UNIVERSITY OF JAMMU

(NAAC ACCREDITED A + GRADE UNIVERSITY)
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

NOTIFICATION

(23/Sept/Adp/87)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Competent Bodies, has been pleased to authorize the adoption of the revised Syllabi and Courses of Studies of **Master of Technology (M.Tech.) in Mechanical Engineering for Semester I to IV** under Credit Based System (as given in the Annexure) for the Examinations to be held in the years indicated against each Semester as under:-

Branch	Semester	For the Examination to be held in the years
Mechanical	**Semester-I**	**December 2023, 2024, 2025**
	Semester-II	**May 2024, 2025, 2026**
	Semester-III	**December 2024, 2025, 2026**
	Semester-IV	**May 2025, 2026, 2027**

The Syllabi of the course are available on the University Website: www.jammuuniversity.ac.in.

Sd/-
DEAN ACADEMIC AFFAIRS

No. F.Acd/III/23/10054-10060
Dated:14/09/2023
Copy for information & necessary action to:-

1. Dean Faculty of Engineering
2. Principal, GCET
3. C.A to the Controller of Examinations
4. Joint/Assistant Registrar (Exams Prof./Eval. Prof./Confidential)
5. Incharge University Website

14/Sept/23
Assistant Registrar (Academic)
14/9/23 14/09/23

UNIVERSITY OF JAMMU, JAMMU

Course Scheme

M. Tech 1st Semester Mechanical Engineering

For Examinations to be held in the December 2023, 2024, 2025

Contact Hours/Week: 21

S. No	Subject Code	Subject	Teaching Hours/ Week			Credits	Marks	
			L	T	P		Internal	External
1	MTME101	Research Methodology	3	1	0	4	25	75
2	MTME102	Advanced Operations & Maintenance Engineering	3	1	0	4	25	75
3	MTME103	Advanced CAD Modeling and 3-D Printing	3	1	0	4	25	75
4	MOOC500	NPTEL	3	0	0	3	100	-
5	**Elective-I**		3	1	0	4	25	75
	MTME121	Flexible Manufacturing Systems						
	MTME122	Quality Control and Reliability						
	MTME123	Condition Monitoring and Fault Diagnosis						
6	MTME111	Advanced CAD Modeling Lab	0	0	2	1	50	-
Total Credits						**20**	**250**	**300**

UNIVERSITY OF JAMMU, JAMMU

Course Scheme

M. Tech 2nd Semester Mechanical Engineering

For Examinations to be held in the May 2024, 2025, 2026

Contact hours: 26

S. No	Subject Code	Subject	Teaching Hours/ Week			Credits	Marks	
			L	T	P		Internal	External
1	MTME201	Industrial Tribology	3	1	0	4	25	75
2	MTME202	Quantitative Methods and Operations Research	3	1	0	4	25	75
3	MTME203	Industrial AI	3	1	0	4	25	75
4	**Elective-II**		3	1	0	4	25	75
	MTME221	Advanced Engineering Materials						
	MTME222	Additive Manufacturing						
	MTME223	Tool and Cutter Design						
4	MTME211	eMaintenance Lab	0	0	4	2	100	-
5	MTME212	Industrial AI LAB	0	0	4	2	100	-
6	MTME213	Research Seminar	-	-	2	1	50	-
Total Credits						**21**	**350**	**300**

UNIVERSITY OF JAMMU, JAMMU

Course Scheme

M. Tech 3rd Semester Mechanical Engineering

For Examinations to be held in the December 2024, 2025, 2026

Contact Hours/Week: 32

S. No	Subject Code	Subject	Teaching Hours/ Week			Credits	Marks	
			L	T	P		Internal	External
1	MTME301	Design of Experiment	3	1	0	4	25	75
2	**Elective-III**		3	1	0	4	25	75
	MTME321	Robotics						
	MTME322	Industrial Automation						
	MTME323	Mechatronics						
3	MTME311	Dissertation-I	-	-	20	10	250	-
4	MTME312	Design of Experiment Lab	0	0	4	2	100	-
Total Credits						**20**	**400**	**150**

UNIVERSITY OF JAMMU, JAMMU

Course Scheme

M. Tech 4th Semester Mechanical Engineering

For Examinations to be held in the 2025, 2026, 2027

Contract Hours/Week: 38

S. No	Subject Code	Subject	Teaching Hours/ Week			Credit	Marks	
			L	T	P		Internal	External
1	MTME411	Dissertation-II **(Students have to submit the final project report at the end of the semester which will be evaluated followed by a seminar, presentation and viva -voice examination)**	-	-	38	19	300	150
Total Credits						**19**	**450**	

M. Tech Mechanical Engineering 1st Semester Examinations to be held in the Year December 2023, 2024, 2025

CLASS: M. TECH 1st SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: RESEARCH METHODOLOGY
COURSE NO.: MTME101
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: Research Methodology is a hands-on course designed to impart education in the foundational methods and techniques of academic research in social sciences and business management context. Research scholars would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation. Once equipped with this knowledge, participants would be well-placed to conduct disciplined research under supervision in an area of their choosing. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Develop understanding of the basic framework of research process by exploring various research designs and techniques.
CO2	Identify various data collection, processing and analysis methods.
CO3	Develop an understanding of the ethical dimensions of conducting applied research.

Unit 1: Research Methodology: An Introduction, Nature and Objectives of Research, Types of Research, Research Methods and Methodology, defining a Research Problem, Techniques involved in Defining a Problem. Alternative approaches to the study of the research problem and problem formulation. Formulation of hypothesis, Feasibility, preparation and presentation of research proposal.

(09 hours)

Unit 2: Statistical Analysis: Introduction to statistical analysis: Probability and probability distributions; binomial, Poisson, exponential and normal distributions and their applications.

(09 hours)

Unit 3: Sampling and Scaling Techniques: Sampling: Primary and secondary data, their collection and validation, methods of sampling: Simple random sampling, stratified random sampling and systematic sampling, Attitude Measurement land Scales: Issues, Scaling of attitude, deterministic attitudes, measurement models, summative models, multidimensional scaling.

(09 hours)

Unit 4: Methods of Data Analysis: Selection of appropriate method Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation, Tests of significance based on normal, t and chi square distributions. Analysis of variance.

(09 hours)

Unit 5: Basic Principles of design of experiments, completely randomized and randomized block designs. Edition, tabulation & testing of hypotheses, interpolation of results, presentation, styles for figures, tables, text, quoting of reference and bibliography. Use of software for statistical analysis like SPSS, Mini Tab or MAT Lab, Report writing, preparation of thesis, use of software like MS Office.

