Rashtreeya Sikshana Samithi Trust

R.V.College of Engineering

(Autonomous Institution Affiliated to VisvesvarayaTechnologicalUniversity, 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 VisvesvarayaTechnologicalUniversity, 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: M.Tech in Computer Integrated Manufacturing

Program Specific Criteria (PSC) as per ASME

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 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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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	Computational Methods(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	Product Data Management
Elective- 6			
16MCM331	Modelling and Simulation of Manufacturing Systems	16MCM332/16MTE332	Design for Manufacture and Assembly
Elective- 7			
16MCM341	Micro and Nano Manufacturing	16MCM342/16MTE342	Applied Metrology and Quality Control

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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**

THIRD SEMESTER

COMPUTATIONAL METHODS (Theory & Practice)						
Course Code	**:**	**16MCM31**		**CIE Marks**	**:**	100 + 50
Hrs/Week	**:**	**L:T:P:S**	**4:0:1:0**	**SEE Marks**	**:**	100 + 50
Credits	**:**	**5**		**SEE Duration**	**:**	**3 + 3 Hours**

Course Learning Objectives (CLO):

Student are able to

- Identify mathematical model for solution of common engineering problems.
- Formulate simple problems into finite elements.
- Solve structural, thermal, fluid flow problems.
- Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
- Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.

Unit – I	**12Hrs**

Finite Element Formulation of Boundary Value: Solution to engineering problems – mathematical modeling – discrete and continuum modeling – need for numerical methods of solution – relevance and scope of finite element methods – engineering applications of FEA. Weighted residual methods –general weighted residual statement – weak formulation of the weighted residual statement –comparisons – piecewise continuous trial functions- example of a bar finite element –functional and differential forms – principle of stationary total potential – Rayleigh Ritz method – piecewise continuous trial functions – finite element method – application to bar element

Unit – II	**10 Hrs**

One Dimensional Finite Element Analysis: General form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element –nodal approximation – development of shape functions – element matrices and vectors – example problems – extension to plane truss– development of element equations – assembly – element connectivity –global equations – solution methods –beam element – nodal approximation – shape functions – element matrices and vectors – assembly – solution – example problems.

Unit – III	**12 Hrs**

Two Dimensional Finite Element Analysis: Introduction – approximation of geometry and field variable – 3 nodedtriangular elements – four nodedrectangular elements – higher order elements – generalized coordinates approach to nodal approximations – difficulties – natural coordinates and coordinate transformations – triangular and quadrilateral elements – iso-parametric elements – structural mechanics applications in 2-dimensions – elasticity equations – stress strain relations – plane problems of elasticity – element equations – assembly – need for quadrature formulae – transformations to natural coordinates – Gaussian quadrature – example problems in plane stress, plane strain and axisymmetric applications.

Unit – IV	**8 Hrs**

Dynamic Analysis using Finite Element Method: Introduction – vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations –solution of eigenvalue problems – vector iteration methods – normal modes – transient vibrations – modeling of damping – mode superposition technique – direct integration methods.

Metal Cutting using Finite element Method : Basic concepts of plasticity and fracture – Solid and flow formulation – small incremental deformation formulation – Fracture criteria – FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency – FE analysis of welding.

Unit – V	**8 Hrs**

Axisymmetric elasticity problems-Governing equations for Axisymmetric elasticity, Axisymmetric linear triangular element, Axisymmetric four node iso-parametric element.

FE analysis of metal casting – special considerations, latent heat incorporation, gap element – Time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure- Heat distribution in machining-effects of various parameters on temperature-methods of temperature measurement in machining-hot machining-cutting fluids.

Unit - VI (Lab Component) **24 Hours**

Lab Exercises:

1. Basic Stress analysis
2. Deflection and Stress Analysis in beams
3. Nonlinear plastic Deformation and buckling Analysis
4. Two dimensional problems (Plane stress & Plane strain problems)
5. Analysis of Composite materials
6. Analysis of pressure vessels
7. Three dimensional FE analysis
8. Contact Problems

Course Outcomes:

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

CO1: Demonstrate the basic concepts of finite element methods
CO2: Develop Finite Element Solutions in Structural, thermal and damping domains
CO3: Analyse systems for structural, thermal and damping
CO4: Create linear and non-linear Finite Element solutions

Reference Books:

1. Chandrupatla T. R., and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall, 2003. *ISBN*-10: 0132162741
2. Reddy, J. N. "An Introduction to the Finite Element Method", 3rd Edition, McGraw-Hill Science/Engineering/Math, 2005. ISBN-10: 0072466855.
3. S. S. Rao “The Finite Element Methods in Engineering, Fifth Edition, Elsevier Publications. *ISBN*-9781856176613
4. Bathe, K.J., “Finite element procedures”, Prentice Hall of India, New Delhi 2001, *ISBN* 620.00422.

