
1	16MCM31	Computer Aided Engineering (Theory & Practice)	ME	4	0	1	0	5
2	16MCM32X	Elective - 5	ME	4	0	0	0	4
3	16MCM33X	Elective - 6	ME	4	0	0	0	4
4	16MCM34X	Elective - 7	ME	4	0	0	0	4
5	16MCM35	Internship/Industrial Training	ME	0	0	3	0	3
6	16MCM36	Technical Seminar	ME	0	0	2	0	2
		Total		**16**	**0**	**6**	**0**	**22**

Elective - 5			
16MCM321	Additive Manufacturing Technology	16MCM322/16MTE322	Applied Metrology and Quality Control
Elective - 6			
16MCM331	Modelling and Simulation of Manufacturing Systems	16MCM332/16MTE332	Design for Manufacture and Assembly
Elective - 7			
16MCM341	Micro and Nano Manufacturing	16MCM342	Product Data Management

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FOURTH SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Self-Study S**	
1	16MCM41	Major Project	ME	0	0	26	0	26
2	16MCM42	Seminar	ME	0	0	2	0	2
		Total		**0**	**0**	**28**	**0**	**28**

FIRST SEMESTER

PROJECT MANAGEMENT

Course Code	**:**	**16 MEM11P**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L: T: P: S**	**3:2:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**4**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

Students are able to

1. Understand the principles and components of project management.
2. Appreciate the integrated approach to managing projects.
3. Elaborate the processes of managing project cost and project procurements.
4. Apply the project management tools and techniques.

Unit – I **7 Hours**

Introduction: Project, Project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge.

Unit – II **8 Hours**

Generation and Screening of Project Ideas: Generation of ideas, monitoring the environment, corporate appraisal, scouting for project ideas, preliminary screening, project rating index, sources of positive net present value. Project costing,

Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope.

Organizational influences & Project life cycle: Organizational influences on project management, project state holders & governance, project team, project life cycle.

Unit – III **7 Hours**

Project Integration Management: Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase.

Project Quality management: Plan quality management, perform quality assurance, control quality.

Unit – IV **7 Hours**

Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk.

Project Scheduling: Project implementation scheduling, Effective time management, Different scheduling techniques, Resources allocation method, PLM concepts. Project life cycle costing.

Unit-V **7 Hours**

Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Planning, Computerized project management.

Syllabus includes tutorials for two hour per week:

- Case discussions on project management
- Numerical problems on PERT & CPM
- Computerized project management exercises using M S Project Software

Course Outcomes:

After going through this course the student will be able to

CO1: Explain the process of project management and its application in delivering successful projects.

CO2: Illustrate project management process groups for various project / functional applications.

CO3: Appraise various knowledge areas in the project management framework.

CO4: Develop project plans and apply techniques to monitor, review and evaluate progress for different types of projects.

Reference Books:

1. Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, 2013, ISBN: 978-1-935589-67-9
2. Harold Kerzner, "Project Management A System approach to Planning Scheduling & Controlling", John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
3. Prasanna Chandra, "Project Planning Analysis Selection Financing Implementation & Review", Tata McGraw Hill Publication, 7th Edition, 2010, ISBN 0-07-007793-2.
4. Rory Burke, "Project Management – Planning and Controlling Techniques", John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	----	M	H	H	H	----	H	----
CO2	----	M	----	-----	M	H	H	H	L	H	----
CO3	---	M	H	---	M	H	H	H	H	H	M
CO4	M	H	M	L	H	H	H	H	----	H	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1		L
CO2	L	
CO3	L	L
CO4		M

PROBABILITY AND STATISTICS FOR ENGINEERS						
Course Code	**:**	**16MAT12B**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**4**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

The students shall be able to:

1. Understand the fundamental concepts of Probability theory and statistics.
2. Identify probability distributions encountered in real life situations and use the concepts of random variables to solve simple problems.
3. Apply appropriate statistical tools for analysing a specific set of data and relationship between two variables.
4. Conduct hypothesis tests and build confidence intervals to reach conclusions about population mean and standard deviation based on single set of data.

Unit – I	**10 Hrs**

Data Summary and Presentation: Tabular and Graphical display: Stem and Leaf diagrams, Histograms, Box plots, Radar diagrams.

Fundamentals of Probability Theory: Sample spaces and Events, Interpretations of probability, Addition rule, Conditional probability, Multiplication and Total probability rules, Independence, Bayes' theorem.

Unit – II	**10 Hrs**

Random Variables and Discrete probability Distributions: Random Variables, Discrete and continuous random variables. Probability distributions and mass functions, Expectations of random variables, Discrete uniform distribution, Binominal distribution, Poisson distribution, Applications.

Unit – III	**09 Hrs**

Continuous Probability Distributions: Continuous Uniform distribution, Normal distribution, Normal approximations, Exponential, Erlang, Gamma, Weibull distributions, Applications.

Unit – IV	**10 Hrs**

Joint Probability and Estimation theory: Marginal probability distributions, Independence, Covariance and correlation, Numerical Problems. Sampling distribution, Central Limit Theorem, Sampling distribution of means.

Unit – V	**09 Hrs**

Statistical Inference for a single sample: Hypothesis testing, Confidence intervals, Inference on the mean of a population (variance known and unknown), Inference on the variance of a normal population, Testing for Goodness of fit.

Course Outcomes:

After going through this course the student will be able to:

CO1: Understand the fundamental concepts of probability theory, statistics and commonly used probability distributions.

CO2: Identify joint distributions and calculate the different moments in addition to establishing goodness of fit.

CO3: Apply random phenomena, joint distribution and sampling theory to solve the problems in field of mechanical Engineering.

CO4: Analyze the physical problem to establish mathematical model and use appropriate method

	to solve.
Reference Books:	
1.	Douglas C Montgomery, George C Runger, "Applied statistics and Probability for Engineers", Wiley, Asia Student Edition, 4th Edition, 2007, ISBN: 978-81-265-2315-3.
2.	Richard I Levin, David S Rubin, "Statistics for Management", Prentice Hall India, 7th Edition, 1997, ISBN: 9780134762920.
3.	Walpole, Myers, Myers, Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc., 8th Edition, 2007, ISBN: 978-81-317-1552-9.
4.	Purna Chandra Biswal, "Probability and Statistics", PHI Learning Private Limited, Eastern Economy Edition, 2007, ISBN: 978-81-203-3140-2.

