RashtreeyaSikshanaSamithi Trust

R.V. College of Engineering

(Autonomous Institution Affiliated to VisvesvarayaTechnologicalUniversity, Belagavi)

Department of Mechanical Engineering

Master of Technology (M.Tech.)

Tool Engineering

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

R.V. College of Engineering, Bengaluru – 59

(Autonomous Institution affiliated to VTU, 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 Tool Engineering

Program Specific Criteria (PSC) as per ASME

Program Educational Objectives (PEO)

M. Tech. in Tool Engineering Program, graduate students will be prepared for:

PEO1: Practicing Design of Tools and Dies through application of the fundamental knowledge and skills of Mechanical Engineering

PEO2: Enhancing their skills through training, independent inquiry and professional development

PEO3: Working independently as well as collaboratively, while demonstrating the professional and ethical responsibilities of the engineering profession

PEO4: Pursuing higher studies at Doctoral level in multidisciplinary areas ofToolEngineering design

Program Outcomes (PO)

M. Tech. in Tool EngineeringGraduates will be able to:

PO1: **Engineering Knowledge** - Apply Mechanical Engineering in the areas of Design, Materials and Manufacturing for design of tools.

PO2: **Problem Analysis -** Analyze the problems of Manufacturing and Assembly to find suitable solutions by tool design

PO3: **Design/development of solutions** - Design and analyze Production Engineering Tools

PO4: **Modern Tool Usage** - Use advanced software tools related to Computer Aided Design, Computer Aided Engineering, MouldFlow Analysis, Statistical Tolerancing and Robust Design

PO5: **The Engineer and Society** - Function in multidisciplinary areas with sound team working, communication skills and ethical standards.

PO6: **Environment and sustainability** - Successful adaptation to technological, cultural and environmental changes and to foster adept functioning in society.

PO7: **Ethics -** Apply professional, ethical, legal, security and social issues in the design and manufacturing of tools and dies.

PO8: **Individual and team work -** Function effectively, individually and in teams, on diverse and multidisciplinary environments to accomplish common goals.

PO9: **Communication** - Communicate effectively with diversified groups to motivate and exhibit leadership qualities in the management of an organization.

PO10: **Project Management and Finance** - Apply the principles of project management like M S Project for effective execution of product manufacturing.

PO11: **Life-Long learning** - Pursue life-long learning as a means of enhancing the knowledge and skills by the application of advanced tools.

Program Specific Outcomes (PSO)

M. Tech. in Tool EngineeringGraduates will be able to:

PSO1: Design tools and dies for manufacturing and assembly of metallic and plastic components

PSO2: Develop advanced analysis tools for evaluating performance of tools and dies to enhance the capability of tool designers

R. V. College of Engineering, Bengaluru – 59

(An Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)

Department of Mechanical Engineering

M. Tech. in Tool Engineering

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	16MTE13	Design of Jigs and Fixtures(Theory & Practice)	ME	4	0	1	0	**5**
4	16MTE14	Die Casting and Die Design	ME	4	0	0	1	**5**
5	16MTE15X	Elective 1	ME	4	0	0	0	**4**
6	16HSS16	Professional Skill Development	HSS	0	0	2	0	**2**
			Total	**19**	**1**	**3**	**1**	**24**

Elective -1			
16MTE151	Plastic Processing	16MTE152	Metallurgy of Tools and Dies

R. V. College of Engineering, Bengaluru – 59

(An Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)

Department of Mechanical Engineering

M. Tech. in Tool Engineering

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	16MTE22	Press Tool Design (Theory & Practice)	ME	4	0	1	0	**5**
3	16MTE23X	Elective 2	ME	4	0	0	0	**4**
4	16MTE24X	Elective 3	ME	4	0	0	0	**4**
5	16MTE25X	Elective 4	ME	4	0	0	0	**4**
6	16MTE26	Minor Project	ME	0	0	5	0	**5**
			Total	**19**	**1**	**6**	**0**	**26**

Elective -2			
16MCM231/16MTE231	Non-Traditional Machining and Testing	16MMD232/16MTE232	Design of Hydraulics and Pneumatics
Elective – 3			
16MCM241/16MTE241	Tooling for Manufacture in Automation	16MTE242	Computer Aided Engineering
Elective – 4			
16MPD251/16MTE251	Additive Manufacturing	16MTE252	Sheet Metal Forming

R. V. College of Engineering, Bengaluru – 59

(An Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)