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								
CO2	M	M	M			L					
CO3	L	H	H	M		M					
CO4		M	L	L	L	H					

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

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

ADDITIVE MANUFACTURING TECHNOLOGY (Elective Group-5)						
Course Code	**:**	**16MCM321**		**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):

Student shall be able to

1. Define the basics of Additive Manufacturing
2. Discuss the principles of Additive Manufacturing
3. Develop the concept of system and informatics of Additive Manufacturing
4. Evaluate the techniques of Additive Manufacturing
5. Apply AM science in implementing the Production Process

Unit – I **10 Hrs**

Basic Principles and Development of AM Technology:

Conventional Machining Processes, Development of CAD/CAM systems, Advantages and Limitations; Concurrent Engineering; Data Format; Rapid Prototyping Technologies, Laminated Object Manufacturing

Generic AM Process; Distinction between Am and CNC, CAD and other Technology, Classification of AM Process; Metal and Hybrid systems; Steps in AM process; Design for AM

Unit – II **10 Hrs**

Powder Bed Fusion Processes: Introduction, Materials, Powder Fusion Mechanisms, Process Parameters and Modeling, Laser, UV and IR; Process Benefits and Drawbacks.

Extrusion-Based Systems: Introduction, Basic Principles, Plotting and Path Control, Fused Deposition Modeling.

Unit – III **10 Hrs**

Stereo lithography: Materials, Processes parameters, advantages and limitations;

Material and BinderJetting: Evolution, Materials, Material Processing Fundamentals, Material Jetting Machines, Process Benefits, binding materials and systems.

Laser Engineered Net Shaping (LENS) : Materials, Process Parameters & Systems

Post Processing of additive manufactured parts.

Unit – IV **10 Hrs**

Design for Additive Manufacturing: Design for Manufacturing and Assembly, AM Unique Capabilities, Core DFAM Concepts and Objectives, CAD Tools for AM.

Applications for Additive Manufacture: Introduction, The Use of AM to Support Medical Applications, Aerospace and Automotive Applications.

Unit – V **08 Hrs**

Rapid Tooling: Introduction, Direct and Indirect AM tooling process; Production of Injection Molding Inserts, EDM Electrodes, Investment Casting and Other Systems, RTV Silicone Tooling, Calcium silicate based castable tooling.

Course Outcomes:

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

CO1 Explain the working process and technology development of Additive Manufacturing.
CO2 Apply the principles of AM in manufacturing industry
CO3 Analyze the concepts of AM in Production Process
CO4 Evaluating the techniques involved in AM

Reference Books:

1. Ian Gibson, David Rosen, Brent Stucker, "Additive Manufacturing Technologies"-Springer, 2nd Edition. ISBN 978-1-4939-2112-6
2. Chee Kai Chua, Kah Fai Leong, "3D Printing and Additive Manufacturing, Principles and Applications", 4th Ed, ISBN 978-9-8145-7140-1
3. AmitBandyopadhyay, Susmita Bose " Additive Manufacturing", CRC Press 2015 ISBN 9781482223590
4. Lihni Wang, Andrew Y.C. Nee "Collabarative design and planning for digital manufacturing" Springer Series, 2009, ISBN 998-1-84882-286-3

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	L	L
CO2		L
CO3	H	
CO4		H

PRODUCT DATA MANAGEMENT (Elective Group -5)						
Course Code	**:**	**16MCM322**		**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: students expected to

- Understand the principles and components of productdatamanagement.
- Appreciate the integrated approach in productdatamanagementof various projects.
- Elaborate the processes of managing product cost and Workflow management.
- Use product data management tools and techniques.

Unit – I **10 hrs**

Introduction: Client Server Systems, Parallel Systems, Distributed Systems, Network Types, Parallel Database, Distributed Database, Security and Integrity, Standardization views.