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	H	-	L	-	-	-	-	-	-	-
CO2	-	H	L	M	-	-	-	-	-	-	-
CO3	M	-	L	M	-	-	-	-	-	-	-
CO4	-	L	-	L	-	-	-	L	-	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	L
CO2	L	L
CO3	M	M
CO4	H	

COMPUTER CONTROL OF MANUFACTURING SYSTEMS (Theory & Practice)						
Course Code	**:**	**16MCM13**		**CIE Marks**	**:**	**100 +50**
Hrs/Week	**:**	**L:T:P:S**	**4:0:2:0**	**SEE Marks**	**:**	**100 +50**
Credits	**:**	**05**		**SEE Duration**	**:**	**3 + 3 Hrs**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Explain the Role of CIM in Product cycle.
2. Classify different types of drives and feedback devices of CNC machine.
3. Differentiate between NC, CNC and DNC.
4. Write CNC program for turning and machining centers.

Unit – I **08 Hrs**

Introduction to Computer Integrated Manufacturing Systems: Manufacturing Systems, Types of Manufacturing Systems, Computer monitoring and control, Manufacturing support systems, The Product Cycle and CAD/ CAM, Functions of computers in CIMS: CIMS Data Files, Benefits of Computer integrated Manufacturing Systems.

Unit – II **10 Hrs**

NC/CNC machine tools: Introduction, Classification, Merits and demerits, Application. Difference between NC and CNC over conventional machine tools. Role of NC/CNC technology in modern manufacturing. Axes designation, coordinate system, turning centers, machining centers, reference points and CNC control systems.

CNC machine tools – structure and elements: Machine tool structure, transmission systems, guide ways, recirculating ball screws. CNC driving system components: hydraulic, servo Motors, stepper Motors. Feedback devices and encoders. Work holding devices and tool holding devices. Automatic tool changers: principles of operation.

Unit – III **10 Hrs**

NC and CNC control systems: NC elements, control systems, modes, advantages and limitations. CNC systems – Introduction, types, features on CNC machining and turning centers, advantages. Coordinate system in CNC machine tools, Machining Centers, Tooling for CNC machines. Interpolator for a CNC System: DDA integrator, hardware and software interpolator.

CNC part programming: Steps involved in preparation of part programming, coding systems, basic categories of NC codes, preparatory and miscellaneous codes, programming functions.

Unit – IV **10 Hrs**

Turning center part programming: manual part programming for turning center, single and multi-pass canned cycles, and exercise problems on turning centers.

Machining center part programming: Manual part programming for machining center, Cutter compensations: cutter radius compensation, tool length compensation and tool wear compensation. Drilling canned cycles, sub-programming, macros and simple exercise problems on machining centers

Unit – V **10 Hrs**

DNC and data communication: Configuration of DNC system, functions of DNC, communication between DNC computer & MCU, DNC software features, networking of CNC machine tools, advantages of DNC.

Adaptive control systems: Elements of Adaptive control systems, Adaptive control optimization system, adaptive control constraint system, applications to machining processes, Benefits of Adaptive control machining.

Unit – VI (Lab Component)	24 Hrs
Manual CNC Part Programming for Turning and Machining Centers - Manual CNC Part Programming Using Standard G and M Codes - Tool Path Simulation – Exposure to Various Standard Control Systems - Machining simple components by Using CNC machines Part programming for CNC Machines using CAM Packages, simulation of turning/drilling/milling operations.	
Course Outcomes: After going through this course the student will be able to: CO1: Explain fundamental concepts of NC and CNC systems. CO2: Apply design considerations for increasing productivity with CNC systems CO3: Analyze latest developments in CNC and DNC systems CO4: Develop manual part programs for complex profiles and test the programs through simulation.	
Reference Books	
1. Y. Koren, "Computer Controls of Manufacturing Systems", Tata McGraw-Hill Edition 2005 ISBN 0-07-060743-5 2. P.N. Rao, "CAD/CAM Principles and Applications", Tata McGraw-Hill 2nd Edition, 2006. ISBN 10: 0070681937 / ISBN 13: 9780070681934. 3. P Radhakrishnan, "Computer Numerical Control Machines and Computer Aided Manufacture", 1st Edition, 2012. ISBN: 9788122433975, 8122433979 4. Groover M P, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall India (P) Ltd, 3rd Edition. ISBN 10: 0133499618 ISBN 13: 9788120334182	

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Practical

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be for 50 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Practical

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H				M						
CO2	M	H	M		L						
CO3	L	L	H	L	M			L			
CO4			M	L	H			M			

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	M
CO2	M	
CO3	M	M
CO4		L

COMPUTER AIDED DESIGN						
Course Code	**:**	**16MCM14**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:4**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Memorize the equations of transformations, curves, solid models and surfaces
2. Understand the concept of computer Graphics
3. Demonstrate the principles of wire frame, Geometric, and surface modeling
4. Distinguish the different concepts of algorithm

Unit – I **08 Hrs**

Computer Graphics: Line drawing algorithms: DDA, Bresenham's algorithms, Mid-point circle algorithms, coordinate systems, windowing, View generation, Clipping, Transformations of geometry.

Unit – II **12 Hrs**

Software Configuration: Software configuration of a graphics system, Functions of a graphics package, Mathematics of projections, Hidden line removal, Hidden surface removal, Shading, Rendering.

Basics of geometry modeling: Requirements of geometric modeling, geometric models, geometric construction methods, modeling facilities desired.

Unit – III **12 Hrs**

Wireframe Modeling: Classification of wire frame entities, curve representation methods, parametric representation of analytic curves, curvature continuity, Lagrange interpolation, Parametric representation of synthetic curves, curve manipulations.

Unit – IV **8 Hrs**

Solid Modeling: Application of solid models, modeling considerations of solids, geometry and topology, solid modeling scheme, Boundary Representation, Winged edge data structure for Boundary representation, Euler operations, Constructive solid geometry, Sweeping, Solid Manipulations.

Unit – V **08 Hrs**

Surface modeling: Introduction, Planes, Vector Planes, surface entities, Surface representation methods, Quadratic Surface in normal forms, Quadratic Surface in general forms, Quadratic Surface in matrix form, parametric surfaces, Parametric representation of analytic surfaces, Parametric representation of synthetic surfaces, Surface Manipulations.

Self Study

The student will have to choose a topic of his/her interest within the scope of the course and pursue a study in that domain. This will be for 20 marks which will be evaluated in TWO phases by a committee consisting of two faculty members including the course faculty. The student has to demonstrate his/her capability of understanding, analyzing and applying the knowledge to solve problems. The study could be a theoretical one involving simulation and analysis or could be an experimental one or even involve building a prototype system.