Department of Mechanical Engineering

M. Tech. in Tool Engineering

THIRD SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Self-Study S**	
1	16MTE31	Plastic Moulds Design (Theory & Practice)	ME	4	0	1	0	**5**
2	16MTE32X	Elective 5	ME	4	0	0	0	**4**
3	16MTE33X	Elective 6	ME	4	0	0	0	**4**
4	16MTE34X	Elective 7	ME	4	0	0	0	**4**
5	16MTE35	Internship/Industrial Training	ME	0	0	3	0	**3**
6	16MTE36	Technical Seminar	ME	0	0	2	0	**2**
			Total	**16**	**0**	**6**	**0**	**22**

Elective -5			
16MTE321	Advanced Mould Techniques	16MPD322/16MTE322	Lean Manufacturing
Elective – 6			
16MTE331	Quality and Reliability Engineering	16MCM332/16MTE332	Design for Manufacturing and Assembly include
Elective-7			
16MTE341	Cutting Tool Design	16MCM342/16MTE342	Applied metrology and Quality Control

R. V. College of Engineering, Bengaluru – 59.

(An Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)

Department of Mechanical Engineering

M. Tech. in Tool Engineering

FOURTH SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Self-Study S**	
1	16MTE41	Major Project	ME	0	0	26	0	26
2	16MTE42	Seminar	ME	0	0	2	0	2
			Total	**0**	**0**	**28**	**0**	**28**

III SEMESTER

Plastic Mould Design						
Course Code	**:**	**16MTE31**		**CIE Marks**	**:**	100+50
Hrs/Week	**:**	**L:T:P:S**	**4:0:2:0**	**SEE Marks**	**:**	100+50
Credits	**:**	**05**		**SEE Duration**	**:**	**03+03 Hrs**

Course Learning Objectives (CLO):

- Understand the properties of the polymers and design principle of mould.
- Identify the feed system and ejection systems for the components.
- Apply the basic principle of the parting surface, cooling system for mould design
- Design injection mould for thermo and thermoset components

Unit – I **10 Hrs**

Introduction to Plastics: Monomer, Polymer, Degree of Polymerization, Classification of Plastics, General review of Properties, Application and Processing, Behaviors of various plastics PE, PP, PYC, PMMA, ABS, NYLON, Polyacetal, Polycarbonate, PTFE, PF, UF & MF.
Mold Construction: Parting Surfaces: Straight, stepped, curved parting surface. Design of various Injection mold elements, cores, cavities, and inserts, fitting core and cavity inserts, pillars and bushes.

Unit – II **08 Hrs**

Feed System: Design of optimum Gates, Runners, Impressions, Layout, Sprue, sprue pullers, mold shrinkage.
Ejectorsystem: Types of ejection, Ejector grids, ejection methods, Ejector Pin, Sleeve ejection, plate ejection, Blade ejection, Air ejection, Ejection from fixed half, Double ejection, Delayed ejection

Unit – III **08 Hrs**

Cooling System: Need for cooling, cooling solid cores and cavities, insert cooling, cooling long cores, cooling elements, baffles, bubblers etc., and cooling calculation.
Parting Surfaces: Straight, stepped, curved parting surface.

Unit – IV **10 Hrs**

Molds with External Under Cuts: Split molds, Actuation of splits, Guiding of splits, side cores.
Molds with internal under cuts : Form pins
Molds for threaded components: External threads, internal threads, Moulds with loose cores, Automatic unscrewing type of molds.

Unit – V **12 Hrs**

Special Molds: 3 Plate molds, hot runner molds (Runner less molds), Multi color molding tools
Thermo plastic moulding: Compression molding tools, transfer molding tools.
Defects in molding and its remedies,

Unit – VI (LAB components)

Design and drafting of :

1. Two plate mouldsdesign
2. Two plate moulds with splits and side core
3. Three plate moulds design.
4. Compression moulds and Transfer moulds

Expected Course Outcomes:

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

CO1: Understand different types of moulds and approach to mould design
CO2: Analyse subsystems involved in different molds, their limitations and applications
CO3: Solve industrial problems for the design of plastic molds
CO4: Create various mould design for complicated plastic parts

Reference Books:

1. Sanjay K Nayak, Pratap Chandra Padhi, & Y Hidayatullah, "Fundamentals of Plastic Mould Design", McGraw Hill Education, 2012, *ISBN-13:* 978-1259006470
2. R. G. W Pye, "Injection MouldDesign"Affiliated East-West Press Pvt. Ltd.-New Delhi, 4th Ed, 2000, ISBN: 9788176710107, 8176710105
3. E. Linder&P. Unger "Injection Mould 108 Proven Design", Hans Gastrow, Edmund Lindner, Oxford University Press, USA. 9thEd. 1993, *ISBN-13:* 978-3446156821
4. Rubin. J. Irvin, "Injection Moulding Theory & Practice", New York-John Wiley & Sons 2013. ISBN 13: 9780471744450

