Rashtreeya Sikshana Samithi Trust

R.V. College of Engineering

(Autonomous Institution affiliated to VTU, Belagavi)

Department of Mechanical Engineering

Master of Technology (M.Tech.)

Product Design and Manufacturing

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

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 Product Design and Manufacturing

Program Specific Criteria (PSC) as per American Society of Mechanical Engineers

The curriculum is designed to enable the students to (a) apply principles of engineering design, analysis, selection of materials and manufacturing processes using modern tools and techniques to new products; (b) be proficient in product costing, quality assessment and its life cycle management; (c) work in teams, communicate effectively, demonstrate concern for environment and sustainability of products and processes.

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

Program Educational Objectives (PEO)

M.Tech in Product Design and Manufacturing Graduate will be able to

PEO1: Demonstrate knowledge and understanding of engineering principles to design and analyze products and their manufacturing processes.

PEO2: Apply modern tools to evaluate product cost, quality and management of its life cycle.

PEO3: Create new products by synthesizing functional requirements with a concern for environment and sustainability.

PEO4: Exhibit good communication skills, ability for life long learning, team work, and professional ethics.

Program Outcomes (PO)

M. Tech. in Product Design and Manufacturing graduates will be able to:

PO1: **Engineering Knowledge**: Apply knowledge of mechanical engineering in the areas of design, manufacturing and materials to design products.

PO2: **Problem Analysis**: Identify need for new product development and design appropriate products.

PO3: **Design & Development of Solutions**: Design and implement new products with improved performance.

PO4: **Modern Tool Usage**: Use advanced software tools to design, analyze and evaluate products for its functional requirements and life cycle.

PO5: **Engineer and Society**: Develop new products considering public health and safety

PO6: **Environment and Sustainability**: Design and evaluate products considering environment and sustainability.

PO7: **Ethics**: Apply professional, legal, ethical issues while designing products

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

PO9: **Communication**: Communicate effectively with diverse groups to exhibit leadership qualities in working environment

PO10: **Project Management and Finance**: Apply principles of project management for effective execution of product development and product life cycle management.

PO11: **Life-long Learning**: Pursue life-long learning for enhancing knowledge and skills.

.

Program Specific Outcomes (PSO)

M.Tech in Product Design and Manufacturing Graduate will be able to

PSO1: **Design products, select materials and process, perform simulation and analysis for automobile, consumer goods, machine tools and allied industries.**

PSO2: **Apply the knowledge of quality, ergonomics, product life cycle management and costing to engineering products and systems**

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

(An Autonomous Institution affiliated to VTU, Belagavi)

Department of Mechanical Engineering

M. Tech in Product Design and Manufacturing

M.TECH FIRST SEMSESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Credits**
				L	**T**	**P**	**S**	
1	16 MEM11P	Project Management	IM	4	0	0	0	4
2	16MAT12B	Probability & Statistics for Engineers	MA	4	0	0	0	**4**
3	16MPD13	Industrial Design and Ergonomics (Theory & Practice**)**	ME	4	0	1	0	**5**
4	16MPD14	Materials and Processes for Design	ME	4	0	0	1	**5**
5	16MPD15X	Elective 1	ME	4	0	0	0	**4**
6	16MPD16	Professional Skill Development	HSS	0	0	2	0	**2**
	Total			20	0	3	1	**24**

LIST OF ELECTIVECOURSES (4 CREDITS)

Elective 1			
16MPD151	Design for Manufacture	16MPD152	Simulation of Manufacturing Systems