Course Outcomes:

After going through this course the student will be able to:

CO1: Demonstrate the concepts of Computer Graphics in CAD

CO2: Apply the concepts of CAD in manufacturing industry CO3: Analyze different types of modeling in CAD CO4: Formulate representation of different types CAD models.
Reference Books
1. Chennakesava R Alavala "CAD/CAM Concepts and Applications", 1st Ed PHI, New Delhi, 2009 ISBN 978-81-203-3340-6 2. P.N. Rao, "CAD/CAM Principles and Applications", 3rd Ed., McGraw Hill, Education Pvt Ltd., New Delhi ISBN 0-07-058373-0 3. Ibrahim Zeid, "Mastering CAD/CAM" , 2nd Ed., TMH Publishing Company Limited., New Delhi, ISBN 0-07-0634334-3 4. M.P. Groover and 3 E W Zimmers, CAD/CAM Computer aided Design and Manufacturing, 9th Ed, 1993, ISBN 81-203-0402-0

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	L	H	-	-	-	-	-	-	-	-
CO2	H	M	M	L	-	-	-	-	-	-	-
CO3	L	H	-	H	M	-	-	-	-	-	-
CO4	-	-	L	M	H	L	-	-	-	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	M	L
CO3	L	M
CO4	-	H

DIGITAL MANUFACTURING (Elective Group – 1)						
Course Code	**:**	**16MCM151**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Define the basics of Digital Manufacturing
2. Discuss the principles of Digital Manufacturing
3. Explain the concept of system and informatics of Digital Manufacturing
4. Demonstrate the DM in implementing the Production Process

Unit – I **10 Hrs**

Introduction: Development of Manufacturing Science, Concepts, Research and Development Status of Digital Manufacturing, Connotation and Research Methods, Architecture, Organization Model and Function Model of Digital Manufacturing System; System of Digital Manufacturing: Operation Mode and Architecture, Modeling Theory and Method,

Unit – II **10 Hrs**

System of Digital Manufacturing: Theory System of Digital Manufacturing.

Computing Manufacturing: Virtual Prototyping, Reverse Engineering, Application of Reverse Engineering, Information Model of Product Life Cycle. Information Model of Manufacturing Technology Resources, Geometric Modeling Forms, Geometric Modeling in Manufacturing Computing, Computational Geometry.

Unit – III **10 Hrs**

Manufacturing Informatics: Information Characteristics, Activities and Manufacturing Informatics, Integration, Sharing and Security of Manufacturing Information. Integration Model, Principle and Mechanism of Sharing Manufacturing Resources.

Intelligent Manufacturing System: The Application of Sensor in the Processing Data Mining, Sensor applications in tool condition monitoring, Intelligent multi information fusion, Data Mining Applied to Digital Manufacturing, Knowledge Reasoning in Engineering Design, Intelligent Knowledge-Based Manufacturing System,

Unit – IV **10 Hrs**

Self-Learning of Manufacturing System, Adaptation of Manufacturing System, The Concepts and Features of Intelligent Manufacturing, Multi-Agent Manufacturing System.

Management of Technology: Concept and Development Process of MOT, Model of MOT. Coordinative Management of Collaborative R&D Network, Technical Capacity of Strategic Management, Human Factors, Human–Machine Coordinated Factors. People–People Coordinated Factors, The Digital Marketing Based on Cultural Differences and Ways of Thinking

Unit – V **08 Hrs**

Key Technology of Digital Manufacturing: Various Digital Technologies in Product Lifecycle, CAX Technology Integration, Digital Equipment Technology, Digital Processing Technology, Remote Failure Diagnosis Based on Network, Digital Logistic Technology.

Course Outcomes:

After going through this course the student will be able to:

CO1: Explain the working process and technology development in Digital Manufacturing

CO2: Apply the principles of DM in manufacturing industry
CO3: Analyze the concepts of DM in Production
CO4: Evaluate the techniques involved in DM

Reference Books

1. Zude Zhou, Shane (Shengquan) Xie, Dejun Chen "Fundamentals of Digital Manufacturing Science" 2012.Springer ISBN 978-0-85729-564-4,
2. Lihni Wang, Andrew Y.C. Nee "Collabarative design and planning for digital manufacturing" Springer Series, 2009, ISBN 998-1-84882-286-3
3. Asterios Agkathidis "Digital Manufacturing in Design and Architecture" Gardener Books, 2010, ISBN 978906392322
4. Ian Gibson, David Rosen, Brent Stucker, "Additive Manufacturing Technologies"- Springer, 2nd Edition. ISBN 978-1-4939-2112-6

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	-	-	-	-	-	-	-	-	-
CO2	M	M	L	M	-	-	-	-	-	-	-
CO3	L	H	M	H	M	-	-	-	-	-	-
CO4	-	L	L	M	H	-	-	-	-	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	L	L
CO3	-	M
CO4	-	H

HYDRAULIC AND PNEUMATIC SYSTEMS (Elective Group – 1)						
Course Code	**:**	**16MCM152**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Understand the symbols used to represent hydraulic and pneumatic components.
2. Identify the control system elements of fluid power in industrial automation.
3. Apply the basic pneumatic systems to build electro pneumatic controls.
4. Evaluate the appropriate components through design calculations.

Unit – I **10 Hrs**

Introduction to hydraulic system: structure of hydraulic control system, pressure compensated pump, cavitation and aeration, pump specifications, motor specifications, applications, cylinders, Mechanics of Hydraulic Cylinder Loading, Classification of control valves, mounting, pressure control valves and flow control valve working principles, symbolic representation of components.

Introduction to pneumatic system: Structure of Pneumatic control System, compressor types, sizing, pneumatic components, air preparation and distribution, symbolic representations.

Unit – II **08 Hrs**

Design of Hydraulic control System: Selection of hydraulic cylinder, selection of hydraulic motors, flow control valves, directional control valves, filters, conduits, pressure losses in valves, selection of pump, reservoir design, sizing of accumulators, numerical problems

Unit – III **10 Hrs**

Industrial Hydraulic Systems: Regenerative circuit for drilling machine, Double Pump Hydraulic System, Hydraulic Cylinder Sequencing Circuits, Speed control circuits, Automatic cylinder reciprocating system, Cylinder synchronizing circuit using different methods, safety circuit, accumulator circuits, hydraulic operation of planning machine, surface grinding machine, automatic lathe, press, circuit for robot arm.

Unit – IV **10 Hrs**

Industrial Pneumatic Systems: Direct and indirect control of double acting cylinders, memory control, logics in circuit design, applications of shuttle valve, twin pressure valve, speed control of double acting cylinder, quick exhaust valve circuit, cyclic operation of cylinder, automatic return motion, applications of pressure sequence valve circuit and time delay valve circuit, signal conflict by cascading method, use of karnough-veitch map in circuits, pneumatically controlled drilling machine.

Unit – V **10 Hrs**

Electro pneumatics: Pneumatic and electro pneumatic controllers, advantages, Solenoid valves, limit switches, relay controls, symbolic representation and working principle, latching circuit, dominant on and dominant off circuit, contactors and switches. Developing an electro pneumatic control system, electro pneumatic multiple actuator circuits.

