1. With respect to the feedback given by Mr.A.L. Ashok, Manager,MRF Ltd about inspection, Measurement systems subject and Measurement lab are added in R2019.

MEASUREMENT SYSTEMS

L	T	P	C
4	0	0	4

OBJECTIVES:

- Describe the principles of engineering tribology.
- Summarize the metrology of surface finish.
- Relate computer in measurement/industrial inspectionsystems.
- Contrast the corrosiontypes and itstesting methods.
- Describe the principle and standardsof destructive and non destructive testing.

UNIT I FRICTION AND WEAR MEASUREMENT 12

Introduction to tribology - friction, wear and lubrication. Wear– types - adhesive, abrasive, fatigue etc. Lubrication: Methods of lubrication; industrial lubricants and their grades. Measurement of friction – tribometer – parameters – different testing methods. Wear debris and surface analysis, wear reduction methods.

UNIT II SURFACE FINISH &VIDEO MEASUREMENT SYSTEMS 12

Surface texture, surface roughness parameter, ideal surface roughness. Factors affecting surface roughness. Roughness measurement equipments - Tomlinson's surface meter, Taylor- Hobson surface meter, grades of roughness, specifications.Video Measurement Systems: introduction and principle, measurement of kerf taper angle, delamination factor, edge slope and corner accuracy.

UNIT III COMPUTER AIDED METROLOGY 12

Computer Aided Metrology - principles and interfacing, soft metrology - application of lasers in precision measurements - laser interface, laser scanners, Coordinate Measurement Machine (CMM), types of CMM & applications. CMM software, scanning, reverse engineers applications, performance evaluation of co-ordinate measuring machines, possible sources of error in CMM.

UNIT IV MEASUREMENT OF CORROSION 12

Introduction – types- definition and principles. Purpose of corrosion testing - corrosion testing equipments –susceptibility tests for intergranular corrosion - Stress corrosion test. Salt spray test humidity and porosity tests, accelerated weathering tests.ASTM standards for corrosion testing.

UNIT V DESTRUCTIVE AND NON DESTRUCTIVE TESTING 12

Destructive Testing: Principle, standards and procedure for the measurement - hardness, tensile strength, fatigue, creep, impact, fracture toughness. Non Destructive Testing: Principle, standards and procedure-Dye penetrant test,Magnetic Particle test,Radiographic test, Eddy current test, Ultrasonic test.

TOTAL: 60 PERIODS

OUTCOMES: At the end of the course the students will be able to learn about:

CO1: The principles of engineering tribology and the procedures for performing tribological tests.

CO2: The fundamentals of metrology of surface finish.

CO3: The applications of computer in measurement/inspection system.

CO4: The various types ofcorrosion, effectsandtesting methods.

CO5: The principles and procedure of destructive and non destructive testing.

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MEASUREMENT LAB

L	T	P	C
0	0	4	2

OBJECTIVES:

- Summarize the applications of measurement sensors and actuators.
- Correlate heat treatment and its effects on materials.
- Develop specimens for microstructure analysis.
- Use of tribological test for wear and friction assessment of different materials.
- Contrast the corrosion and surface roughness of different materials.

LIST OF EXPERIMENTS

1. Study of measurement sensors and actuators.
2. Effect of ultra-sonication on the properties of castings.
3. Effect of heat treatment on microstructure of engineering materials.
4. Preparation of specimen for microstructure analysis.
5. Analysis of microstructure using optical microscope.
6. Determination of friction and wear characteristics at dry and wet conditions.
7. Determination of friction and wear characteristic at elevated conditions.
8. Measurement of surface roughness on different work samples.
9. Determination of pH values for various concentration of a given solutions.
10. Measurement of corrosion on different materials.

LIST OF EQUIPMENTS:

1. Ultra-sonication assisted casting Setup.
2. High temperature furnace.
3. Moulding machine.
4. Polishing machine.
5. Optical microscope.
6. Weighing balance.
7. Pin-on-disc Tribometer.
8. Surface roughness meter.
9. pH meter.
10. Salt spray corrosion tester.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course, students should be able to:

CO1:Demonstrate the necessary skills to collect data and interpret results.
CO2:Perform the heat treatment on materials to assess the thermal effects.
CO3:Prepare specimen and perform microstructural characterization.
CO4:Perform the tribological test at different conditions.
CO5:Analyse the corrosion behaviour of various materials.

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

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2. With respect to the feedback given by Mr.A.L. Ashok, Manager,MRF Ltd about New product development ,Product design and value engineering subject is added in R2019.

PRODUCT DESIGN AND VALUE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES :

- Gain knowledge of product development integrated with value engineering.
- Summarize the development of new products through conceptualization, design and development phases.
- To associate various aspects of product development with industrial design and manufacturing.
- Check the value of a product using tools and techniques.
- Generate products which are suitable for the needs of the society.

UNIT I VALUE ENGINEERING BASICS 9

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity in Value Engineering.

UNIT II VALUE ENGINEERING JOB PLAN AND PROCESS 9

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

UNIT III IDENTIFYING CUSTOMER NEEDS and PRODUCT SPECIFICATIONS 9

Product Development process – Product development organizations.Gather raw data – Interpret raw data- organize the needs into a hierarchy – Relative importance of the needs. Specifications – Refining specifications.