(09 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1. "Research Methodology", C.R. Kothari, Wiley Eastern.
2. "Formulation of Hypothesis", Willkinson K.P, L Bhandarkar, Himalaya Publication, Bombay.
3. "Research in Education", John W Best and V. Kahn, PHI Publication
4. "MATLAB, An introduction with Applications", Amos Gilat, O'Reilly Media,2003.
5. Booth, Colomb and Williams. The Craft of Research, University of Chicago Press, Chicago & London, 2003.
6. John W. Creswell. Research Design, Sage Publications, New Delhi, Third Edition, 2009.

M. Tech Mechanical Engineering 1st Semester Examinations to be held in the Year December 2023, 2024, 2025

CLASS: M. TECH 1ST SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: ADVANCED OPERATIONS & MAINTENANCE ENGINEERING
COURSE NO.: MTME102
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: This course provides the necessary knowledge, understanding and skills for the future to those learners who wish to start a fulfilling career as technician in the area of operations and maintenance engineering. Learners will have the opportunity to learn basic scientific and mathematical methods to apply in subjects such as thermodynamics and heat engines. Learners will be exposed to the different materials used in common engineering situations and their properties. This qualification not only provides access to more specialist units but it also broadens and deepens the learners' experience in preparation for the real world at work. This course includes work related training and practice.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Explain maintenance objectives and functions and determine failure probability, survival probability and age specific failure rates of equipment and components.
CO2	Determine the optimal overhaul/repair/replacement maintenance policy for an equipment subject to breakdown and to determine optimal interval between preventive replacements for individual and group replacement of equipment.
CO3	Explain different maintenance systems and the steps involved in establishing a maintenance plan and designing a technically sound preventive maintenance and lubrication program.

Detailed Syllabus

Unit 1: Importance of Maintenance, Definition of Maintenance and objectives, Modelling of an industrial plant, Principles of Planned Preventive Maintenance (PM), Total Productive Maintenance, Industrial case studies and issues with customization. **(9 hours)**

Unit 2: Availability, Effectiveness and User Requirements, Concept and definitions for system effectiveness, Mean Time between Failure (MTBF) and Mean Time to Repair (MTTR), Failure rate and distribution, FMECA and FTA techniques, Reliability Centred Maintenance (RCM), Human System Integration (HSI), Testing and Evaluation, Data collection and management/interpretation of data. **(9 hours)**

Unit 3: Introduction to failure analysis, Failure modes, Machinery component failures, Case studies of machine failures, Introduction to condition-based maintenance, Machine condition monitoring techniques, Statistical data analysis and machine health diagnosis. **(9 hours)**

Unit 4: The principles of work planning and work control, Asset and facilities maintenance requirements planning, Maintenance resources and capability planning, Inventory and supply chain management, Human Factors in Maintenance, Optimising Scheduled, unscheduled and condition-based maintenance, financial control in maintenance, Maintenance Management Systems, Industrial case studies. **(9 hours)**

Unit 5: Introduction to the Diagnostics, PHM/CBM Design with emphasis on holistic life cycle design; Requirements, Metrics, and Cost Benefit; business intelligence, and system design for support solution, Systems thinking for FMECA and PHM/CBM modelling process; Fault Detection and Isolation Approaches; and wider reliability and maintainability management, Advanced R&D in PHM Algorithms; PHM/CBM Reasoning Methods and Examples; Prognostic Algorithm Approaches and Examples in relation to the design of a support solution. **(9 hours)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 1981
2. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995

M. Tech Mechanical Engineering 1st Semester Examinations to be held in the Year December 2023, 2024, 2025

CLASS: M. TECH 1st SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: ADVANCED CAD MODELING & 3D-PRINTING
COURSE NO.: MTME103
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: This course will demonstrate how to use 3D printing software to create digital designs that can be turned into physical objects. It will also demonstrate how 3D scanners work to turn physical objects into digital designs. This course is hands-on in nature and will provide step-by-step instructions to guide you through two popular 3D modeling programs. Learners who complete this course will be able to use 3D software to design a wide variety of objects for both personal and professional use.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Demonstrate knowledge of key historical factors that have shaped manufacturing over the centuries.
CO2	Explain current and emerging 3D printing applications in a variety of industries and describe the advantages and limitations of each 3D printing technology.
CO3	Evaluate real-life scenarios and recommend the appropriate use of 3D printing technology.

Detailed Syllabus

Unit 1: Advanced solid modeling operations, Modeling of parts with complex shapes and freeform surfaces, Diverse and unconventional methodologies for CAD work, Mechanical Drawing Modelling operations for sheet metal parts.

(9 hours)

Unit 2: Modern CAD system for high quality CAD models with complex shapes, 3D CAD models, CAD models for additive manufacturing.

(9 hours)

Unit 3: Introduction & History of 3D- Printing, Need for the compression in Product development Growth of 3DPrinting Industry.

(9 hours)

Unit 4: Classification of 3D- Printing, Stereo lithography (SLA) system & principle, Process parameter, process details of SLA, Data preparation, data files of SLA, Machine details & Application of SLA.

(9 hours)

Unit 5: Selective Laser Sintering (SLS)- Introduction, SLS Machine Type – Details, SLS principle of operation, Process parameters of SLS. Laminate Object Manufacturing (LOM) - Principle of operation, LOM materials, LOM Process details & Application.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1. Paul F. Jacobs: "Stereo lithography and other RP & M Technologies", SME, NY 1996.
2. Flham D. T & Dinjoy S.S "Rapid Manufacturing" Verlog London 2001.
3. Rapid automated by Lament wood. Indus press New York
4. Terry Wohlers "Wohler's Report 2000" Wohler's Association 2000.
5. Rapid prototyping materials by Gurumurthi, IISc Bangalore.
6. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015

M. Tech Mechanical Engineering 1st Semester Examinations to be held in the Year December 2023, 2024, 2025

CLASS: M. TECH 1ST SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: NPTEL
COURSE NO.: MOOC 500
DURATION OF EXAM: 3 HOURS

CREDITS: 03

L	T	P	Marks	
			External	Internal
3	0	0	0	100

The department shall offer the SWAYAM/NPTEL course (12 weeks) out of the list of courses offered by the SWAYAM around the time of commencement of the semester. However, the selected NPTEL course should not be similar to the regular courses offered as a part of the department curriculum.

The overall monitoring of the NPTEL course will be under the supervision of the teacher incharge of the department.

The NPTEL/SWAYAM certification course comprises of Assignments (25%) and Proctor Examination (Online examination MCQ's based = 75%) conducted at the end of the semester by IIT Madras as per the schedule.

The marks obtained by the student in the NPTEL/SWAYAM certification course will be tabulated by the concerned department.

Note: In case the student does not pass the certification exam or remains absent in the proctor examination, no certificate will be given to the candidate by the NPTEL and the student will be deemed to have failed in the course. The examination of the said NPTEL course will be taken by the department concerned in the next semester under the supervision of Examination Cell of GCET Jammu. The paper will be of 75 marks and assignment marks will be carried forward from the previous semester.