Course Outcomes:

After going through this course the student will be able to:

CO1: Describe the constructional features of hydraulic and pneumatic components

CO2: Apply hydraulic and pneumatic controls in the design of automated controls.

CO3: Evaluate design of hydraulic and pneumatic components for building circuits.
CO4: Design hydraulic and pneumatic systems for industrial applications.
Reference Books
1. James L Johnson, "Introduction to fluid power", Cengage Learning, first edition 2003, ISBN-981-243-661-8 2. R Srinivasan, "Hydraulic and pneumatic controls", , Tata McGraw hill, second edition,2010 ISBN – 978-81-8209-138-2 3. Joji P, "Pneumatic Controls", , Wiley First edition 2009, ISBN – 978-81-265-1542-4 4. SR majumdar, "Pneumatic systems",Tata Mcgrawhill, Second edition 2012, ISBN – 978-0-07-460231-7

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H		H		M						
CO2		L	M		L						
CO3	M	H	M	L	L			L			
CO4		M		M	L			L			

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	L
CO2	M	L
CO3		H
CO4	H	

PROFESSIONAL SKILL DEVELOPMENT						
Course Code	**:**	**16HSS16**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L:T:P:S**	**0:0:4:0**	**Credits**	**:**	**02**

Course Learning Objectives:

Students are able to

1. Understand the importance of verbal and written communication
2. Improve qualitative and quantitative problem solving skills
3. Apply critical and logical think process to specific problems
4. Manage stress by applying stress management skills

UNIT 1	**5 Hours**

Communication Skills: Basics of Communication, Personal Skills & Presentation Skills, Attitudinal Development, Self Confidence, SWOC analysis.

Resume Writing: Understanding the basic essentials for a resume, Resume writing tips Guidelines for better presentation of facts.

UNIT 2	**6 Hours**

Quantitative Aptitude and Data Analysis*:* Number Systems, Math Vocabulary, fraction decimals, digit places etc. Reasoning and Logical Aptitude, - Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. Verbal Analogies – introduction to different question types – analogies, sentence completions, sentence corrections, antonyms/synonyms, vocabulary building etc. Reading Comprehension, Problem Solving

UNIT 3	**4 Hours**

Interview Skills: Questions asked & how to handle them, Body language in interview, Etiquette, Dress code in interview, Behavioral and technical interviews, Mock interviews - Mock interviews with different Panels. Practice on Stress Interviews, Technical Interviews, General HR interviews

UNIT 4	**5 Hours**

Interpersonal and Managerial Skills: Optimal co-existence, cultural sensitivity, gender sensitivity; capability and maturity model, decision making ability and analysis for brain storming; Group discussion and presentation skills;

UNIT 5	**4 Hours**

Motivation and Stress Management: Self motivation, group motivation, leadership abilities Stress clauses and stress busters to handle stress and de-stress; professional ethics, values to be practiced, standards and codes to be adopted as professional engineers in the society for various projects**.**

Note: The respective departments should discuss case studies and standards pertaining to their domain

Course Outcome:

After going through this course the students will be able to

CO1: Develop professional skill to suit the industry requirement

CO2: Analyze problems using quantitative and reasoning skills

CO3: Develop leadership and interpersonal working skills

CO4: Demonstrate verbal communication skills with appropriate body language.

References
1. Stephen R Covey, "The 7 Habits of Highly Effective People", Free Press, 2004 Edition, ISBN: 0743272455
2. Dale Carnegie, "How to win friends and influence people", General Press, 1st Edition, 2016, ISBN: 9789380914787
3. Kerry Patterson, Joseph Grenny, Ron Mcmillan, "Crucial Conversation: Tools for Talking When Stakes are High", McGraw-Hill Publication, 2012 Edition, ISBN: 9780071772204
4. Ethnus, "Aptimithra: Best Aptitude Book", Tata McGraw Hill, 2014 Edition, ISBN: 9781259058738

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in TWO Phases.

Phase	Activity	Weightage
I	After 7 weeks - Unit 1, 2 & Part of Unit 3	50%
II	After 12 weeks – Unit 3, 4, 5	50%

CIE Evaluation shall be done with weightage as follows:

Writing skills	10%
Logical Thinking	25%
Verbal Communication & Body Language	35%
Leadership and Interpersonal Skills	30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	---	L	---	----	H	----	H	H	H	M
CO2	H	M	H	---	---	---	----	---	M	H	M
CO3	---	---	L	---	---	H	---	H	H	H	H
CO4	---	---	H	---	----	H	L	H	H	H	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1		
CO2		L
CO3		
CO4	L	

SECOND SEMESTER

RESEARCH METHODOLOGY

Course Code	**:**	**16MEM21R**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L: T: P: S**	**3:2:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

Students are able to

1. Understand of the underlying principles of quantitative and qualitative research
2. Perform the gap analysis and identify the overall process of designing a research study.
3. Choose the most appropriate research methodology to address a particular research problem
4. Explain a range of quantitative and qualitative approaches to analyze data and suggest possible solutions.

Unit – I **7 Hours**

Overview of Research

Meaning of Research, Types of Research, Research and Scientific Method, Defining the Research Problem, Research Design, Different Research Designs.

Unit – II **7 Hours**

Methods of Data Collection

Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

Unit – III **8 Hours**

Sampling Methods

Sampling process, Non-probability sampling, probability sampling: simple random sampling, stratified sampling, cluster sampling systematic random sampling, Determination of sample size, simple numerical problems.

Unit – IV **7 Hours**

Processing and analysis of Data

Processing Operations, Types of Analysis, Statistics in Research, Measures of: Central Tendency, Dispersion, Asymmetry and Relationship, correlation and regression, Testing of Hypotheses for single sampling: Parametric (t, z and F) Chi Square, ANOVA, and non-parametric tests, numerical problems.

Unit-V **7 Hours**

Essential of Report writing and Ethical issues:

Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Precautions for Writing Research Reports.

Syllabus includes 12 hours of tutorials in which:

- Faculty is expected to discuss research methodology for specializations under consideration.
- Numerical problems on statistical analysis as required for the domains in which students are studying must be discussed.
- Statistical analysis using MINITAB/ MatLab and such other softwares can be introduced.

Course Outcomes:

After going through this course the students will be able to

CO 1. Explain various principles and concepts of research methodology.

CO 2. Apply appropriate method of data collection and analyze using statistical methods.

CO 3. Analyze research outputs in a structured manner and prepare report as per the technical and ethical standards.

CO 4. Formulate research methodology for a given engineering and management problem situation.