R. V. College of Engineering, Bengaluru – 59

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

Department of Mechanical Engineering

M. Tech in Product Design and Manufacturing

M.TECH SECOND SEMSESTER								
Sl. No.	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Credits**
				L	**T**	**P**	**S**	
1	16MEM21R	Research Methodology	IM	3	1	0	0	**4**
2	16MPD22	Computer Aided Engineering (Theory & Practice **)**	ME	4	0	1	0	**5**
3	16MPD23X	Elective 2	ME	4	0	0	0	**4**
4	16MPD24X	Elective 3	ME	4	0	0	0	**4**
5	16MPD25X	Elective 4	ME	4	0	0	0	**4**
6	16MPD26	Minor Projects (in-house)	ME	0	0	5	0	**5**
	Total			19	1	6	0	**26**

LIST OF ELECTIVECOURSES (4 CREDITS)

Elective -2			
16MPD231	Design of Moulds and Dies	16MPD232/16MCM232	Design of Machine tools
Elective - 3			
16MPD241	Product Cost Analysis and Optimization	16MPD242	Design for Quality
Elective - 4			
16MPD251/16MTE251	Additive Manufacturing	16MPD252	Optimization Techniques

R. V. College of Engineering, Bengaluru – 59

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

Department of Mechanical Engineering

M. Tech in Product Design and Manufacturing

M.TECH THIRD SEMSESTER								
Sl. No.	Course Code	Course Title	BoS	CREDIT ALLOCATION				Credits
				L	T	P	S	
1	16MPD31	Creative Engineering Design & Analysis (Theory & Practice)	ME	4	0	1	0	**5**
2	16MPD32X	Elective 5	ME	4	0	0	0	**4**
3	16MPD33X	Elective 6	ME	4	0	0	0	**4**
4	16MPD34X	Elective 7	ME	4	0	0	0	**4**
5	16MPD35	Internship/Industrial Training	ME	0	0	3	0	**3**
6	16MPD36	Technical Seminar	ME	0	0	2	0	**2**
		Total		16	0	6	0	**22**

LIST OF ELECTIVECOURSES (4 CREDITS)

Elective -5			
16MPD321	Product Life cycle management	16MPD/MTE322	Lean Manufacturing Systems
Elective - 6			
16MPD331	Robust Design	16MPD332	Design of Hydraulic and Pneumatic Systems
Elective-7			
16MPD341	System Engineering	16MPD342	Industrial Robotics and Automation

R. V. College of Engineering, Bengaluru – 59

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

Department of Mechanical Engineering

M. Tech in Product Design and Manufacturing

M.TECH FOURTH SEMSESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Credits**
				L	**T**	**P**	**S**	
1	16MPD41	Major Project	ME	0	0	26	0	26
2	16MPD42	Seminar	ME	0	0	2	0	2
		Total		**0**	**0**	**28**	**0**	**28**

III SEMESTER

CREATIVE ENGINEERING DESIGN & ANALYSIS (Theory & Practice)						
Course Code	**:**	**16MPD31**		**CIE Marks**	**:**	**100+50**
Hrs/Week	**:**	**L:T:P:S**	**4:0:2:0**	**SEE Marks**	**:**	**100+50**
Credits	**:**	**5**		**SEE Duration**	**:**	**3 +3 Hrs**

Course Learning Objectives (CLO):

The students shall be able to:

(1) Explain the mechanism of thinking

(2) Select the visual elements and principles for visualization.

(3) Distinguish between processes for creativity, innovation and design

(4) Evaluate the design, innovation considerations for successful growth

Unit – I	**10 Hrs**

INTRODUCTION:

Need for design creativity – creative thinking for quality – essential theory about directed creativity

MECHANISM OF THINKING:

Definitions and theory of mechanisms of mind heuristics and models : attitudes, Approaches and Actions that support creative thinking

Unit – II	**10 Hrs**

VISUALIZATION:

Advanced study of visual elements and principles- line, plane, shape, form, pattern, texture gradation, color. Symmetry. Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation – Animation aerodynamics – virtual environments in scientific Visualization – Unifying principle of data management for scientific visualization - Visualization benchmarking

Unit – III	**09 Hrs**

CREATIVITY:

Methods and tools for Directed Creativity – Basic Principles – Tools of Directed Creativity – Tools that prepare the mind for creative thought – stimulation of new ideas – Development and Actions: - Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation The Bridge between man creativity and the rewards of innovativeness – Applying Directed Creativity to the challenge of quality management

Unit – IV	**10 Hrs**

DESIGN:

Process Design, Emotional Design – Three levels of Design – Viceral, Behavioral and Reflective-Recycling and availability-Creativity and customer needs analysis – Innovative product and service designs, future directions in this application of creativity thinking in quality management

Unit – V	**09 Hrs**

INNOVATION:

Achieving Creativity – Introduction to TRIZ methodology of Inventive Problem Solving - the essential factors – Innovator's solution – creating and sustaining successful growth – Disruptive Innovation model – Segmentive Models – New market disruption - Commoditation and DE-commoditation – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth

– Passing the Baton

UNIT –VI (Laboratory)

1. Preparation of Polymer Composite Laminate
2. Preparation of Sandwich Panel
3. Preparation of Ceramic Mould
4. Preparation of Polymer Composite Product
5. Preparation of Carbon Epoxy Laminate
6. Preparation of 3D Drawings of a Component
7. Manufacture of mould using 3D printing
8. Preparation of Samples using Injection Moulding
9. Powder Metallurgy Process – Preparation of Green Compacts
10. Powder Metallurgy Process – Sintering

Course Outcomes:

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

CO1: Demonstrate the mechanism of thinking

CO2: Understand the various techniques adopted for stimulating creativity and innovation

CO3: Apply the techniques to design and develop new products.

CO4: Synthesize the design, innovation considerations for successful growth

Reference Books:

i. Rousing Creativity: Think New NowFloyd Hurr, ISBN 1560525479, Crisp Publ Inc. 1999
2. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999, ISBN 978-1-118-02227-6.
3. Donald A. Norman," Emotional Design", Perseus Books Group New York , 2004, ISBN 123-1-118-027-6
4. Clayton M. Christensen Michael E. Raynor," The Innovator's Solution", Harvard Business School Press Boston, USA, 2003, ISBN 215-8-02227-6.
5. Semyon D. Savransky," Engineering of Creativity – TRIZ", CRC Press New York USA," 2000, ISBN 815-118-02227-6.

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

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

	PSO1	PSO2
CO1	H	
CO2		L
CO3	M	
CO4		L

PRODUCT LIFE CYCLE MANAGEMENT						
Course Code	**:**	**16MPD321**		**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. Define the fundamentals of PLCM system.
2. Choose a suitable strategy for the requirement.
3. Understand the importance of concurrent engineering.
4. Discuss the various components of PDM with related concepts.
5. Learn the projects and roles.
6. Understand the change management.

Unit – I	**10 Hrs**

Product life cycle management – Need for PLM, Components of PLM, Product Data and Product workflow, Drivers for Change, The PLM Strategy, Developing a PLM Strategy, A Five-step Process.

Unit – II	**10 Hrs**

Cost of design changes, Concurrent Engineering, schemes for concurrent engineering like Design for manufacturing and assembly, robust design, failure mode and effect-analysis, Computer aided DFM, Design rules. (10 schemes)

Unit – III	**09 Hrs**

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

Unit – IV	**10 Hrs**

Document Management Systems: Document management and PDM, Document life cycle, Content Management.

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

Unit – V	**09 Hrs**

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

Self Study : Usage of PDM Tools, Matrix One, TeamCenter, Windchill. Enovia

Course Outcomes:

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

CO1: Explain product life cycle management concepts. (L2)
CO2: Analyse schemes of concurrent engineering. (L4)
CO3: Appraise product data management concepts. (L5)
CO4: Adapt PDM system architecture for a case study (L6)

Reference Books:

Product Lifecycle Management Paradigm for century Product Realization - John Stark, Springer-Verlag, 21st, London, 3rd printing -2006, ISBN: 1-85233-810-5.
Crnkovic, Ivica; Asklund, Ulf; & Dahlqvist, Annita Persson. *Implementing and Integrating Product Data Management and Software Configuration Management*, Artech House Publishers, 2003. ISBN 1580534988
Burden, Rodger *PDM: Product Data Management*, Resource Pub, 2003. ISBN 0970035225
Grieves, Michael. *Product Lifecycle Management*, McGraw-Hill, 2006. ISBN 0071452303

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

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

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

LEAN MANUFACTURING SYSTEMS						
Course Code	**:**	**16MPD/MTE322**		**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	**10 Hrs**

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	**10 Hrs**

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

Unit – III	**09 Hrs**

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	**10 Hrs**

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	**09 Hrs**

Planning and Goals: Hoshin–Kanri Planning, importance of Goals and Goal Deployment,Policy Deployment,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

ROBUST DESIGN						
Course Code	**:**	**16MPD331**		**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) Explain basic principles of design of experiments.

2)Develop factorial and fractional factorial designs for product and process optimization.

3) Design and conduct orthogonal array experiments for process improvement.

4) Illustrate robust design concepts.

Unit – I **10 Hrs**

Quality by Experimental Design: Quality, western and Taguchi quality philosophy, Elements of cost, Noise factors causes of variation, Quadratic loss function and variation of quadratic loss functions.

Robust Design: Steps in robust design: parameter design and tolerance design, reliability improvement through experiments, illustration through numerical examples.

Unit – II **10 Hrs**

Experimental Design: Classical experiments: factorial experiments, terminology, factors. Levels, Interactions, Treatment combination, randomization, 2-level experimental design for two factors and three factors. 3-level experiment deigns for two factors and three factors, factor effects, factor interactions, Fractional factorial design, Saturated design, Central composite designs, Illustration through numerical examples.

Measures of Variability: Measures of variability, Concept of confidence level, Statistical distributions : normal, log normal and Weibull distributions. Hipothesis testing, Probability plots, choice of sample size illustration through numerical examples.

Unit – III **09 Hrs**

Analysis and interpretation of experimental data: Measures of variability, Ranking method, column effect method and ploting method, Analysis of variance (ANOVA), in factorial experiments : YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data, illustration through numerical examples.

Taguchi's Orthogonal Arrays : Types orthogonal arrays, Selection of standard orthogonal arrays, Linear graphs and interaction assignment, dummy level technique, Compound factor method, modification of linear graphs, Column merging method, Branching design, Strategies for constructing orthogonal arrays

Unit – IV **10 Hrs**

Signal to Noise ratio (S-N Ratios) : Evaluation of sensitivity to noise, Signal to noise ratios for static problems, Smaller – the – better types, Nominal – the – better – type, larger – the- better – type. Signal to noise ratios for dynamic problems, Illustrations through numerical example

Unit – V **09 Hrs**

Reliability Improvement Through Robust Design : Role of S-N ratios in reliability improvement ; Case study; Illustrating the reliability improvement of routing process of a printed wiring boards using robust design concepts.

Course Outcomes:

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

CO1: Remember the basic terms as used and applied in the context of design of experiments

CO2:Understand the process of developing strategic plans for experimentation and apply the principles of DoE to generate experimental

CO3: Evaluate the performance of the research investigations based on factorial and fractional factorial de signs

CO4:Create experimental designs for product and process quality improvement projects for various scientific and engineering applications.

Reference Books:

1. Quality by Experimental Design - Thomas B. Barker - Marcel Dekker Inc ASQC Quality Press, 1985

2. Experiments planning, analysis and parameter design optimization - C.F. Jeff Wu, Michael Hamada -John Willey Ed., 2002.