M. Tech Mechanical Engineering 1st Semester Examinations to be held in the Year December 2023, 2024, 2025

CLASS: M. TECH 1ST SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: FLEXIBLE MANUFACTURING SYSTEMS
COURSE NO.: MTME121
DURATION OF EXAM: 3 HOURS

CREDIT: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: The course will cover the practical integration of individual pieces of automation and various levels of electronic control to create stand-alone automated fabrication and assembly systems. Theory modules of the course will present the various types of communication interfacing required, the various levels of machine hierarchy, the human skills and knowledge levels needed to achieve a successful CIM operation. Included will be a study of product design requirements for parts, feeding and automated assembly and the effects of component quality on automated assembly. The learner will integrate a variety of manufacturing equipment to create, program and operate a automated manufacturing cell and an automated material handling cell (AMHC). This cell is joined to the AMHC. Flexible Manufacturing Systems (FMS) will be presented. Students will evaluate the requirements of implementing an FMS.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Understand different types of manufacturing available today such as the Special Manufacturing System, the Manufacturing Cell, and the Flexible Manufacturing System (FMS).
CO2	Learn the fundamentals of computer assisted numerical control programming and programming languages, the automated flow lines.
CO3	Summarize the concepts of modern manufacturing such as JIT, supply chain management and lean manufacturing etc.

Detailed Syllabus

Unit 1: Introduction: Introduction to Manufacturing Systems, Different types of manufacturing systems, Volume Variety relationships for understanding manufacturing systems.

(9 hours)

Unit 2: Flexibility and automation: Different types of flexibility in manufacturing, Different types of FMS buildingblocks., Work station, Storage retrieved system, material handling systems, computer control system.

(9 hours)

Unit 3: Machining system of FMS: Horizontal machining Centers, Vertical machining Centers, Integrated Material Handling, Automated Guided Vehicles, Automatic Storage and Retrieved System.

(9 hours)

Unit 4: Group technology: Part classification and coding, production flow analysis, Machine Cell design, Computer Aided Process Planning.

(9 hours)

Unit 5: JIT System: Characteristics of JIT pull method, small lot sizes, work station loads, flexible work force, line flow strategy. Supply chain management, Preventive maintenance - Kanban system, value engineering, MRP, JIT, lean manufacturing, quality concepts and management.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entiresyllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Books recommended:

1. Automation, Production Systems and Computer integrated Manufacturing by MP. Groover.
2. Hand-book of Flexible Manufacturing Systems by Nand K. Jha.
3. Flexible Manufacturing Systems by Joseph Talavage.

M. Tech Mechanical Engineering 1st Semester Examinations to be held in the Year December 2023, 2024, 2025

BRANCH: MECHANICAL ENGINEERING
CLASS: M. TECH 1st SEMESTER
COURSE TITTLE: QUALITY CONTROL & RELIABILITY
COURSE NO.: MTME122
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: This course introduces students to concepts and methods of modern statistical quality control. Students learn to apply standard quality control tools. They learn the theoretical statistical concepts that justify the use of particular quality control tools in particular situations. They learn theory and methods for analyzing the performance of different quality control tools. The use of appropriate software for statistical and quality analysis is taught, and is necessary for successful completion of some homework assignments. Issues of ethics and professional responsibility and their relation to product quality are discussed. Reliability Engineering is designed for practicing engineers, this course focuses on teaching you to increase product reliability. The course covers such topics as model product failure times, analyzing data to determine reliability characteristics, and other general data driven decisions to insure a reliable product.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Understand the concepts of reliability and maintainability and use control charts to analyze for improving the process quality.
CO2	Describe different sampling plans.
CO3	Acquire basic knowledge of total quality management.

Detailed Syllabus

Unit 1: Introduction: Concept of quality, Need, Factor influencing quality, Types of quality, Quality control, Cost of quality control, Quality assurance, Benefits, Modern concept, Inspection and quality control, Quality characteristics, Quality circles with case study.

(9 hours)

Unit 2: Statistical Concepts and Control Charts: Review of fundamental statistical concept, Frequency distribution, Central tendency, measures of dispersion, Probability distributions, statistical quality control, Theory of control charts, Control charts for variables and attributes (X, R, P, np and C chart), their advantages and disadvantages, Applications.

(9 hours)

Unit 3: Total Quality Management: Introduction, Concept of Total quality, Quality function deployment tools for continuous quality improvement with case study, ISO 9000:2000 family of standards, Six sigma: DMAIC and its comparison with ISO system.

(9 hours)

Unit 4: Reliability: Introduction, Factors effecting Reliability, Failure and its types, Failure curve, reliability and its management, MTBF, MTTF, Relationship b/w reliability failure rate and MTBF, and its characteristics, reliability predictions and analysis, System reliability analysis, Reliability test and life testing plans, Types of test, Maintainability and Availability.

(9 hours)

Unit 5: Reliability Design: Design for reliability, design process, assessment methodology, reliability allocation, reliability improvement, selection of components to improve system reliability. Breakdown time distribution.

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Books Recommended:

1. Statistical Quality control by R.C. Gupta.
2. Modern Methods for Quality Control and Improvement by Harrism; M. Wadsworth.
3. Statistical Quality control by E.L. Grant.
4. Reliability Mathematics by B.L. Ams Tadter.
5. Fundamental of Quality Control and Improvement by Amitava Mitra.
6. Reliability Engineering and Tero technology by A.K. Gupta.

M. Tech Mechanical Engineering 1st Semester Examinations to be held in the Year December 2023, 2024, 2025

CLASS: M. TECH 1st SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: CONDITION MONITORING & FAULT DIAGNOSIS
COURSE NO.: MTME123
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: The course deals with detection of fault conditions based on measurements of vibration made on rotary machines in various industries. Detection of sources of vibration will be made based on the amplitude spectra and phase relationships of vibrations of individual machine parts, using the envelope of technology in detecting recurring events with low levels of the measured signal and processing of high-frequency signal in the range of acoustic emission.

COURSE OUTCOMES **At the end of the course student will be able to:**	
CO1	Understand the signal processing techniques Fourier analysis, Hilbert transforms, practical FFTanalysis.
CO2	Understand data Acquisition, Vibration instrumentation and transducers, Fluid Film and RollingElement Bearing with Condition Monitoring.
CO3	Perform condition Monitoring of Machines & Case studies.

Detailed Syllabus

Unit 1: Introduction to maintenance and condition-based maintenance: Definition, system approach, objectives, responsibilities of maintenance department, maintenance strategies, principles of maintenance, concepts ofmaintainability, availability and reliability, implementation of CBM, comparison of CBM with other maintenance techniques and case studies (overview).