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

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

	PSO1	PSO2
CO1		M
CO2	H	
CO3		L
CO4	M	

ADVANCED MOULD TECHNIQUES (Elective Group –5)						
Course Code	**:**	**16MTE321**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**03 Hrs**

Course Learning Objectives (CLO)

Student should be able to

1. Understand the techniques for manufacturing of plastic components
2. Outline the significance of die and feed systems
3. Analysecomponents of variousmouldsdepictingparting surfaces
4. Evaluate the effect of mould on the component

UNIT-01	10 Hours

Injection Moulding Technology : Microprocessor control injection moulding machine, close loop control, open loop control, CNC control, multicolor injection moulding, rotary injection moulding, structural foam moulding, sandwich injection moulding.

Metal injection moulding, contact injection moulding, moulding of cellular product like EPS, steam chest moulding, future trends in injection moulding like external & internal inter locking alignment of large moulds, processing of specialty polymers.

UNIT-02	8 Hours

Extrusion: General consideration during extrusion process likespecific heat, latent heat, internal conductivity, shape & size of granular hygroscopic nature over temperature, effect of flow property like relaxation time & defects like shark skin, elastic turbulence, influence of TG, TM & crystal growth rate, cooling rate, impact strength, manufacturing of woven sacks etc. co extrusion, co extruded pipe, multilayer pipe, foam pipe, biaxial oriented pipe.

UNIT-03	12 Hours

Blow Moulding : Microprocessor / CNC controlled blow moulding machine, injection stretch blow moulding of PET, precut moulding, multi-layer blow moulding, Parison programming.

Reaction Injection Moulding (RIM):RIM of Polyurethane, material for RIM, liquid RIM & its advantages over conventional injection moulding, RRIM

UNIT-04	06 Hours

Lamination:Lamination by extrusion coating, twin screw extrusion, co-rotating & counter rotating, feeding mechanism in twin screw extruder, roll of side feeder & injection feeder, principles of compounding, mixing mechanism etc.

UNIT-05	14 Hours

PTFE Moulding:Processing techniques used for PTFE, Material consideration, sintering, Ram extrusion, and Paste extrusion, Iso-statistic. Moulding and skewing technique for PTFE processing.

Advancement in Other Processing Technique: New techniques like Resin transfer moulding, Pultrusion. Filament winding, multi-layer rotation moulding, Electro plating and printings, Centrifugal casting, Shrink film, Clink film.

Expected Course Outcomes:

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

CO1: Understand Injection moulding, Extrusion, Lamination, Blow moulding and Special

moulding techniques.
CO2: Analyse the plastic components and challenges in selection of feed system.
CO3:Apply the engineering knowledge for the selection of type of mould for plastic components.
CO4: Design and evaluate the effects of mould on the components.

Text Books:

1. Injection Moulding, Theory and Practice by Irvin I. Rubin. Wiley-Interscience, ISBN-13: 978-0471744450
2. Extrusion Die Design, M. V. Joshi. PublisherMacmillan Publishers India LtdISBN-13: 9780333904497
3. Polymer Extrusion 5E, Rauwendaal, C. New York, Hanser Publications ISBN: 9781569905166
4. Blow Molding Handbook: Technology, Performance, Markets, Economics: The Complete Blow Molding Operation, Dominick V. Rosato, Hanser Gardner Publications (ISBN13: 9781569903438) 2003

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

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

	PSO1	PSO2
CO1		L
CO2	H	
CO3		M
CO4	M	

LEAN MANUFACTURING SYSTEMS (Elective Group –5)						
Course Code	**:**	**16MPD322/16MTE322**		**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 practices of lean manufacturing in Toyota production system.
2. Analyze the various processes in organizations.
3. Develop lean manufacturing strategies for improving various processes.
4. Implement lean manufacturing principles in different organizations.