Reference Books:

1. Kothari C.R., "Research Methodology Methods and techniques", New Age International, 2004, ISBN: 9788122415223
2. Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., "Management Research Methodology", Pearson Education India, 2009 Edition, ISBN:9788177585636
3. Levin, R.I. and Rubin, D.S., "Statistics for Management", 7th Edition, Pearson Education: New Delhi, ISBN-13: 978-8177585841

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	---	---	M	----	----	---	H	---	H	-----
CO2	---	L	H	H	M	M	L	L	----	M	L
CO3	L	M	M	M	H	M	L	M	---	---	M
CO4	H	H	H	H	----	L	L	M	H	---	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1		
CO2	L	
CO3	M	M
CO4		L

MECHATRONICS SYSTEMS (Theory & Practice)						
Course Code	**:**	**16MCM22**		**CIE Marks**	**:**	**100 + 50**
Hrs/Week	**:**	**L:T:P:S**	**4:0:2:0**	**SEE Marks**	**:**	**100 + 50**
Credits	**:**	**05**		**SEE Duration**	**:**	**3 + 3 Hrs.**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Substantiate the need for interdisciplinary study in technology education.
2. Understand the evolution and development of Mechatronics as a discipline.
3. Compare various types of transducers used in industrial automation, machine control systems, instrumentation and equipments.
4. Understand the applications of microprocessors in various systems and to know the functions of each element.

Unit – I	**07 Hrs**

Introduction: Definition, Multidisciplinary Scenario, Evolution of Mechatronics, Design of Mechatronics system, Objectives, advantages and disadvantages of Mechatronics.

Transducers and Sensors: Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, proximity switches and Hall effect sensors.

Unit – II	**10 Hrs**

Microprocessors and Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers, Microprocessor architecture, Terminology-CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data, Registers, Program Counter, Flags, Fetch cycle; write cycle, state, bus interrupts. Intel's 8085A Microprocessor.

Unit – III	**12 Hrs**

PLC: Introduction to PLC's, basic structure, Principle of operation, Programming and concept of ladder diagram, Concept of latching & selection of a PLC.

Integration: Integration: Introduction & background, Advanced actuators, Pneumatic actuators, Industrial Robot, different parts of a Robot-Controller, Drive, Arm, End Effectors, Sensor & Functional requirements of robot.

Unit – IV	**12 Hrs**

Mechanical Actuation: Mechanical systems, types of motion, Cams, Gear trains, Ratchet & Pawl, Belt and chain drives, Mechanical aspects of motor selection.

Electrical Actuation System: Electrical systems, Mechanical switches, Solenoids, Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.

Unit – V	**09 Hrs**

Pneumatic and Hydraulic systems: Actuating systems, Pneumatic and hydraulic systems, Classifications of Valves, Pressure relief valves, Pressure regulating/reducing valves, Pressure sequence valve, Cylinders and rotary actuators.

DCV& FCV: Principle & construction details, types of sliding spool valve, Solenoid operated, Symbols of hydraulic elements, Components of hydraulic system, functions of various units of hydraulic system.

Unit – VI (Lab Component)	**24 Hrs**

Introduction to the hydraulic work benches and lab equipments. Principals of hydraulic systems,

power and control circuits. Introduction to the pneumatic work benches and lab equipments, Matlab /SIMULINK Analysis - Analysis of Simple Hydraulic Circuits, Meter-In Circuit Analysis, Meter-out circuit, Bleed Off Circuit, Analysis of circuit - valves in series, Analysis of circuit - valves in parallel.

Course Outcomes:

After going through this course the student will be able to:

CO1: Illustrate types of transducers used in industrial automation and machine control systems.
CO2: Select the architecture of microprocessors
CO3: Analyse the working principles of mechanical, electrical, pneumatic and hydraulic actuators
CO4: Design ladder logic based PLC circuit for controlling industrial activities

Reference Books

1. Nitaigour Premchand Mahalik, "Mechatronics-Principles, Concepts and Applications", Tata Mc Graw Hill –2003, ISBN:0070483744
2. Anthony Esposito, "Fluid Power", Pearson Education 6th Edition-2011, ISBN:0135136903
3. W.Bolton, "Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering", Pearson Education-2005, ISBN: 0273742868
4. Mechatronics by "HMT Ltd. – Tata Mc GrawHill -2000.ISBN: 007463643X

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Practical

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be for 50 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Practical

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H		L	M	L						
CO2	L	L	M		L						
CO3	H	L			M						L
CO4		L	M		M	L					

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	H
CO2	M	
CO3	M	L
CO4	H	L

NON TRADITIONAL MACHINING AND TESTING (Elective Group – 2)						
Course Code	**:**	**16MCM231/16MTE231**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs.**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Understand the principle, mechanism of metal removal of various non-traditional machining processes.
2. Identify the various process parameters and their effect on the component machined on various non-traditional machining processes.
3. Apply the applications of different processes parameters for different NTM and NDT techniques.
4. Evaluate the different NTM and NDT methods for different applications.

Unit – I **08 Hrs**

Introduction: Need for unconventional machining processes, classification of non-traditional machining processes.

Abrasive Jet Machining (AJM): Abrasive Jet Machining Setup – Gas propulsion System, Abrasive feeder, Machining Chamber, AJM Nozzle; Parametric Analysis – Stand-off-distance, Abrasive flow rate, Nozzle pressure, Mixing ratio; Process Capabilities.

Ultrasonic machining (USM): Ultrasonic Machining System, Mechanics of cutting, Model proposed by Shaw – Grain Throwing Model, Grain Hammering Model; Parametric Analysis, Process Capabilities.

Unit – II **12 Hrs**

Water Jet Cutting (WJC): WJC Machine, Process Characteristics, Process Performance. Applications, Advantage and Limitations.

Abrasive Water Jet Machining (AWJM): Working Principle, AWJM Machine – Pumping System, Abrasive Feed System, Abrasive Water Jet Nozzle, Catcher; Process Analysis – Water Jet Pressure during Slotting, Water Flow Rate, Abrasive Flow Rate, Abrasive Particle Size, Abrasive Material, Cutting Parameters – Traverse Speed, Number of Passes, Stand-Off-Distance, Process Capabilities.

Abrasive Flow Machining (AFM): Working Principle of Abrasive flow Machining System Process Variables,

Magnetic Abrasive Finishing (MAF) – Working Principle of MAF, Material Removal and Surface Finish – Type and Size of Grains.

Unit – III **10 Hrs**

LASER Beam Machining (LBM): Production of LASERS, Working Principle of LASER Beam Machining, Types of Lasers – Solid State Lasers, Gas Lasers; Process Characteristics. Applications, Advantage and Limitations.

Plasma Arc Machining (PAM): Working Principle, Plasma Arc Cutting System, Elements of Plasma Arc Cutting System, Process Performance.

Electron Beam Machining (EBM): Working Principle, Electron Beam Machining System – Electron Beam Gun, Power Supply, Vacuum System and Machining Chamber; Process Parameters, Characteristics of the Process. Applications, Advantage and Limitations.