(9 hours)

Unit 2: Introduction to condition monitoring: Basic concept, techniques - visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, crack monitoring, thickness monitoring, noise and sound monitoring. Basic signal processing techniques, Probability distribution and density, Fourier analysis, Hilbert Transform, Cepstrum analysis, Digital filtering, Deterministic / random signal separation, Time-frequency analysis.

(9 hours)

Unit 3: Vibration Monitoring: Introduction, vibration data collection, techniques, instruments, transducers, selection, measurement location, time domain analysis, frequency domain analysis, time-frequency domain analysis and commonly witnessed machinery faults diagnosed by vibration analysis.

(9 hours)

Unit 4: Rotating and reciprocating machines: Vibration signals from rotating and reciprocating machines – signal classification, signals generated by rotating machines, signals generated by reciprocating machines. Mechanical faultdiagnosis Wear monitoring and lubricant analysis - sources of contamination, techniques, Spectrometric Oil Analysis Procedure (SOAP) and ferrography. **(9 hours)**

Unit 5: Nondestructive testing techniques: Measurement of surface and subsurface flaws – liquid penetrant inspection, eddy current inspection, radiographic inspection, ultrasonic inspection. **(9 hours)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1. Robert Bond Randall – Vibration-Based Condition Monitoring – Industrial, Aerospace and Automotive applications,John Wiley & Sons Ltd., 2011
2. R.A.Collacot – Mechanical Fault Diagnosis – Chapman and Hall Ltd., 1977.
3. ISTE Course material on Condition Monitoring.
4. R.C.Mishra, K.Pathak – Maintenance Engineering and Management, Prentice Hall ofIndia Pvt. Ltd., 2002.
5. K. P. Soman, K. I. Ramachandran, N. G. Resmi – Insight into wavelet from theory to practice, Third Edition, Prentice Hall of India, ISBN: 978-81-203-4053-4
6. Dr. K.Balaveera Reddy, ISTE Summer School on Machinery Diagnostics and Preventive Maintenance, KREC, Surathkal, June 19-25, 1995.

M. Tech Mechanical Engineering 1st Semester Examinations to be held in the Year December 2023, 2024, 2025

CLASS: M. TECH 1st SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: ADVANCED CAD MODELING LAB
COURSE NO.: MTME111
DURATION OF EXAM: 3 HOURS

CREDITS: 01

L	T	P	Marks
			Internal
0	0	2	50

Course Overview:
This course will help understand how 3D printing is being applied across a number of domains, including design, manufacturing, and retailing. It will also demonstrate the special capabilities of 3D printing such as customization, self-assembly, and the ability to print complex objects. This course will also provide an overview of design thinking and how you can use this framework to develop ideas.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Build complex engineering assemblies in plastic material with less process planning.
CO2	Design and fabricate working models for the conceptual testing applications and micro-sizedmodels for the functional testing applications.
CO3	Identify and correct the problems in STL files during modelling.

Detailed Syllabus

1. Review of CAD Modeling Techniques and Introduction to 3D printing.
2. Generating STL files from the CAD Models & Working on STL files.
3. Modeling Creative Designs in CAD Software.
4. Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation).
5. Sending the tool path data to FDM RP machine.
6. Fabricating the physical part on FDM RP machine.
7. Removing the supports & post processing (cleaning the surfaces).
8. Modeling of Resin and Metal Parts in CAD Software.
9. STL File Manipulation (stitching, orientation, scaling, etc.,)
10. Slicing of corrected STL files in EOS RP Tools Software.
11. Fabrication of Resin parts on MSL RP Machine.
12. Post curing of Fabricated Resin parts.

Note: Laboratory work will be evaluated on internal scheme with following components:

1. Lab. Work (Continuous Assessment)	**70%**
2. Viva	**30%**

M. Tech Mechanical Engineering 2nd Semester Examinations to be held in the Year May 2024, 2025, 2026

CLASS: M. TECH 2nd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: INDUSTRIAL TRIBOLOGY
COURSE NO.: MTME201
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: This course helps the learners to get expertise in the field of tribology and applications of tribology in various fields. Tribology is the science and technology of friction, wear and lubrication which makes a vital contribution to almost every area of industrial activity as friction an wear are present in all moving parts of any equipment of industry

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Develop a solution oriented approach by in depth knowledge of Industrial Tribology.
CO2	Address the underlying concepts, methods and application of Industrial Tribology.
CO3	Identify different areas of Industrial Tribology and find the applications of all the areas in day to daylife.

Detailed Syllabus

Unit 1: Introduction: Definition and Scope of tribology, Contact of solids, nature of surfaces, surface topography,surface interactions and characterization, micro and nano tribology, surface roughness measurement techniques.

(9 hours)

Unit 2: Friction and Wear: Types, laws, modern theories, dry sliding friction, temperature of sliding surface,Mechanism of rolling friction, friction instabilities, measurement of friction. Classification, theories of adhesive,abrasive, surface fatigue and corrosives wear, erosive, cavitation and fretting wear, wear models, wear ofmiscellaneous machine components such as gears, plain bearings and rolling element bearings, ASTM standards for wear measurement, wear resistant materials, wear resistant components, Study of abrasion in grinding, lapping and honing. **(9 hours)**

Unit 3: Lubrication Theories: Lubrication regimes: hydrodynamic lubrication, hydrostatic lubrication, elastohydrodynamic lubrication, boundary lubrication, squeeze films, turbulent lubrication. Reynold's equation, Pressure distribution, load carrying capacity, friction forces in oil film and co-efficient of friction in journal bearing.

(9 hours)

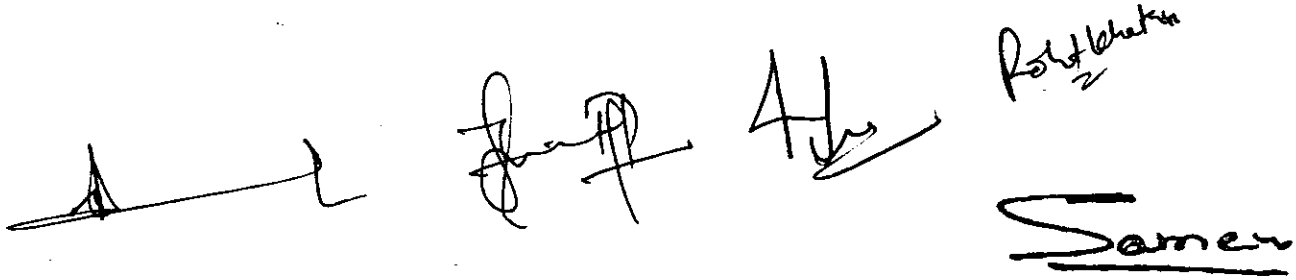
Unit 4: Bearing Design: Clearance in journal bearing, minimum film thickness, Sommerfeld Number. Oil grooves andflow of oil in axial and circumferential grooves, cavitation and turbulence in oil bearing. Heat generation and cooling of bearing. Design of air bearing and other gas bearings. **(9 hours)**