Unit – II **10Hrs**

Product Data Management: Product life cycle, Complexity in Product Development, General Description of PDM.

Basic functionality of PDM: Information architecture, PDM System architecture, Applications used in PDM systems, Trends in PDM.

Unit – III **10 Hrs**

Document Management Systems: Document management and PDM, Document life cycle, Content Management, Document management and related technologies, Document management resources on the Internet.

Unit – IV **8Hrs**

Workflow Management in PDM: Structure Management, Engineering Change Management, Release Management, Version Management, Configuration Management

Creating Product Structures: Part centric approach, CAD centric approach, Product Structure configuration, Managing Product Structures

Unit-V **10 Hrs**

PDM Implementation Case Studies: Sun Microsystems, Inc., Mentor Graphics Corporation, Ericsson Radio Systems AB, Ericsson Mobile Communications AB, ABB Automation Technology Products, SaabTech Electronics AB. **PDM Tools:** Matrix One, TeamCenter, Windchill.Enovia, PDM resources on the Internet

Course Outcomes:

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

CO1: Explain the concepts, tools and techniques for managing product data.
CO2: Analyze various processes in the product data management frameworks.
CO3: Evaluate risks in large and complex workflow management environments.
CO4: Develop product data management plans for various types of organizations.

Reference Books:

1. **Implementing and Integrating Product Data Management and Software Configuration Management -20** IvicaCmkovic Ulf Asklund - AnnitaPerssonDahlqvist - Archtech House Publishers. ISBN:1580534988
2. **Product Data Management** - Rodger Burden - Publisher: Resource Publishing- ISBN-10: 0970035225,*ISBN*-10: 0970035225
3. **The AutoCAD Database Book – Accessing and Managing CAD Drawing Information** – Galgotia Publications - Third Edition.ISBN 978-0940087286

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 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.

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	M	L		L							
CO3		M				M	M			M	
CO4	M	L	M	M				L			

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

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

MODELLING AND SIMULATION OF MANUFACTURING SYSTEMS
(ELECTIVE GROUP-6)

Course Code	**:**	**16MCM331**		**CIE Marks**	**:**	**100**
Hours /Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credit	**:**	**4**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

Student shall be able to

1. Explain a given engineering system in terms of purpose, parameters, constraints, performance requirements, subsystems, interconnections and environmental context.
2. Analyse a modeling strategy for a real world engineering system by integrating sub-system models.
3. Apply a model to facilitate engineering decision making and predicted advantages over alternative models.
4. Evaluate the simulation results of an engineering system model, within the context of its capabilities and limitations, to address critical issues in an engineering project

Unit –I **10Hrs**

Principles of Modeling And Simulation

Basic concepts of systems, General systems, Elements of systems, system environment.
Types of systems-discrete and continuous systems.
Models of a system, Types of models.
Concept of simulation, Monte carlo-simulation, Simulation as a decision making tool, advantages and limitations of simulation, areas of application.

Unit –II **10Hrs**

Probability and Statistical conceptsfor Simulation

Discrete distributions, continuous distributions.

Discrete Event Simulation

Concepts in discrete event simulation, simulation using event scheduling, single channel queue, two server queue, simulation of lead time-demand of inventory.

Unit –III **10Hrs**

Random Number Generation

Techniques for generating random numbers- congruential methods. Tests for random numbers -The Kolmogorov-Smirnov test, the Chi-square test.

Random Variable Generation

Inverse transform technique, acceptance- rejection technique

Unit-IV **10Hrs**

Data collection, Verification and validation of simulation models

Method of collecting useful data, verification, calibration and validation of models, Naylor-finger method

Unit-V **10Hrs**

System simulation software's

Selection of simulation software's, demonstration of system simulation using ARENA software

Course Outcomes:

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

CO1. Explain elementary tools of modeling of mechanical, electrical, fluid, and thermo fluid Systems.

CO2. Discuss real-world systems to which modeling and analysis tools are applied.

CO3. Evaluatebasic concepts in numerical integration and computer simulation of Mathematical models.

CO4:Apply decision-making skills needed to devise models that adequately represent relevant behaviors yet remain simple.