3. Reliability improvement by Experiments - W.L. Condra, - Marcel Dekker Inc ASQC Quality Press, 1985.

4. Quality Engineering using Robust Design - Madhav S. Phadake: Prentice Hall, Englewood Clifts, New Jersey 07632, 1989.

5 Design and analysis of experiments - Douglas Montgomery: Willey India Pvt. Ltd., V Ed., 2007.

6 Techniques for Quality Engineering - Phillip J. Ross: Taguchi 2nd edition. McGraw Hill Int. Ed., 1996.

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

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

	PSO1	PSO2
CO1	H	
CO2		M
CO3	M	
CO4		L

DESIGN OF HYDRAULIC & PNEUMATIC SYSTEMS						
Course Code	**:**	**16MPD332**		**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 symbols used to represent hydraulic and pneumatic components.
2. Identify the control system elements of fluid power in industrial automation.
3. Apply the basic pneumatic systems to build electropneumatic controls.
4. Evaluate the appropriate components through design calculations.

Unit – I	**10 Hrs**

Introduction to hydraulic system: structure of hydraulic control system, pressure compensated pump, cavitation and aeration, pump specifications, motor specifications, applications, cylinders, Mechanics of Hydraulic Cylinder Loading, Classification of control valves, mounting, pressure control valves and flow control valve working principles, symbolic representation of components.
Introduction to pneumatic system: Structure of Pneumatic control System, compressor types, sizing, pneumatic components, air preparation and distribution, symbolic representations.

Unit – II	**10 Hrs**

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

Unit – III	**09 Hrs**

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

Unit – IV	**10 Hrs**

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

Unit – V	**09 Hrs**

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

Course Outcomes:

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

CO1: Describe the constructional features of hydraulic and pneumatic components
CO2: Apply hydraulic and pneumatic controls in the design of automated controls.
CO3: Evaluate design of hydraulic and pneumatic components for building circuits.
CO4: Design hydraulic and pneumatic systems for industrial applications.

Reference Books:

1. James L Johnson, "Introduction to fluid power", Cengage Learning, first edition 2003, ISBN-981-243-661-8
2. R Srinivasan, "Hydraulic and pneumatic controls", , Tata McGraw hill, second edition,2010 ISBN – 978-81-8209-138-2
3. Joji P, "Pneumatic Controls", , Wiley First edition 2009, ISBN – 978-81-265-1542-4
4. SR majumdar, "Pneumatic systems",Tata Mcgrawhill, Second edition 2012, ISBN – 978-0-07-460231-7

Scheme of Continuous Internal Evaluation (CIE):

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

Scheme of Semester End Examination (SEE):

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

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

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

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

	PSO1	PSO2
CO1	L	
CO2	H	
CO3		M
CO4		M

SYSTEMS ENGINEERING						
Course Code	**:**	**16MPD341**		**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. Develop an appreciation and understanding of the role of system engineering processes and system management in production products and services.
2. Document systematic measurement approaches for generally cross disciplinary development effort.
3. Discuss capability assessment models to evaluate and improve organizational systems engineering capabilities.

Unit – I	**10 Hrs**

System Engineering and the World of Modem System: Definition, Origin, Examples of Systems Requiring Systems engineering, System Engineering view point, System Engineering as a Profession, The power of System Engineering, Problems.

Structure of Complex Systems: Systems building blocks and interfaces, Hierarchy of Complex systems, System building blocks, The system environment, Interfaces and Interactions.

The System Development Process: System Engineering through the system Life cycle, Evolutionary Characteristic of the development process, The system engineering method, Testing throughout system development, problems

Unit – II	**10 Hrs**

S**ystem Engineering Management:** Managing system development and risks, Work break down structure (WBS), System Engineering Management Plane (SEMP), Risk Management, Organization of System Engineering Capability Maturity Assessment, System Engineering standards, Problems.

Needs Analysis: Origination of a new system, Operation analysis, Functional analysis, Feasibility analysis, Feasibility definition, Needs validation, System operational requirements, Problems.

Concept Exploration: Developing the system requirements, Operational requirements analysis, Performance requirements formulation, Implementation concept exploration, Performance requirements validation, Problems.