Unit 5: Applications: Application of tribology in manufacturing processes, Metal machining, Metal cutting, Tool wear,Action of lubricants, Friction welding, Extrusion process. **(9 hours)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1. Basu S K., Sengupta A N., Ahuja B. B., Fundamentals of Tribiology PHI 2006.
2. Mujumdar B. C., Introduction to Tribiology Bearings, S. Chand company Pvt. Ltd 200 3.
3. Industrial Tribology, Tribology failures and their analysis, Dr. B.S. Prabhu



M. Tech Mechanical Engineering 2nd Semester Examinations to be held in the Year May 2024, 2025, 2026

CLASS: M. TECH 2ND SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: QUANTITATIVE METHODS & OPERATIONS RESEARCH
COURSE NO.: MTME202
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: This course enables the students to formulate some real-life linear programming problems and identifying the characteristics of linear programming problems. This will provide a basic understanding of the quantitative techniques to analyze and examine the results with the proposed recommendations for decision makingin order to incorporate in the organizations. This course is designed to include the fundamentals of operation research for reporting and exploring mathematical software to solve the proposed models. This course is designed to prepare students to handle responsible roles in business analytics to apply mathematical tools to solve the optimization problems.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
CO2	Build and solve Transportation Models and Assignment Models.
CO3	Design new simple models, like: CPM, MSPT to improve decision –making and develop criticalthinking and objective analysis of decision problems.

Detailed Syllabus

Unit 1: Role of quantitative methods in decision making. Probability and decision making, decision making under uncertainty, the value of additional information, Bayes theorem. Probability models and decision making.

(9 hours)

Unit 2: Sample survey methods. Methods of measuring and forecasting business changes, index numbers, time series analysis. Markov Chain Analysis. Background of Operations Research, classification of problems in operations research, phases of operations research study.

(9 hours)

Unit 3: Linear programming, formulation of mathematical models, solution of linear programming problems involvingdesign of product mix, resource allocation, transportation and assignment by graphical, simplex and dual simplex methods, Duality theorem and applications, use of computer to solve linear programming problems.

(9 hours)

Unit 4: Dynamic programming, principles of optimality, characteristics of dynamic programming problem, deterministic programming models for solution of investment problem, allocation problem, production scheduling and equipment replacement problem, probabilistic dynamic programming. Games theory, mini max - minimum pure strategies, mixed strategies and expected pay off, solution of 2x2, 2xn, mx2 games, Brown's algorithm.

(9 hours)

Unit 5: Queuing theory notation and assumptions, Poisson's queuing models, non-Poisson queuing models, queues in series, queuing decision models, Application to scheduling and maintenance problems.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entiresyllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Reference Books:

1. Quantitative Techniques in management Vohra, N.D Tata McGraw Hill 1995
2. Principles of Operations Research Wagner H.M Prentice Hall 1982
3. Operations Research Hira D.S & Gupta P.K, S. Chand & Co. 1995
4. Operations Research Taha, H.A Macmillan Pub. Co. 1972
5. Quantitative Methods Ahuja, K.K, Kalyani Publisher 1990
6. Operations Research for Business and Economics ,Gopikuttan, Himalya Publishers

M. Tech Mechanical Engineering 2nd Semester Examinations to be held in the Year May 2024, 2025, 2026

CLASS: M. TECH 2ND SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: INDUSTRIAL AI
COURSE NO.: MTME203
DURATION OF EXAM: 3 HOURS

CREDIT: 04

L	T	P	MARKS	
			External	Internal
3	1	0	75	25

Course Overview: This course will survey the aspects of intelligence exhibited in biological systems and algorithmic approaches to mimic it. Material will include theoretical and applicative treatment of inductive learning, reinforcement learning, artificial neural networks and knowledge representation. This course will help the learners to revolutionise manufacturing in many ways by delivering insights to reduce unplanned machine downtime, increase production throughput, reduce maintenance costs, and deliver an increase in quality.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Understand advance analytics and machine learning topics.
CO2	Apply AI to commercial and real world problems and create human like abilities like sight, learning, conversatio and creativity in machines.
CO3	Use modern technology, techniques, software and methodologies.

Detailed Syllabus

Unit 1: Introduction: Introduction to Industrial artificial intelligence, History of AI, Proposing and evaluating Industrial AI applications, Demonstration: AI Industrial Use cases.

(9 hours)

Unit 2: Machine learning, Supervised, unsupervised learning, Regression -- linear, logistic, Classification – decisiontrees, SVM, Model performance evaluation, PCA, Clustering – k-means, hierarchical clustering, Semi-supervised methods.

(9 hours)

Unit 3: Reinforcement learning, choosing among machine learning techniques. Deep Learning, Neural networks and back-propagation, Industrial application of Machine Learning and Deep learning, Petri Nets, Markov chain

(9 hours)

Unit 4: Robotic and Intelligent systems: Sensing and Manipulation, Introduction to robotics, sensing, Manipulation, Human-robot interaction, Navigation and path planning, Learning and robotics: Reinforcement learning, Autonomous vehicles technologies and impacts, AI in the enterprise.

(9 hours)

Unit 5: AI and the future Industrial work, Appropriate uses of AI, The future of AI: Emerging developments.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entiresyllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, 2015
2. Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 2014
3. Artificial Intelligence: Strategies and techniques for complex problems solving by George Luger, Addison-Wesley, 2003.
4. Artificial Intelligence - A Modern Approach by Stuart Russell & Peter Norvig, Prentice Hall.

M. Tech Mechanical Engineering 2nd Semester Examinations to be held in the Year May 2024, 2025, 2026

CLASS: M. TECH 2ND SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: ADVANCED ENGINEERING MATERIALS
COURSE NO.: MTME221
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	MARKS	
			External	Internal
3	1	0	75	25

Course Overview: This course provides you with an in-depth understanding of the key factors that govern the design and selection of materials for use in advanced engineering applications, as well as their processing, properties and stability. Focusing on composites, advanced alloys and engineering ceramics, you will explore the technologies used in the manufacturing and processing of advanced materials and develop an understanding of the relationships between composition, microstructure, processing and performance.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO21A.1:	Recognize the conventional methods for processing of advanced composite materials
CO21A.2:	Understand the different types of phase diagrams and distinguish between the availablereinforcing fibre performances.
CO21A.3:	Describe the different imperfections and strengthening mechanisms in solids.