Reference Books

1. Jerry Banks &John S Carson II,"Discrete Event System Simulation",Prentice Hall Inc.-1984., ISBN : 57:04577-02-0253
2. Gordan. G,"Systems Simulation", Prentice Hall India Ltd -1991, ISBN : 52: 02526820001
3. NusingDeo ,"System Simulation With Digital Computer", Prentice Hall of India – 1979, ISBN : 42: 025268205011
4. Francis Neelamkovil, "Computer Simulation and Modeling", John Wilely& Sons - 1987, ISBN : 57:04581-02-0235

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	L			M	M		L
CO2	M	H	H	H	L	L		L		M	L
CO3	H	M	M	L			M				H
CO4	L	H	L	M				L		L	

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

	PSO1	PSO2
CO1	H	
CO2		L
CO3		M
CO4	M	

DESIGN FOR MANUFACTURE AND ASSEMBLY (Elective Group-6)						
Course Code	**:**	**16MCM332/16MTE332**		**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. Understanding of the major manufacturing processes, including machining, casting, forming, assembly
2. Analyze the relationships between customer desires, project materials, product design, and manufacturing process selection.
3. Develop an appreciation of product design and manufacturing process trade-offs
4. Determine how products were manufactured and why?

Unit – I **10Hrs**

Introduction to DFMA: History of DFMA, Steps for applying DFMA during product design, Advantages of applying DFMA during product design, Reasons for not implementing DFMA,

Introduction to Manufacturing Process: Classification of manufacturing process, Basic manufacturing processes, Mechanical properties of material: Tensile properties, Engineering stress-strain, True stress strain, Compression properties, Shear properties,

Introduction to materials and material selection: Classification of engineering materials, Material selection for product design.

Unit – II **12Hrs**

Sand casting: Introduction to sand casting, Typical characteristics of a sand cast part, Design recommendation for sand casting. **Investment casting**: Introduction, Steps in investment casting, Design consideration of Investment casting, Typical characteristics and applications, **Die casting**: Introduction to die casting, Advantages of the die casting process, Disadvantages of the die casting process, Applications, Suitable material consideration, General design consideration.

Injection molding: Introduction to injection molding, Typical characteristics of injection moulded parts, Effect of shrinkage, Suitable materials, Design recommendations.

Unit – III **10Hrs**

Design for machining: Introduction to machining, Recommended materials for machinability, Design recommendations, Design for tuning operation: Process description, Typical characteristics and applications, Suitable materials, Design recommendations, Design for machining round holes: Introduction, Suitable materials, Design recommendations and Recommended tolerances.

Parts produced by milling: Process description, Characteristics and applications of parts produced on milling machines, Design recommendations for milling, Dimensional factors and tolerances, Parts produced by planning, shaping and slotting: Process description, Design recommendation planning.

Unit – IV **08Hrs**

Introduction to Assembly: The assembly process, Characteristics and applications, Example of common assembly, Economic significance of assembly, General taxonomies of assembly operation and systems, Assembling a product, Design for Assembly: Introduction, Design consideration, Design for Fasteners: Introduction, Design recommendation for fasteners.

Unit – V **08Hrs**

Introduction to CAD: Geometric Representation in CAD, Extraction of part feature information from CAD Model: Introduction, Feature recognition techniques, Free Form Features, Hybrid

Techniques, Reference, Extraction of assembly feature information from CAD Model: Introduction, Assembly features, Definition of assembly feature attributes, Characterization of assembly feature.

Course Outcomes:

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

CO1: Describe the role of manufacture and assembly within the overall design process

CO2: Evaluate and select manufacturing and assembly processes relevant to the aerospace industry

CO3: Quantify cost and metrics for manufacturing and assembly processes relevant to the aerospace industry

CO4: Design a complex, well-defined component accounting for manufacture and assembly.

Reference Books

1. Geoffrey Boothroyd, Peter Dewhurst and Winston A. Knight. "Product Design for Manufacture and Assembly".Standardsmedia. 2010.ISBN-13: 978-1420089271
2. Karl T. Ulrich and Steven D. Eppinger. "Product Design and Development". McGraw-Hill Education; 5 edition. 2011. ISBN-13: 978-0073404776
3. Chitale A. K and Gupta R. C. "Product Design and Manufacturing", Prentice Hall India Learning Private Limited; 5 edition. 2011. ISBN-13: 978-8120342828

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		H	M							
CO3	M	M	M	M							
CO4	M	M	M	M							

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

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

Micro and Nano Manufacturing
(Elective Group -7)

Course Code	**:**	**16MCM341**		**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):

1. Explain principal and process of micro and nano fabrication.
2. Describe the various CVD and PVD based coating methods
3. Discus the various applications of micro and nano fabrication

Unit – I **10 hrs**

Introduction to Micro & Nanofabrication, Classification, lithography – principles and processes of optical lithography, types of substrates, silicon wafers, crystallography, positive and negative photoresists, masking techniques, wet chemical etching and surface-micromachining.