UNIT IV CONCEPT GENERATION, SELECTION AND PRODUCT ARCHITECTURE 9

Clarify the problem – Search internally – Search externally – Explore systematically. Concept Screening – Concept scoring. Product architecture – Implication of architecture –Establishing the architecture – Related system level design issues.

UNIT V INDUSTRIAL DESIGN, PROTOTYPING AND ECONOMICS OF PRODUCT DEVELOPMENT 9

Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design.

TOTAL: 45 PERIODS

OUTCOMES:

Student will be able to:

CO1: To understand the basic concept of product development integrated with value engineering.
CO2: Design new products in a systematic manner considering the concept of value engineering.
CO3: To associate various aspects of product development with industrial design and manufacturing.
CO4: To practically access the value of a product using tools and techniques.
CO5: To be able to design products which are suitable for the needs of the society.

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3. With respect to the feedback given by Mr.A.L. Ashok, Manager,MRF Ltd about System Audit ,Quality Audits for improved performance subject is added in R2019.

QUALITY AUDITS FOR IMPROVED PERFORMANCE

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand Various Auditing Process
- Prepare and Manage the Audit Program
- Perform Auditing and Reporting
- Follow Up Audit Procedure and Perform Closure of Audit Procedures.
- Perform Process Based Auditing

UNIT I INTRODUCTION 9

Brief history of auditing – General model of auditing – The compliance audit – Performance audit – Product audits – Process audits – System audits – Audit defined – Management principles

UNIT II AUDIT PROGRAM MANAGER AND PREPARATION 9

Accountability – Resources for audit program – Phases of audit – The audit team – Second rule of auditing – Authority – Requirements – Understand the process – Audit Plan – Evaluate documents

UNIT III PERFORMANCE AND REPORTING 9

Opening meeting – Gather the facts – Tracing – Interviews – Interview Techniques – Perceptions – Team meetings – Daily briefings – Onward – Report Characteristics – Pain and pleasure – Findings – Preparing the finding sheets – Recommendations – Exit meeting – Formal report – Report distribution

UNIT IV FOLLOW UP AND CLOSURE 9

Closure phase – Remedial action – Corrective action – Corrective action response – Adequacy of the response – Records – An Example Procedure.

UNIT V PROCESS BASED AUDITING 9

The process approach – Auditing process based Quality Management System – Audit program management – The process of Auditing – Audit reporting phase – Audit closure phase

Total: 45 Periods

OUTCOMES:

Co1 : Able to Understand Various Auditing Process
Co2 : Able to Prepare and Manage the Audit Program
Co3 : Able to Perform Auditing and Reporting
Co4 : Able to Follow Up Audit Procedure and Perform Closure of Audit Procedures.
Co5 : Able to Perform Process Based Auditing

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

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4. With respect to the feedback given by Dr S P Srinivasn ,Past Chairman, IIE, Chennai chapter, about Industry 4.0 and feedback given by Mr.A.L. Ashok, Manager,MRF Ltd about productivity improvement ,Modern Manufacturing Management concepts subject is added in R2019.

MODERN MANUFACTURING MANAGEMENT CONCEPTS **L T P C**

3 0 0 3

OBJECTIVE:

- Develop basic knowledge on lean manufacturing concepts.
- Inculcate knowledge in agile manufacturing principles.
- Solve and analyze various concepts in sustainable manufacturing.
- Teach the tools and techniques used in sustainable manufacturing.
- Articulate knowledge about the design, principles and challenges in industry 4.0

UNIT I LEAN MANUFACTURING 9

Introduction to Lean Manufacturing, Comparison of Mass Manufacturing and Lean Manufacturing, Lean Principles, Types of Wastes –Types of activities –Examples - Tools of Lean Manufacturing- Principle, Procedural - Lean rules - Implementation for lean systems- Leanness assessment – Indicators, methods.

UNIT II AGILE MANUFACTURING 9

Fundamentals of Agile Manufacturing, Agile Principles, Conceptual models, Product Development Strategies for agility, Developing the agile enterprise, Managing People in agile organizations ,Strategic approach to agile manufacturing, Information Technology applications in Agile Manufacturing, Assessment of agility - Activity Based Costing - Case studies .

UNIT III SUSTAINABLE MANUFACTURING 9

Concepts of sustainability and sustainable development – Need for sustainable development - Components of sustainability- Social, Economic, Environmental dimensions - Linkages between technology and sustainability - Sustainable Manufacturing –Scope, Need and Benefits.

UNIT IV TOOLS AND TECHNIQUES OF SUSTAINABLE MANUFACTURING 9

Tools and Techniques of Sustainable Manufacturing – Environmental Conscious Quality Function Deployment, Life cycle assessment, Design for Environment, R3 and R6 cycles, Design for Disassembly -Sustainable Product Development Phases. Frameworks for measuring sustainability-Indicators of sustainability – Environmental, Economic, Societal and Business indicators - Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment.

UNIT V INDUSTRY 4.0: 9

Definition, Design, Principles, Challenges

OUTCOMES: **TOTAL HOURS :45**

Students should be able to

CO1 – Understand the basic philosophies of lean manufacturing concepts
CO2 – Effectively gain knowledge in agile manufacturing principles
CO3 – Apply and analyze various concepts in sustainable manufacturing
CO4 – Understand the tools and techniques used in sustainable manufacturing
CO5 – Gain knowledge about the design, principles and challenges in industry 4.0

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

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