Detailed Syllabus

Unit 1: Introduction, Atomic Structure, Interatomic Bonding and Structure of Crystalline Solids:
Historical perspective of Materials Science. Why study properties of materials? Classification of materials. Advanced Materials, Future materials and modern materials, Atomic structure. Atomic bonding in solids, Crystal structures, Crystalline and noncrystalline materials. Miller indices. Anisotropic elasticity. Elastic behaviour of composites. Structure and properties of polymers. Structure and properties of ceramics.

(9 hours)

Unit 2: Imperfections in Solids and Strengthening Mechanisms: Point defects. Theoretical yield point. Line defects and dislocations. Interfacial defects. Bulk or volume defects. Atomic vibrations. Elastic deformation. Plastic deformation. Interpretation of tensile stress-strain curves Yielding under multiaxial stress. Yield criteria and macroscopic aspects of plastic deformation. Property variability and design factors. Mechanisms of strengthening in metals. Recovery, recrystallization and grain growth. Strengthening by second phase particles. Optimum distribution of particles.

(9 hours)

Unit 3: Diffusions and Dislocation: Diffusion mechanisms. Steady and non-steady state diffusion. Factors that influence diffusion. Non-equilibrium transformation and microstructure, Dislocation and plastic deformation.. Lattice resistance to dislocation motion. Fick's Law.

(9 hours)

Unit 4: Phase Diagrams: Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions.Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron carbon system.

(9 hours)

Unit 5: Applications and Processing of Metals and Alloys, Polymers, Ceramics: Types of metals and alloys.Fabrication of metals. Thermal processing of metals. Heat treatment. Precipitation hardening. Types and applications of ceramics. Fabrication and processing of ceramics. Mechanical behaviour of polymers. Mechanisms of deformation and strengthening of polymers. Crystallization, melting and glass transition. Polymer types. Polymer synthesis and processing.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entiresyllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1. Materials Science and Engineering, William D. Callister, Jr, John Wiley & sons, 07
2. Modern Physical Metallurgy and Material Engineering, Science, Process, application,
3. Smallman R.E., Bishop R J, Butterworth Heinemann, Sixth Ed., 1999.

M. Tech Mechanical Engineering 2nd Semester Examinations to be held in the Year May 2024, 2025, 2026

CLASS: M.TECH 2nd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: ADDITIVE MANUFACTURING
COURSE NO.: MTME222
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	MARKS	
			External	Internal
3	1	0	75	25

Course Overview: The implications of additive manufacturing (AM) span the complete product life-cycle, from concept-stage design to service part fulfillment. Recent advances, including industrially viable high-speed AM processes, improved materials, and optimization software, now enable AM to be considered hand-in-hand with conventional production technologies. Moreover, the unprecedented design flexibility of AM allows us to invent products with new levels of performance, and to envision digitally-driven manufacturing systems that achieve rapid, responsive production with reduced cost and risk.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Describe additive manufacturing and explain its advantages and disadvantages.
CO2	Explain the processes used in additive manufacturing for a range of materials and applications.
CO3	Understand the role of additive manufacturing in the design process and the implications fordesign.

Detailed Syllabus

Unit 1: Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM.

(9 hours)

Unit 2: Vat Photopolymerization AM Processes: Stereolithography (SL), Materials, Process Modeling, SL resin curing process, SL scan patterns, Micro-stereolithography, Mask Projection Processes, Two-Photon vat photopolymerization, Process Benefits and Drawbacks, Applications of Vat Photopolymerization, Material Jetting and Binder Jetting AM Processes.

(9 hours)

Unit 3: Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion- Based Processes. **Sheet Lamination AM Processes:** Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.

(9 hours)

Unit 4: Powder Bed Fusion AM Processes: Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes. **Materials science for AM:** Multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, microstructural studies, Structure property relationship.

(9 hours)

Unit 5: Post Processing of AM Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques. **Guidelines for Process Selection:** Introduction, Selection Methods for a Part, Challenges of Selection, Example System for Preliminary Selection, Process Planning and Control.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entiresyllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015. 2. Patri K. Venuvinod and Weiyin Ma, "Rapid Prototyping: Laser-based and Other Technologies", Springer, 2004.

3. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015.

M. Tech Mechanical Engineering 2nd Semester Examinations to be held in the Year May 2024, 2025, 2026

CLASS: M. TECH 2nd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: TOOL AND CUTTER DESIGN
COURSE NO.: MTME223
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Theory External	Internal
3	1	0	75	25

Course Overview: This course would encompass a comprehensive study of metal cutting and machine tools. This course would elaborate on the theory of metal cutting supplemented with numerical problems. Tool geometry, chip formation, cutting force calculations and measurement, tool wear and other aspects will be given due attention. Thiswould be followed by a descriptive study of the machine tools like lathe, milling, grinding, drilling and shaping machines, followed by numerical problems.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Acquire fundamental knowledge of principles used in material removal processes, tool materials,cutting fluids and tool wear mechanisms.
CO2	Apply the fundamentals and principles of metal cutting to practical applications.
CO3	Develop the knowledge and importance of metal cutting parameters.

Detailed Syllabus

Unit 1: Introduction: Fundamentals of cutting Tool design, Cutting tools and their principal elements, tool Geometry,system of nomenclature and their relations, setting for the grinding of various basis cutting tool (Turning, drilling, Milling).

(9 hours)

Unit 2: Tool Materials: Development of various tool materials then relative characteristics, Modern trend in tool development. Concept of tool life. Single point cutting tools, Purpose and principal, types and their characteristics, Design procedures of single point tools, design of various high production tools, design of carbide tools.

(9 hours)

Unit 3: Tool & Design: Form tools, purpose and types, design procedure and sharpening. Drills: Purpose and principaltypes and their construction and Geometry, development in the shape of twist drills.

(9 hours)

Unit 4: Milling Cutters: Purpose and type and their construction procedure of profile sharpened and form relievedcutter, design of hobs. **Broaches:** Purpose and types, design features of various broaches.

(9 hours)

Unit 5: Failure of Cutting Tools: Tool failure, analysis of plastic failure (Form stability criterion), Analyzing failure by brittle fracture, wear of cutting tools, criterion, Flank and creature wear analysis, optimum tool life, tool life equations (Taylor's) Tool life test, machining optimization predominant types of wear: flank, crater, abrasive, adhesive, diffusion wear models, wear measurements techniques, Theory of tool wear, oxidative, Mathematical modeling for wear, Test of machinability and influence of metallurgy on machinability.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1. Manufacturing Science by Amitava Ghosh, and Ashok kumar Mallik, Affiliated East-West Press Private Limited,New Delhi
2. Principle of Machine Tools, Sen & Bhattacharya.
3. Principle of Metal Cutting, Shaw.
4. Tool Design, Donaladson.