Unit – II **10Hrs**

Electron beam Machining – principles of electron optics, vector and raster scan systems, micro-machining systems; **Ion-beam Machining** – Ion sources, focusing systems for ion-beams, sputtering and deposition using ion-beams, ion etching. Atomic Layer Deposition Process (ALD)

Unit – III **10 Hrs**

Physical & Chemical Vapor Deposition – introduction, thermal evaporation, molecular beam epitaxy, laser assisted sputtering, ion plating, energy source for chemical vapor deposition, plasma-enhanced chemical vapor deposition, characterization of thin films – methods and instruments

Unit – IV **8Hrs**

Micro-machining – Laser micromachining, ultrasonic micromachining, micro-electro-discharge machining, micro electo-chemical machining, abrasive jet micro-machining, magneto-rheological machining, metrology for micro-machined parts

Unit-V **10 Hrs**

Applications of Micro &Nanomanufacturing Technologies – VLSI circuits, nanoelectronic devices, opto-electronic devices, magnetic storage devices, MEMS, lab-on-chip, bio-chips, accelerometers, micro-mirrors, micro-cantilevers, packaging and assembly of nano& micro devices

Course Outcomes:

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

CO1: Explain the fundamental concepts of micro and nano fabrications

CO2: Apply their knowledge to understand the principle and working of nano and micro fabrication techniques.

CO3: Analyze the different CVD and PVD techniques.

CO4: Evaluate the suitable fabrication technique and coating method for various relevant applications.

Reference Books:

1. Zheng Chui, Micro-Nanofabrication Technologies & Applications, Springer-Higher Education Press, ISBN-13: 978-3540289227.

2. Marc J Madou, Fundamentals of Microfabrication, CRC Press, ISBN 9780849308260.
3. Jain V K, Introduction to Micromachining, 2nd Edn, Narosa Publishers, ISBN-13: 978-1842658918

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 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.

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

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

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

	PSO1	PSO2
CO1	H	
CO2	M	L
CO3		M
CO4	L	

APPLIED METROLOGY AND QUALITY CONTROL (Elective Group – 7)						
Course Code	**:**	**16MCM342 /16MTE 342**		**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 fundamental concepts of metrology
2. Discus the various elements/ parameters present for measurement
3. Choose the right optical and non-contact measuring techniques.
4. Demonstrate the quality checking by using various charts.

Unit – I **08 Hrs**

INTRODUCTION TO METROLOGY:Basic Concepts - Legal Metrology - Precision - Accuracy - Types of errors –least square fit. Linear and Angular Measurements - Standards of Measurements - Calibration - Interchangeability and selective assembly- Gauges for inspection-types- Gauge design-Taylor's principle- Introduction to Comparators - Types of Comparators - Mechanical, Mechanical - Optical, Electrical and Electronic, pneumatic- flow type differential pressure type.

Unit – II **10 Hrs**

MEASUREMENTS OF SCREW THREAD - GEAR ELEMENTS – SURFACE FINISH: Internal and External screw threads: Measurements of various elements of thread - Best size wire - Two and three wire method. Gear: Measurements of various elements - Constant chord method - Base tangent method. Surface Finish: Surface topography definitions - Measurement of Surface Texture - Methods - Evaluation of Surface finish.

Unit – III **10 Hrs**

OPTICAL METROLOGY and NON CONTACT MEASUREMENT TECHNIQUES: Principle of light wave interference - Light sources –Measurement with optical flats-Types of Interferometers - Michelson, Twyman Green Specialization of Michelson, NPL flatness Interferometers, The Pitter NPL gauge - laser interferometer- laser micrometer- surface roughness measurement using laser. Machine vision –Image processing techniques-edge detection-feature extraction- applications.