Unit – III	**09 Hrs**

Concept Definition: Selecting the system concept, Performance requirements analysis, Functional analysis and formulation, Concept selection, Concept selection, Concept validation, System Development planning, System Functional Specification, Problems.

Advanced Development: Reducing program risks, Requirement analysis, Functional analysis and Design. Prototype development, Development testing, Risk reduction, problems.

Unit – IV	**10 Hrs**

Engineering Design: implementing the System Building blocks, Requirements analysis, Functional analysis and design, Concept design, Design validation, Configuration Management, Problems. **Integration and Evaluation:** Integrating, Testing and evaluating the total system, Test planning and preparation, System integration, Developmental system testing, Operational test and evaluation, problems.

Unit – V	09 Hrs

Production: System Engineering in the factory, Engineering for production, Transition from development to production, Production operations, Acquiring a production knowledge base, Problems.**Operation and support:** Installing, maintenance and up grading the system, Installation and test, In-service support, Major system upgrades: Modernization, Operational factors in system development, problems.

Course Outcomes:

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

CO1: Explain the role of Stake holders and their need in organizational system.

CO2: Develop and document the knowledge base for effective system engineering processes.

CO3: Apply available tool, methods and technologies to support high technology systems.

CO4: Create the framework for quality processes to ensure high reliability of systems.

Reference Books:

(1) Alexander Kossoakoff, William N Sweet, "System Engineering-Principles and Practice" John Wiley & Sons, Inc, Edition: 2012, ISBN: 978-81-265-2453-2

(2) Andrew P. Sage, William B. Rouse, "Hand book of System Engineering And Management" John Wiley & sons, Inc., Edition: 1999, ISBN 0-471-15405-9

(3) Ludwig von Bertalanffy,"General System Theory: Foundation, Development, Application", Penguin University Books, 1973, Revised, ISBN: 0140600043, 9780140600049

(4) Balanchard, B., and Febrycky, W.System Engineering and analysis, Saddle river, NJ, USA: Prentice Hall, 5th Edition, 2010

(5) Checkland, P.Systems Thinking, Systems Practice. Hoboken. NJ, USA: Weley, 2nd Edition, 1999, ISBN:047196062, 9780471986065

(6) Rechtin, E. Systems Architecting. Upper Saddle River, NJ, USA: Prentice Hall, 1991, ISBN: 0138803455, 9780138803452

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

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

	PSO1	PSO2
CO1	M	
CO2		L
CO3	M	
CO4		H

INDUSTRIAL ROBOTICS & AUTOMATION						
Course Code	**:**	**16MPD342**		**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):

Graduates shall be able to

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

Unit – I	**10 Hrs**

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

Unit – II	**10 Hrs**

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

Unit – III	**09 Hrs**

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

Unit – IV	**10 Hrs**

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

Unit – V	**09 Hrs**

Autonomous Robot: Locomotion Introduction, Key issues for locomotion Legged Mobile Robots Leg configurations and stability Examples of legged robot locomotion Wheeled Mobile Robots Wheeled locomotion: the design space Wheeled locomotion: case studies Mobile Robot Kinematics Introduction Kinematic Models and Constraints Representing robot position Forward kinematic models Wheel kinematic constraints Robot kinematic constraints, Mobile Robot Maneuverability Degree of mobility Degree of steerability Robot maneuverability.

Course Outcomes:

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

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

Reference Books:

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

Scheme of Continuous Internal Evaluation (CIE):

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

Scheme of Semester End Examination (SEE):

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

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

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

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

	PSO1	PSO2
CO1		L
CO2	M	
CO3	L	
CO4		M

INTERNSHIP / INDUSTRIAL TRAINING						
Course Code	**:**	**16MPD35**		**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	**:**	**16MPD36**		**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 of Head 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	**:**	**16MPD41**		**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	**:**	**16MPD42**		**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