M. Tech Mechanical Engineering 2nd Semester Examinations to be held in the Year May 2024, 2025, 2026

CLASS: M. TECH 2nd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: eMAINTENANCE LAB
COURSE NO.: MTME211

CREDITS: 02

L	T	P	Internal
0	0	4	100

Course Overview: The eMaintenance Lab will boost research and education in maintenance and will provide a platform for the development of decision-making documentation for maintenance. The lab course enables the learners to have domain knowledge of various services to logistics and maintenance departments. The eMaintemnace lab objective is to maintenance manage and assisted via computing. The course lab will be a foundation for industry institute partnership by coordinating industry and research activities. Learners who complete this lab course will be able to have knowledge of maintenance decision support, integrated logistic support and prediction and preventing.

COURSE OUTCOMES **At the end of the course student will be able to:**	
CO1	To implement the understanding of eMaintenance concepts.
CO2	To summarize basic knowledge of eMaintenance on the basis of advanced context adaptation,visualization & Simulation capability.
CO3	To optimize the effectiveness of maintenance strategies, policies and resources for innovationand education.

Detailed Syllabus

List of Experiments:

1. To provide a common platform for maintenance research, focusing on e-Maintenance.
2. To study Small scale models of real environment and Data processing capacity knowledge.
3. To evaluate best practices, designs and research support focusing on aspects of maintenance.
4. To develop domain knowledge of advanced context adaptation, visualization & Simulation capability.
5. Dissemination of new technology & new methods.

Note: Laboratory work will be evaluated on internal scheme with following components:

1. Lab. Work (Continuous Assessment) **70%**
2. Viva **30%**

M. Tech Mechanical Engineering 2nd Semester Examinations to be held in the Year May 2024, 2025, 2026

CLASS: M. TECH 2ND SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: INDUSTRIAL AI LAB
COURSE NO.: MTME212

CREDITS: 02

L	T	P	Internal
0	0	4	100

Course Overview: Artificial Intelligence (AI) education breaks a new ground with the recent approaches to let students understand how people being activated by their thinking rule The Industrial AI lab will boost research and education in artificial intelligence with a view to enhance the efficacy in industrial setups. The lab course enables the learners to have domain knowledge of various services related to artificial intelligence, machine learning and IoT. This will enhance the decision-making ability of the stakeholders and boost us to develop proper documentations. Learners who complete this lab course will be able to have knowledge of AI and ML in decision support, integrated logistic support and prediction and preventing the failures.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	To understand the various Artificial intelligence concepts.
CO2	To summarize basic knowledge of AI & ML on the basis of advanced context adaptation,visualization & Simulation capability.
CO3	To optimize the effectiveness of different strategies, policies and resources for innovation and education using Artificial Intelligence.

Detailed Syllabus

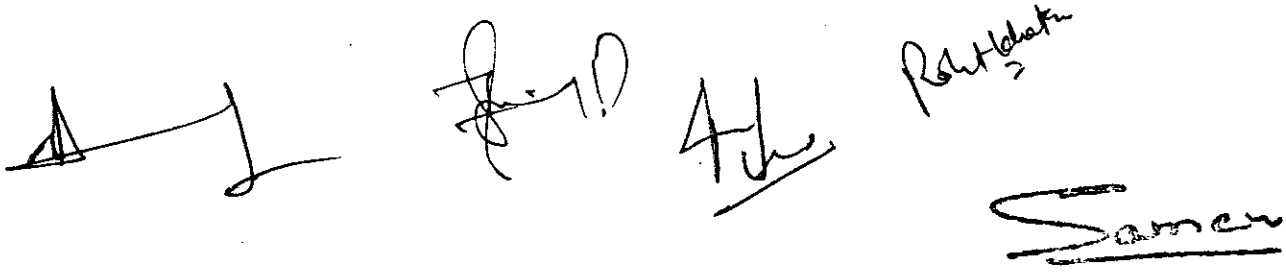
List of Experiments:

1. To study the importance of Artificial intelligence in Conceptual Design Generation and Evaluation.
2. To demonstrate the Industrial AI case studies.
3. To study the implications of linear regression in Machine learning.
4. To develop a program for predicting the machine life.
5. To study the importance of AI & ML in maintenance.

Note:

1. **Additional lab/experiment can be performed based on course content requirement.**
2. **Simulation/virtual labs can be used to enhance the practical ability of students.**
3. **Laboratory work will be evaluated on internal scheme with following components:**

(i) Lab. Work (Continuous Assessment)	**70%**
(ii) Viva	**30%**



M. Tech Mechanical Engineering 2nd Semester Examinations to be held in the Year May 2024, 2025, 2026

CLASS: M. TECH 2ND SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: RESEARCH SEMINAR
COURSE NO.: MTME213

CREDITS: 01

L	T	P	Internal
0	0	2	50

Course Overview: The course aims to expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions. To promote and develop presentation skills and import a knowledgeable society. To set the stage for future recruitment by potential employers.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	Able to work in actual working environment and identify and compare technical and practical issuesrelated to the area of program specialization.
CO2	Able to write technical documents and give oral presentations related to the work completed.
CO3	Describe, interpret and analyze technical issues and develop competence in presenting.

Detailed Syllabus

The student will select a topic of seminar in emerging areas of Mechanical Engineering and study the same independently. The topic of the seminar should not be the part of the curriculum. Each student is required to givea seminar talk on the same before the committee constituted by the head of the dept. as per the guidelines decided by the department from time to time.

Contents and Format of Report:

The procedure for preparation of the report has to follow the format determined by the Faculty based on theguidelines below.

a) **General Report Format**: The report has to be typewritten on white A4 size paper, font-size of 12 points with type face of Times New Roman has to be used throughout the report, with line spacing of 1. The report has to be properlybound with 'spiral bound'.

b) **Abstract/Preface**: This section of the report should contain brief description of summary of the Report

c) **Table of Contents**: This section of the report should consist of: i. Titles ii. Sub-titles iii. Page numbers Everyappendix must have a title and each page must be numbered accordingly.

d) **References**: Provided that there are important resources that are used as references while preparing the report, acomplete list of the titles of references concern must be included.

e) **Appendix**: Appendixes are additional information considered appropriate to support the main text. Others a) Figures/Tables All figures, tables and similar contents must be captioned and labeled. Every figure or table must be mentioned in the main text.

f) **List of Notations and Symbols:** If the report contains notations and symbols, the full definition must be given when each notation or symbol first appeared in the main text. The list of notations and symbols with the full definitions can be placed after 'Table of Contents'. Every appendix must have a title and be mentioned in the main text where appropriate. DO NOT include irrelevant materials.