Unit – IV **10Hrs**

COORDINATE METROLOGY AND FORM MEASUREMENT: Coordinate Measuring Machine-components of CMM-types-measuring head -types of probe- alignment error-causes of error -measuring accuracy-calibration of CMM performance of CMM-applications-measurement integration, Measurement of straightness - Flatness - squareness - parallelism - circularity – roundness and run out.

Unit – V **10 Hrs**

THEORY OF CONTROL CHARTS & ACCEPTANCE SAMPLING

Introduction - Definition of Quality - Chance Causes and assignable Causes – SQC Benefits and Limitations-Theory of Control Charts: Control Charts for Variables - R, -σ charts - run up - run down - Process capability studies. Control Charts for attributes – P chart, nP chart, C and U chart. acceptance sampling- OC curve - AQL - LTPD - AOQL - Sampling Plans - Simple - Double - Multiple and sequential sampling plans –simple problems

Course Outcomes:

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

CO1: Explain the fundamental concepts of metrology

CO2: Apply their knowledge to use the various measuring instruments. CO3: Analyze the different measuring techniques CO4: Evaluate the quality of product using different types of charts
Reference Books
1. Jain.R.K, "Engineering Metrology", Khanna Publishers, New Delhi, 2012.ISBN 13:9788174091536 2. Gupta.R.C, "Statistical Quality Control", Khanna Publishers, New Delhi, 1994. ISBN:8174091114 3. Kevin G Harding ,"Handbook of Optical Dimensional Metrology", CRC Press, A Taylor & Francis group, 2013. ISBN: 9781439854815. 4. Robert.JHocken, Paulo H. Pereira,Coordinate, "Measuring Machines and Systems", CRC Press,Taylor& Francis Group, 2011. ISBN:9781574446524 5. Grant E. L., "Statistical Quality Control", McGraw Hill, New York, 2000. ISBN-10:0071004475;

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	M	L	M							
CO4	L		M		H						

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

	PSO1	PSO2
CO1	H	
CO2		L
CO3	M	M
CO4		L

INTERNSHIP / INDUSTRIAL TRAINING						
Course Code	**:**	**16MCM35**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**0:0:6:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**3**		**SEE Duration**	**:**	**30 min**

GUIDELINES FOR INTERNSHIP

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the process of applying engineering knowledge to produce product and provide services.

(2) Explain the importance of management and resource utilization

(3) Comprehend the importance of team work, protection of environment and sustainable solutions.

(4) Imbibe values, professional ethics for life long learning.

1) The duration of the internship shall be for a period of 8 weeks on full time basis between II semester final exams and beginning of III semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization or the M.Tech program in which the student has enrolled.
4) Students undergoing internship training are advised to use ICT tools such as skype to report their progress and submission of periodic progress reports to the faculty members.
5) Every student has to write and submit his/her own internship report to the designated faculty.
6) Students have to make a presentation on their internship activities in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the internship final report. However interim or periodic reports and reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
7) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.
8) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization – Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 - Activities of the Department -

- Chapter 3 – Tasks Performed – summaries the tasks performed during 8 week period
- Chapter 4 – Reflections – Highlight specific technical and soft skills that you acquired during internship
- References & Annexure

Course Outcomes:

After going through the internship the student will be able to:

CO1: Apply engineering and management principles
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of the Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

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) Explanation of the application of engineering knowledge in industries 35%
(2) Ability to comprehend the functioning of the organization/ departments 20%
(3) Importance of resource management, environment and sustainability 25%
(4) Presentation Skills and Report 20%

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

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

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

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

GUIDELINES FOR INDUSTRIAL TRAINING

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the process of applying engineering knowledge to industrial products & processes

(2) Explain the importance of skilling, training and resource management.

(3) Comprehend the importance of team work, communication and sustainable solutions.

(4) Imbibe values, professional ethics for life long learning.