Unit – I	**10Hrs**

Lean Manufacturing and the Toyota Production System: Definition of Lean, Ohno's thought about the Toyota Production System, The TPS and Lean Manufacturing Defined, The Two Pillars of the TPS, Several Revolutionary Concepts in the TPS, The TPS Is Not a Complete Manufacturing System, Where Lean Will Not Work… or Not Work Quite so Well. case study

Unit – II	**10Hrs**

Inventory and Variation: Background, Need of the Inventory, disadvantages of Inventory,About Variation, Buffers, Kanban, KanbanCalculations,Finished Goods Inventory Calculations, KanbanCalculations,Make-to-Stock versus Make-to-Order Production Systems,The Philosophy and Objectives, Foundation of Quality Control, Quantity Control**,** case study

Unit – III	**09Hrs**

The Significance of Lead Time: History of Lead Time, Benefits of Lead-Time Reductions,Lead-Time Reductions, Techniques to Reduce Lead-Time

How to Do Lean—Cultural Change Fundamentals: Three Fundamental Issues of Cultural Change,Some Cultural Aspects of a Lean Implementation

How to Do Lean—the Four Strategies to Becoming Lean: Overview of the Lean Implementation Strategies,Implementing Lean Strategies on the Production Line,Implementing Lean Strategies on the Production Line

Unit – IV	**10Hrs**

How to Implement Lean—The Prescription for the Lean Project: An Overview on How to Implement Lean and steps,Assess the Three Fundamental Issues to Cultural Change,Complete a System wide Evaluation of the Present State,Perform an Educational Evaluation,Document the Current Condition,Redesign to Reduce Wastes, Evaluate and Determine the Goals for the Line,Evaluate the Newly Formed Present State, Stress the System, case study

Unit – V	**09Hrs**

Planning and Goals: Hoshin–KanriPlanning, importance of Goals and Goal Deployment,PolicyDeployment,Leadership in Goal Development and Deployment

Sustaining the Gains: Importance of Sustaining the Gains, existence of Process gain and loss

Course Outcomes:

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

CO 1. Explain the concepts of Lean Manufacturing Systems.

CO 2. Analyze the causes of waste in various processesin an organisation.

CO 3. Apply tools and techniques of Lean Manufacturing Systems for process improvement.

CO4: Develop strategies for planning and implementing Lean Manufacturing Systems in organizations.

Reference Books:

1. Lonnie Wilson, "How to Implement Lean Manufacturing", McGraw-Hill, 2009 Edition, ISBN: 978-0-07-162508-1,
2. Michael Hammer & James Champy, "Reengineering the Corporation, A Manifesto for Business Revolution", Harper Business Essentials, 2006 Edition, ISBN-978-0060559533
3. Jeffrey K. Liker, "The Toyota Way", The McGraw-Hill, 1st Edition, 2004, **ISBN-13:** 978-0070587472.
4. M.G. Korgaonker, "Just In Time Manufacturing", Macmillan India Ltd., 2006 Edition, ISBN: 0333 926633.

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

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

	PSO1	PSO2
CO1	L	
CO2		L
CO3	M	
CO4		M

QUALITY & RELIABILITY ENGINEERING
(Elective group-6)

Course Code	**:**	**16MTE331**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**4**		**SEE Duration**	**:**	**3 Hrs**

COURSE LEARING OBJECTIVES (CLO)

(1) Describe the quality control techniques for a production systems
(2) Explain the importance of value addition to products through analysis
(3) Prepare QC, FMEA, VA, VSM charts
(4) Analyze test data and predict reliability of components

PART A (Theory)

Unit – 1

Introduction

The seven traditional tools of quality – New management tools – Six - sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality Performance measures

Control Charts

Statistical quality control, sample size, parameter selection, control charts for variables and control charts for attributes, process capability.

6 Hours

Unit -2

Quality Systems :

Need for ISO 9000-ISO 9000-2000 Quality System –Elements, Documentation, Quality auditing- QS 9000 –ISO 14000 –Concepts, Requirements and Benefits –Case studies of TQM implementation in manufacturing and service sectors.

Maintenance Concepts :

Objectives and functions–Terotechnology –Reliability Centered Maintenance (RCM) - maintainability prediction –availability and system effectiveness-maintenance costs – maintenance organization.Minimal repair –maintenance types –balancing PM and breakdown maintenance.

08 Hours

Unit -3

Quality and Reliability: Reliability improvements -techniques- use ofPareto analysis - design for reliability - redundancy unit and standby redundancy - Optimization in reliability - Product design - Product analysis - Product development - Product life cycles.