Unit – IV **08 Hrs**

Electrochemical Machining (ECM): Electrolysis, ECM Principle, ECM Machine Tool-Power

Source, Electrolyte supply and Cleaning System, Tool and Tool Feed System, Workpiece and Work Holding Device; Theory of ECM – Faraday's Laws of Electrolysis, Electrochemical Equivalent of Alloys, Material Removal Rate in ECM.

Chemical Processes: Introduction, Maskants – Cut and Peel, Screen Printing, Photoresist Maskant; Electropolishing – Introduction, Process Description, Process parameters, Process limitations, Applications, Advantage and Limitations.

Unit – V **10 Hrs**

Non Destructive Testing: Scope and advantages of NDT, comparison of NDT with DT, classifications of NDT, introduction, principle, equipment, procedures and characteristics of Visual Inspection, Eddy Current Testing, Liquid Penetrant Testing, Magnetic Particle Testing and Radiographic Testing.

Course Outcomes:

After going through this course the student will be able to:

CO1: Illustrate the principles of non-conventional machining and testing
CO2: Analyse the mechanism of material removal in non-conventional machining processes
CO3: Evaluate the performance of non-conventional machining processes
CO4: Justify non-conventional machining and non-destructive testing techniques

Reference Books

1. Bennedict, G. F., "Non Tradtional Machining Techniques", Marcel Decker, New York, 1990 ISBN 9780824773526
2. Pandey and Sha, "Modern Manufacturing Process", Prentice Hall, New Delhi, 1997 ISBN: 978-81-7319-138-1
3. Garry F. Benedict, "Unconventional Machining Process", Marcel Dekker Publication, New York, 1987. ISBN: 0-8247-7352-7
4. I. J Prasad, C G K Nair, "Non-Destructive Testing and Evaluation of Materials", Tata McGraw Hill Education Private Limited

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	L	H							
CO2	L	H		M							
CO3	H	L	M								
CO4	L	M		H							

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	
CO2		L
CO3	L	M
CO4	M	

DESIGN OF MACHINE TOOLS (Elective Group – 2)						
Course Code	**:**	**16MPD232/16MCM232**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs.**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Understand the fundamentals of Machine Tool Design
2. Demonstrate the principles of Machine Tool Design concepts
3. Develop the Design Intricacies
4. Solve the design problems of Machine Tool
5. Apply the concepts to design the Machine Tool

Unit – I	**06 Hrs**

INTRODUCTION: Working and Auxiliary Motion, Parameters Defining Working Motion Of Machine Tool, Machining time problems, Machine Tool Drives, Hydraulic Transmission And Its Elements, Mechanical Transmission And Its Elements, General Requirements, Layout Of Machine Tool, Aim of Speed and Feed Rate Regulation

Unit – II	**12 Hrs**

REGULATION OF SPPED AND FEED RATES: Stepped Regulation of Speed, Design of Feed Box, Machine Tool Drives Using Multiple Speed Motors, Special Cases of Gear Box Design, Determining The Number of Teeth of Gears, Classification of Speed and Feed Boxes, Functions and Requirements

Unit – III	**12 Hrs**

DESIGN OF MACHINE TOOL STRUCTURES: Design Criteria, Materials, Static Stiffness, Profile of Machine Tool Structures, Basic Design Procedure, Design of Beds, Design of Columns, Design of Housing, Design of Bases and Tables, Design of Cross Rails, Arms, Saddles, Carriages and Rams.

Unit – IV	**10 Hrs**

DESIGN OF GUIDEWAYS AND POWER SCREWS: Function and Types Guideways, Design of Slideways, Design Criteria and Calculations slideways, guideways operating under liquid friction conditions, Design of Power Screws.

Unit – V	**08 Hrs**

DESIGN OF SPINDLES AND SPINDLE SUPPORTS: Functions of Spindles Unit and requirements, Materials of Spindles, Effect of Machine Tool Compliance on Machining accuracy, Design Calculation of Spindles, Anti-friction Bearings, Sliding Bearings.

Course Outcomes:

After going through this course the student will be able to:

CO1: Demonstrate the fundamental concepts of Machine Tool Design
CO2: Apply mathematical models in the design of Machine Tools
CO3: Analyse speed and feed rates in machine tools
CO4: Design components of machine tools

Reference Books

1. N K Mehta, "Machine Tool Design and Numerical Control", Tata McGraw Hill, 3rd Ed, ISBN: 978-1-25-900457-5
2. N. Acherkan V Push, Nicholas Weinstein, "Machine Tool Design" University Press, 2000,

ISBN: 9780898750485
3. Nicholas Lisitsyn, Alexander Gavryusin, Oleg Trifonov, Alexander Kudryashov, " Machine Tool Design" Ardent Media Inc. ISBN: 9780829014761
4. CMTI, "Machine Tool Design Handbook" Tata McGraw-Hill, 2008, ISBN: 978-0-07-451564-8

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	L	H	-	-	-	-	-	-	-	-
CO2	M	M	L	M	-	-	-	-	-	-	-
CO3	-	L	M	H	M	-	-	-	-	-	-
CO4	-	-	L	M	H	-	-	-	-	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	M	L
CO3	-	M
CO4	-	H

TOOLING FOR MANUFACTURE IN AUTOMATION (Elective Group – 3)						
Course Code	**:**	**16MCM241/16MTE241**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs.**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Understand the basic of Tooling in manufacturing
2. Demonstrate the principle involved in Tooling
3. Develop the concept of machinability
4. Evaluate the cutting tool material in manufacturing
5. Analyze the concepts of cutting fluids

Unit – I **10 Hrs**

Cutting Tool Materials: Cutting Technology – an Introduction, The Evolution of Cutting Tool Materials, Tool Coatings: Chemical Vapour Deposition (CVD), Physical Vapour Deposition (PVD), Diamond-Like CVD Coatings, Cubic Boron Nitride (CBN) and Poly-crystalline Diamond (PCD), Natural Diamond.

Turning and Chip-breaking Technology: Cutting Tool Technology, Chip-Development, Tool Nose Radius, and Multi-Functional Tooling.

Unit – II **12 Hrs**

Drilling and Associated Technologies: Drilling Technology, Boring Tool Technology, Reaming Technology.

Milling Cutters and Associated Technologies: Milling, Pocketing, Closed-Angle Faces, Thin-Walled and Thin-Based Milling Strategies, Rotary and Frustum-Based Milling Cutters – Design and Operation, Customised Milling Cutter Tooling, Mill/Turn Operations.

Unit – III **12 Hrs**

Threading Technologies: Threads, Hand and Machine Taps, Fluteless Taps, Threading Dies, Thread Turning, Thread Milling, Thread Rolling.