1) The duration of industrial training must be for a minimum of 1 week and maximum of 8 weeks on full time basis.
2) Industrial Training in which students pays a fee to the organization / industry will not be considered.
3) He/she can undergo training in one or more industry /organization.
4) The student must submit letters from the industry clearly specifying his / her name and the duration of the training provided by the company with authorized signatures.
5) Industrial training must be related to the field of specialization or the M.Tech program in which the student has enrolled.
6) Students undergoing industrial training are advised to use ICT tools such as skype to report their progress and submission of periodic progress reports to the faculty members.
7) Every student has to write and submit his/her own industrial training report to the designated faculty.
8) Students have to make a presentation on their industrial training in front of the departmental cmmittee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the final report.
9) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.
10) The broad format of the industrial training report shall be as follows
    - Cover Page
    - Certificate from College
    - Training Certificate from Industry / Organization
    - Acknowledgement
    - Executive Summary
    - Table of Contents
    - Chapter 1 - Profile of the Organization –Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices
    - Chapter 2 – Details of the Training Modules
    - Chapter 3 – Reflections – Highlight specific technical and soft skills that you acquired

    References & Annexure

Course Outcomes:

After going through the industrial training the student will be able to:

CO1: Understand the process of applying engineering knowledge to solve industrial problems

CO2: Develop skills through training relevant to industrial requirement

CO3: Communicate effectively and work in teams

CO4: Imbibe ethical practices and develop it as life skill.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

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) Explanation on the application of engineering knowledge 25%
(2) Ability to comprehend the importance of skilling and training 25%
(3) Importance of communication, professional ethics, sustainability 20%
(4) Oral Presentation and Report 30%

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

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

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

GUIDELINES FOR INDUSTRIAL VISITS

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the role of industries and service organization in meeting the demands of the society.

(2) Explain the working of different industries and organizations with an engineering

perspective
(3) Comprehend the importance of team work, communication and sustainable solutions.
(4) Imbibe values, professional ethics for life long learning.

1) Student must visit a minimum of THREE organizations/industry. The duration of the visit per organization must be for ONE full day, during which he/she must comprehend the importance of organization structure, function of various departments, application of engineering knowledge, resource management, importance to environment and safety, professional ethics.
2) It is mandatory to visit ONE private multi-national company or public sector industry / organization, ONE medium-small enterprise and ONE rural based or NG organization.
3) The student must submit letter from the industry clearly specifying his / her name and the date of visit to the industry with authorized signatures.
4) Industrial visit must be related to the field of specialization or the M.Tech program in which the student has enrolled.
5) Every student has to write and submit his/her own report on each industrial visit and submit the report to the designated faculty advisor for evaluation.
6) A photograph outside the industry with the name and logo of the industry in the background along with the students and faculty members could be included in the report.
7) Students have to make a presentation on their industrial visit in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the final report.
8) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.
9) The broad format of the industrial visit report shall be as follows
    - Cover Page
    - Certificate from College
    - Acknowledgement
    - Synopsis / Executive Summary
    - Table of Contents
    - Chapter 1 - Profile of the PSU or MNC – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices
    - Chapter 2 – Profile of the SME – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices
    - Chapter 3 - Profile of the NGO – must include Organizational structure, services, Manpower, Societal Concerns, Professional Practices
    - Chapter 4 – Comparative Analysis of PSU/MNC – SME – NGO
    - References & Annexure (Permission letters from the organizations for the visit & photographs)

Course Outcomes:

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

CO1: Classify the role of different industries and organization in addressing the needs of the society.

CO2: Explain the process of applying engineering knowledge in industries and organizations.

CO3: Describe the importance of communication and team work

CO4: Recognize the importance of practicing professional ethics and need for life skills.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

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) Explanation of the application of engineering knowledge in industries 25%
(2) Ability to comprehend the functioning of the organization/ departments 30%
(3) Importance of resource management, environment and sustainability 20%
(4) Presentation Skills and Report 25%

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

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

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

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

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

TECHNICAL SEMINAR						
Course Code	**:**	**16MCM36**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L:T:P:S**	**0:0:4:0**	**SEE Marks**		**50**
Credits	**:**	**2**		**SEE Duration**		**30 min**

Course Learning Objectives (CLO):

The students shall be able to:

(1) Understand the technological developments in their chosen field of interest
(2) Explain the scope of work and challenges in the domain area
(3) Analyze these engineering developments in the context of sustainability and societal concerns.
(4) Improve his/her presentation skills and technical report writing skills

GUIDELINES

1) The presentation will have to be done by individual students.
2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research.
3) The topic could be an extension or complementary to the project
4) The student must be able to highlight or relate these technological developments with sustainability and societal relevance.
5) Each student must submit both hard and soft copies of the presentation.