Failure Mode Effects Analysis

Review product or process, brainstorm failure modes and its effect, assign severity, occurrence detection ranking, calculate RPN, prioritize and initiate action

07 Hours

Unit -4

Introduction to Reliability Engineering

Failure Data Collection, Failure Distribution, Mean Time to Failure, MTBF and MTTF,

Reliability Life Testing, Bath Tub Curve, Accelerated Life Testing, Fault Tree Analysis

Failure Models

Constant Failure Rate Models: Exponential Reliability Function, Redundancy and CFR model; Time Dependent Failure Models: Weibull distribution, Normal distribution and Log Normal Distribution

8 Hours

Unit-5

Design for Reliability Serial, parallel and combined configurations, System structure function, Common mode failure, Three state devices, Load Sharing Systems, Standby Systems, reliability specifications.

7 Hours

COURSE OUTCOMES

(1) Describe importance of quality control and reliability engineering
(2) Evaluate the test data and determine the quality and reliability of the component
(3) Recognize the importance of statistical and probability tools in QC.
(4) Create control charts given a component, dimensions, production quantity
(5) Operate in teams to ensure higher value for a given product

Reference Books

(1) Juran J.M., Gryna.F.M., 'Quality Planning and Analysis', Tata Mcgraw Hill Publication, 2 Edn, 1982.
(2) Balagurusamy, 'Reliability Engineering', TMH publications, 10th Edn., 1984, ISBN:978007048339-2
(3) R.K.Jain, 'Engineering Metrology', Khannan Publishers, 1997
(4) Del Younker, 'Value Engineering-Analysis & Methodology', Marcel Dekker Inc., 2003, ISBN: 082470696

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

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

	PSO1	PSO2
CO1		H
CO2	M	
CO3		M
CO4	L	

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

CUTTING TOOL DESIGN
(Elective Group –7)

Course Code	**:**	**16MTE341**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**03 Hrs**

Course Learning Objectives:

Graduates shall be able to

- Understand thefundamentals of metal cutting theory and its practice in industries.
- Estimate the operational costs for maximum productivity.
- Analysecutting forces of various machining operations.
- Design the cutting tools for longer tool life.

UNIT-01	10 Hours

Introductions : Mechanism of chip formation,Mechanism of yielding,concept ofshearingstrain, Fracture, overviewofchip formation, Mechanismof Metal Cutting,
Force system during turning- velocity relationships – Force analysis in turning, milling, drilling etc..

UNIT-02	8 Hours

Tool dynamometers: Design requirements of tool force dynamometer, turning tool dynamometer, milling tool dynamometer, grinding tool dynamometer.
Cutting tool Inserts: Design features of inserts, IndexableInserts, Chip breakers,ISO and ANSIclassification ofinserts and tool holders.

UNIT-03	10 Hours

Turning Tool: Design of shank cross section, Classification of form tools, Design characteristics, Graphical and analytical method for profile calculation, chip breakers purpose and types,
Milling Tool: Nomenclature, Design principles of plain milling cutter, Life and wear.

UNIT-04	08 Hours

Drilling Tool: Drills with Indexable insert, deep hole drill, carbide tipped drill, core drill, counter pores, and counter sinks.
Broaching Tool: Elements, types of broach, broach design aspects, broach strength.

UNIT-05	10 Hours

Boring: Types ofboring tool, Boringheads, Cartridges. **Reamer:**Types of reamers, Geometryof flutes.
Economics of machining: Elements of machining cost, Tool cost, Cutting speed for minimum cost, Cutting speed for maximum productivity.

Expected Course Outcomes:

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

CO1: Understandmechanismofchip formation, measurementofcuttingforces
CO2: Analyse the different types of machining operations
CO3: Design cutting tools based on analytical and graphical method for industrial requirements
CO4: Apply engineering knowledge for development of cutting tools for various operations

Text Books:

1. Metal Cutting and ToolDesign, Dr. B. J. Ranganath, VikasPublishingHousePvt. Ltd., New Delhi, Second Revised Edition,2009. ISBN: 0706975103, 9780706975109
2. Tool Design, Herman W. Pollack, Prentice Hall PTR, 2nd Edn. 1988. ISBN: 0139251812
3. **Cutting tools for productive machining,** T A Sadasivan, D Sarathy, WIdia (India) Limited,

1st Edn, 1999.
4. Metal Cutting Theory andCutting Tool Design,Arshinov MIR Publication…….

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											
CO2											
CO3											
CO4											

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

	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		

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	**:**	**16MTE35**		**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)

	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 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

TECHNICAL SEMINAR						
Course Code	**:**	**16MTE36**		**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	**:**	**16MTE41**		**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	Mid-term progress review shall check the compliance with the	

10th week	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	**:**	**16MTE42**		**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