Modular Tooling and Tool Management: Modular Quick-Change Tooling, Tooling Requirements for Turning Centers, Machining and Turning Centre Tooling, Balanced Modular Tooling for HS.

Unit – IV **07 Hrs**

Machinability and Surface Integrity: Machinability, Chatter in Machining Operations, Milled Roundness, Machined Surface Texture, Machining Temperatures, Tool Wear and Life

Unit – V **07 Hrs**

Cutting Fluids: Primary functions, high pressure Jet-assisted coolant delivery, types, classification, selecting the correct cutting fluid- care, handling, control and usage of cutting fluids, multi-functional fluids, disposal of cutting fluids, health and safety factors.

Course Outcomes:

After going through this course the student will be able to:

CO1: Illustrate fundamental concepts of tooling in automation manufacturing
CO2: Analyze the concepts of Tooling
CO3: Explain the principles of Tooling
CO4: Evaluate the machining and coolant capabilities

Reference Books

1. Graham T. Smith "Cutting Tool Technology- Industrial Handbook" - Springer.2nd Ed, ISBN 978-1-84800-204-3.
2. Cyrol Donaldson, "Tool Design" -, Tata McGraw Hill, , India, 4th Ed ISBN 0070992746.
3. Edward G Hoffman, "Fundamentals of Tool Design" SME, USA. ISBN 0872634906.
4. David A.Stephenson, John S. Agapiou, "Metal cutting theory and practice", CRC Taylor and Francis publishers, 2nd Ed. ISBN 0824795792.

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	-	-	-	-	-	-	-	-	-
CO2	L	H	M	-	-	-	-	-	-	-	-
CO3	-	L	M	H	M	-	-	-	-	-	-
CO4	-	-	L	M	H	-	-	-	-	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	M	L
CO3	-	M
CO4	-	H

INDUSTRIAL ROBOTICS (Elective Group – 3)						
Course Code	**:**	**16MMD242/16MCM242**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs.**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Understand the structure and configuration of Industrial robots.
2. Analyze the kinematic and dynamic related analysis of industrial robots.
3. Demonstrate the basic structure of trajectory interpolator
4. Describe the configuration of various types of autonomous robots

Unit – I **07 Hrs**

Automation and Robotics - Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, Types of Drive Systems and their Relative Merits, the Wrist & Gripper Subassemblies. Concepts and Model about Basic Control System, Control Loops of Robotic Systems, PTP and CP Trajectory Planning, Control Approaches of Robots

Unit – II **10 Hrs**

Kinematics of Robot Manipulator: Introduction, General Description of Robot Manipulator, Mathematical Preliminaries on Vectors & Matrices, Homogenous Representation of Objects, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation, Relative Transformation, Direct & Inverse Kinematics' Solution, D H Representation & Displacement Matrices for Standard Configurations, Geometrical Approach to Inverse Kinematics. Homogeneous Robotic Differential Transformation: Introduction, Jacobian Transformation in Robotic Manipulation

Unit – III **12 Hrs**

Robotic Workspace & Motion Trajectory: Introduction, General Structures of Robotic Workspaces, Manipulations with n Revolute Joints, Robotic Workspace Performance Index, Extreme Reaches of Robotic Hands, Robotic Task Description. Robotic Motion Trajectory Design: – Introduction, Trajectory Interpolators, Basic Structure of Trajectory Interpolators, Cubic Joint Trajectories. General Design Consideration on Trajectories: 4-3-4 & 3-5-3 Trajectories, Admissible Motion Trajectories.

Unit – IV **12 Hrs**

Dynamics of Robotic Manipulators: Introduction, Bond Graph Modeling of Robotic Manipulators, Examples of Bond Graph Dynamic Modeling of Robotic Manipulator. Brief Discussion on Lagrange–Euler (LE) Dynamic Modeling of Robotic Manipulators: - Preliminary Definitions, Generalized Robotic Coordinates, Dynamic Constraints, Velocity & Acceleration of Moving Frames, Robotic Mass Distribution & Inertia Tensors, Newton's Equation, Euler Equations, The Lagrangian& Lagrange's Equations. Application of Lagrange–Euler (LE) Dynamic Modeling of Robotic Manipulators: - Velocity of Joints, Kinetic Energy T of Arm, Potential Energy V of Robotic Arm, The Lagrange L, Two Link Robotic Dynamics with Distributed Mass, Dynamic Equations of Motion for A General Six Axis Manipulator.

Unit – V **07 Hrs**

Autonomous Robot: Locomotion Introduction, Key issues for locomotion Legged Mobile Robots Leg configurations and stability Examples of legged robot locomotion Wheeled Mobile Robots

Wheeled locomotion: the design space Wheeled locomotion: case studies Mobile Robot Kinematics Introduction Kinematic Models and Constraints Representing robot position Forward kinematic models Wheel kinematic constraints Robot kinematic constraints, Mobile Robot Maneuverability Degree of mobility Degree of steerability Robot maneuverability.

Course Outcomes:

After going through this course the student will be able to:

CO1: Analyze the manipulator design including actuator, drive and sensor issues
CO2: Calculate the forward kinematics, inverse kinematics and Jacobian industrial robots
CO3: Solve trajectory and dynamic related robotic problems
CO4: Evaluate the different configurations and stability of autonomous robots

Reference Books

1. Mohsen Shahinpoor "A Robot Engineering Textbook" Harper & Row publishers, New York. ISBN:006045931X
2. Fu, Lee and Gonzalez, "Robotics, control vision and intelligence," McGraw Hill International. ISBN:0070226253
3. John J. Craig, "Introduction to Robotics", Addison Wesley Publishing, ISBN:0201543613
4. Roland Illah R. Siegwart Nourbakhsh, Autonomous mobile robots, The MIT Press Cambridge, Massachusetts London, England, 2004.ISBN:0262015358

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H			L							
CO2	M			M							
CO3	M	M	M	M							
CO4	M	M	M	M							

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	L
CO2	M	
CO3		L
CO4	L	H

AUTOMATION AND PRODUCTION SYSTEMS (Elective Group – 4)						
Course Code	**:**	**16MCM251**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs.**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Understand the basic Fundamentals of Automation Production System
2. Demonstrate the principles of PLC
3. Demonstrate the principles of Automated MH, AS/RS
4. Analyze the equations in Material Handling, Storage System
5. Explain the components of and Automated Data Capture, Assembly

Unit – I	**08 Hrs**

Introduction: Production System Facilities, Manufacturing Support Systems, Automation in Production Systems, Manual Labor in Production Systems, Automation Principles and Strategies, Ten Strategies for Automation and Production Systems, Basic Elements of Automated System, Advanced Automation Functions, Levels of Automation.

Unit – II	**13 Hrs**

Basic Elements of an Automated System: Process Industries Versus Discrete Manufacturing Industries, Continuous Versus Discrete Control, Computer process control Forms of Computer Process Control.