Course Outcomes:

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

CO1:Identify topics that are relevant to the present context of the world
CO2: Perform survey and review relevant information to the field of study.
CO3: Enhance presentation skills and report writing skills.
CO4: Develop alternative solutions which are sustainable

Scheme of Continuous Internal Evaluation (CIE): Evaluation would be carried out in TWO phases. The evaluation committee shall comprise ofHead of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide. The evaluation criteria shall be as per the rubrics given below:

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.

Rubrics for Evaluation:

1) Topic – Technical Relevance, Sustainability and Societal Concerns 15%
2) Review of literature 25%
3) Presentation Skills 35%
4) Report 25%

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

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

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

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

IV SEMESTER

MAJOR PROJECT						
Course Code	**:**	**16MCM41**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**0:0:52:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**26**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

The students shall be 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 good verbal presentation and technical report writing skills.
4. Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES

1. Major project will have to be done by only one student in his/her area of interest.
2. Each student has to select a contemporary topic that will use the technical knowledge of their program of specialization.
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 three.
5. The project can be carried out on-campus or in an industry or an organization with prior approval from the Head of the Department.
6. The standard duration of the project is for 16 weeks, however if the guide and the evaluation committee of the department, after the assessment feel that the work is insufficient and it has to be extended, then the student will have to continue as per the directions of the guide and the committee.
7. It is mandatory for the student to present his/her work in one of the international conferences or publish the research finding in a reputed unpaid journal with impact factor.

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 project and resource managements skills, professional ethics, societal concerns

CO4: Synthesize self-learning, sustainable solutions and demonstrate life long learning

Scheme of Continuous Internal Examination (CIE)
Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of: guide, two senior faculty members, one industry member and Head of the Department.

Phase	Activity	Weightage
I 5th week	Synopsis, Preliminary report for the approval of selected topic along with literature survey, objectives and methodology.	20%
II 10th week	Mid-term progress review shall check the compliance with the objectives and methodology presented in Phase I, review the work performed.	40%
III 15th week	Oral presentation, demonstration and submission of project report. After this presentation, the student will have one week time to correct / modify his report to address the issues raised by the committee members.	40%

CIE Evaluation shall be done with marks distribution as follows:

- Selection of the topic & formulation of objectives 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing / analysis 25%
- Demonstration & Presentation 20%
- Report writing 20%

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. Formulation of Project Objectives & Methodology 20%
3. Experiments / Analysis Performed; 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	H	H	H	M	L	M	L				
CO2				L				M	H		
CO3					L	M	M			H	
CO4					L	M	H	M			H

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

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

SEMINAR						
Course Code	**:**	**16MCM42**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L:T:P:S**	**0:0:4:0**	**SEE Marks**		**50**
Credits	**:**	**2**		**SEE Duration**		**30 min**

Course Learning Objectives (CLO):

The students shall be able to:

1) Understand the technological developments in their chosen field of interest
2) Explain the scope of work and challenges in the domain area
3) Analyze these engineering developments in the context of sustainability, societal concerns and project management.
4) Improve his/her verbal presentation and report writing skills

GUIDELINES

1) The presentation will have to be done by individual students.
2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research.
3) The topic could be an extension or complementary to the project topic.
4) Topics could be in multidisciplinary areas and strongly address the technical design issues.
5) The student must be able to highlight or relate these technological developments with sustainability and societal relevance.
6) The students must mandatorily address legal, ethical issues as related to the topic of study.
7) The student shall make an attempt to perform financial / cost analysis or apply project management tools as related to his/her topic of study.
8) Each student must submit both hard and soft copies of the presentation.

Course Outcomes:

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

CO1: Identify topics that are relevant in the present context of the world and relate it to sustainability and societal relevance.

CO2: Perform literature/market/product survey and analyse information to the field of study.

CO3: Enhance presentation and report writing skills.

CO4: Develop creative thinking abilities.

Scheme of Continuous Internal Evaluation (CIE): Evaluation would be carried out in TWO phases. The evaluation committee shall comprise of TWO senior faculty members. The evaluation criteria shall be as per the rubrics given below:

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.

Rubrics for Evaluation:

- Topic – Technical Relevance, Sustainability and Societal Concerns 15%
- Literature Review 25%
- Presentation Skills 35%
- Report 25%

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

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

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

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