Sensors, Actuators, and Other Control System Components: Sensors, Actuators, Analog-to-Digital Conversion, Digital-to-Analog Conversion, Input / Output Devices for Discrete Data.

Unit – III	**15 Hrs**

Discrete Control Using Programmable Logic Controllers and Personal Computers: Discrete Process Control, Ladder Logic Diagrams, Programmable Logic Controller, Personal Computers Using Soft Logic.

Material Handling and Transportation System: Overview Material Handling Equipment, Considerations in Material Handling System Design, Principles of Material Handling, Industrial Trucks, Automated Guided Vehicle Systems, Monorails and Other Rail Guided Vehicles, IDA Conveyors Systems, Crane and Hoists, Analysis of Material Transport Systems.

Unit – IV	**06 Hrs**

Storage Systems: Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated storage systems, Engineering Analysis of Storage System.

Unit – V	**06 Hrs**

FMS and Automated System Assembly: What is FMS, FMS Components, FMS Applications and Benefits, FMS Planning and Implementation Issues, Quantitative Analysis of Flexible Manufacturing Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, Quantitative Analysis of Assembly Systems

Course Outcomes:

After going through this course the student will be able to:

CO1: Classify the types of Automation and Production System

CO2: Analyze the concepts of Automation

CO3: Apply the concepts of mathematical equation in material handling and AS/RS and Automation System CO4: Evaluate the techniques involved in FMS
Reference Books
1. David J Parrish "Flexible manufacturing" Butterworth-Heinemann Publisher, 1990 ISBN: 9780750610117 2. Mikell P Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall India (P) Ltd, 2008 ISBN: 9780132393218 3. William W. Luggen "Flexible Manufacturing Cells & Systems" Prentice hall, 2006, ISBN: 9780133217384 4. Viswanadham N, Narahari Y, " Performance Modeling of Automated Manufacturing Systems", Prentice Hall of India (P) Ltd, 1992. ISBN: 9780136588245

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	-	-	-	-	-	-	-	-	-
CO2	M	M	L	M	-	-	-	-	-	-	-
CO3	L	H	M	H	M	-	-	-	-	-	-
CO4	-	L	L	M	H	-	-	-	-	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	L	L
CO3	-	M
CO4	-	H

COMPUTER AIDED PROCESS PLANNING (Elective Group – 4)						
Course Code	**:**	**16MCM252**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs.**

Course Learning Objectives (CLO):

Graduates shall be able to

1. Understand the need of computer aided process planning
2. Differentiate generative and retrieval type CAPP system
3. Explain the machining parameter and tolerance needed for planning
4. Analyze tool path to implement technique of CAPP

Unit – I	**10 Hrs**

Introduction to CAPP: Information requirement for process planning system, Role of process planning, advantages of conventional process planning over CAPP, Structure of Automated process planning system, feature recognition, methods.

Generative CAPP system: Importance. Principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.

Unit – II	**10 Hrs**

Retrieval CAPP system: Significance, group technology, structure, relative advantages, implementation, and applications.

Selection of manufacturing sequence: Significance, alternative manufacturing processes, reduction of total set up cost for a particular sequence. quantitative methods for optimal selection, Examples.

Unit – III	**10 Hrs**

Determination of machining parameters: reasons for optimal selection of machining parameters, effect of parameters on production rate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

Unit – IV	**08 Hrs**

Determination of manufacturing tolerances: design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach, integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach.

Unit – V	**10 Hrs**

Generation of tool path: Simulation of machining processes, NC tool path generation, graphical Implementation, determination of optimal index positions for executing fixed sequence, quantitative methods.

Implementation techniques for CAPP: MIPLAN system, Computer programming languages tbr CAPP, criteria for selecting a CAPP system and benefits of CAPP. Computer integrated planning systems, and Capacity planning system.

Course Outcomes:

After going through this course the student will be able to:

CO1: Explain the role of CAPP in manufacturing system

CO2: Apply suitable idea to select the computer aided process planning

CO3: Analyze and determine the machining parameter and manufacturing tolerance

CO4: Evaluate the tool path to implement the CAPP technique

Reference Books

1. P N Rao, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000, ISBN: 0074631039
2. Nanua Singh, "Systems approach to Computer integrated Design and Manufacturing", John Wiley & sons, 1996. ISBN:0471585173
3. Gideon Halevi and Rol and. D. Weill, "Principles of Process Planning, A logical approach ', Chapman & Hall 1995. ISBN:978-0-412-54360-9
4. Tien – Chien Chang, Richard. A. Wysk, "An introduction to Automated process planning system", Prentice Hall, 1985. ISBN:0134781406

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L			L						
CO2	M	M									
CO3	M	M	L	L	L						
CO4	M	M	L	L							

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	L
CO2	M	L
CO3	M	L
CO4		H

MINOR PROJECT						
Course Code	**:**	**16MCM26**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**0:0:10:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**05**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

Students are able to

1. Understand the method of applying engineering knowledge to solve specific problems.
2. Apply engineering and management principles while executing the project
3. Demonstrate the skills for good presentation and technical report writing skills.
4. Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES

1. Each project group will consist of maximum of two students.
2. Each student / group has to select a contemporary topic that will use the technical knowledge of their program of study after intensive literature survey.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The number of projects that a faculty can guide would be limited to four.
5. The minor project would be performed in-house.
6. The implementation of the project must be preferably carried out using the resources available in the department/college.

Course Outcomes:

After going through this course the students will be able to

CO1: Conceptualize, design and implement solutions for specific problems.

CO2: Communicate the solutions through presentations and technical reports.

CO3: Apply resource managements skills for projects

CO4: Synthesize self-learning, team work and ethics.

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of FOUR members : guide, two senior faculty members and Head of the Department.

Phase	Activity	Weightage
I	Synopsis submission, Preliminary seminar for the approval of selected topic and Objectives formulation	20%
II	Mid-term seminar to review the progress of the work and documentation	40%
III	Oral presentation, demonstration and submission of project report	40%

****Phase wise rubrics to be prepared by the respective departments**

CIE Evaluation shall be done with weightage / distribution as follows:

- Selection of the topic & formulation of objectives 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing 25%
- Demonstration & Presentation 15%
- Report writing 25%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Presentation / Demonstration of the project 20%
3. Methodology and Experimental Results & Discussion 25%
4. Report 20%
5. Viva Voce 30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	H	H	H	---	---	M	---	H	H
CO2	----	---	----	---	H	----	---	H	H	H	----
CO3	H	H	M	---	M	M	H	H	---	M	H
CO4	---	H	----	---	----	H	M	M	M	H	---

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	M
CO2		L
CO3		M
CO4	M	M