Note: Seminar will be evaluated on internal scheme with following components:

1. **Presentation:** 30%
2. **Viva-Voce:** 30%
3. **File:** 40%

M. Tech Mechanical Engineering 3rd Semester Examinations to be held in the Year December 2024, 2025, 2026

CLASS: M. TECH 3rd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: DESIGN OF EXPERIMENT
COURSE NO.: MTME301
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: Design of experiments (DOE) is a rigorous methodology that enables scientists and engineers to study the relationship between multiple input variables, or factors, on key output variables, or responses. In this course, you will learn why designed experiments are better than trial and error and one-factor-at-a-time approaches to gain an understanding of cause and effect relationships and interactions between factors.

COURSE OUTCOMES	
At the end of the course student will be able to:	
C01	Learn how to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions.
C02	Understand the process of designing an experiment including factorial and fractional factorial designs.
C03	Develop appropriate experimental design to conduct experiments for a given problem and formulate objective(s) and identify key factors in designing experiments for a given problem.

Detailed Syllabus

Unit 1: Introduction: Strategy of experimentation, Some typical applications of experimental design, Basic principles, Guidelines for designing experiments, A brief history of statistical design, Using statistical design in experimentation. Simple Comparative Experiments: Introduction, Basic statistical concepts, Sampling and sampling Distribution, Inferences about the Differences in means, randomized designs, Paired comparison Designs, Inferences about the Variances of Normal Distributions.

(9 hours)

Unit 2: Introduction to Factorial Design: Basic definition and principles, Advantages of factorials, The two factor factorial design, General factorial design, Fitting response curves and Surfaces, Blocking in a factorial design 2k and 3k factorial designs Introduction, analysis of the 2k factorial design and 3k factorial design. Fractional factorial designs Introduction, fractional replication of the 2k factorial design-onehalf, one-quarter and the general 2k-p fractional factorial design.

(9 hours)

Unit 3: Regression analysis: Introduction, simple linear regression, hypothesis testing in simple linear regression, interval testing in simple linear regression, model adequacy checking-residual analysis, the lack-of-fit test, the coefficient of determination, Multiple linear regression, hypothesis testing in multiple linear regression, other linear regression models. Related problems.

(9 hours)

Unit 4: Taguchi Method of Design of Experiments: Concept design, Parameter design, Tolerance design, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments, Analysis of Mean (ANOM), Quality characteristics, Selection and testing of noise factors, Selection of control factors, Parameter optimization experiment, Parameter design case study.

(9 hours)

Unit 5: Response surface methodology: Introduction, the method of steepest ascent, analysis of quadratic models, response surface designs-designs for fitting the 1st order and 2nd order models, related problems. Analysis of Variance (ANOVA): Introduction, Example of ANOVA process, Degrees of freedom, Error variance and pooling, Error variance and application, Error variance and utilizing empty columns, the F-test.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entiresyllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Recommended Books:

1 Introduction to Linear Regression Analysis, Montgomery D.C., Runger G.C., John Wiley

2. Process and Product Optimization Using Designed Experiments Myres R.H. and Montgomery D.C John Wiley

3. Introduction to Quality Engineering Taguchi, GUNIPUB, White Plains, New Yor

M. Tech Mechanical Engineering 3rd Semester Examinations to be held in the Year December 2024, 2025, 2026

CLASS: M. TECH 3rd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: ROBOTICS
COURSE NO.: MTME321
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: Robotics courses cover multiple science, linear math and technology disciplines including machine learning, artificial intelligence, data science, design and engineering. This course is designed to introduce you to each of these areas and jump start your career in this exciting and rapidly expanding field. Students will learn the math and robot programming tools required to build robots, from the assessment of a real-world problem to the design and development of a solution.

COURSE OUTCOMES.	
At the end of the course student will be able to:	
C01	Calculate the forward kinematics and inverse kinematics of series and parallel robots.
C02	Do the path planning for a robotic system.
C03	Calculate the Jacobian for series and parallel robots.

Detailed Syllabus

Unit 1: Introduction to robotics, classification of robots, workspace analysis, manipulator. Kinematics I: Geometry Mathematics preliminary, position and orientation of a rigid body, co-ordinate transformation, Euler angle, homogeneous transformations.

(9 hours)

Unit 2: Kinematics modeling of manipulator arms, open kinematic chains, the denairt-Hartenberg notation, kinematics equations. Kinematics II: Differential Motion: Kinematic modeling of instantaneous motions, differential relations, infinitesimal relations, computation of the manipulators, Jacobian.

(9 hours)

Unit 3: Statics: Force and moment analysis, equivalent joint torques, duality, transformations of force and moments. Dynamics: Newton-Euler formulation of equation of motion, basic dynamic equation, closed form Dynamic equations, physical interpretation of the dynamic equation.

(9 hours)

Unit 4: Langrangian Formulation of the manipulator dynamics, LaGrange dynamics, the manipulators inertia tensor, deriving LaGrange motion equation, transformations of generalized co-ordinates.

(9 hours)

Unit 5: Trajectory control: Introduction, position control, load scheme work, trajectory control, sliding surfaces, Perfect tracking using switched control laws, continuous control law to approximate switched control.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entiresyllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Books Recommended:

1. Robotics by J. Baillieul, D.P. Martin, R.W. Brockett, Bruce R.Donald
2. Robotics: Designing the Mechanisms for Automated Machinery by Ben-ZionSandler
3. Computational Principles of Mobile Robotics by Michael Jenkin, Gregory Dudek
4. Error Detection and Recovery in Robotics by Bruce R Donald –Technology
5. Remote Control Robotics by CraigSayers
6. Handbook of Industrial Robotics edited by ShimonY.

M. Tech Mechanical Engineering 3rd Semester Examinations to be held in the Year December 2024, 2025, 2026

CLASS: M. TECH 3rd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: INDUSTRIAL AUTOMATION
COURSE NO.: MTME322
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: This course provides an overall exposure to the technology of Industrial Automation and Control as widely seen in factories of all types both for discrete and continuous manufacturing. The course discusses a wide range of related topics from the advantage and architecture of automation systems, measurement systems including sensors and signal conditioning, discrete and continuous variable control systems, hydraulic, pneumatic and electric actuators, industrial communication and embedded computing and CNC Machines.

COURSE OUTCOMES	
At the end of the course student will be able to:	
C01	Design, install and maintain automation and control systems and implement computer integrated manufacturing and flexible manufacturing systems in industries.
C02	Acquire the skills required for automation, control and monitoring of industrial processes.
C03	Implement industrial processes include discrete manufacturing, control of sequences, batch processing and process control.

Detailed Syllabus

Unit 1: Concept of automation in industry, mechanization and automation, classification of automation systems,advantages and disadvantages of automation in industry, applications of automation.

(9 hours)

Unit 2: Air cylinders –their design and mounting; pneumatic and hydraulic valves- flow control valves, metering valves, direction control valves, hydraulic servo systems; pneumatic safely and remote-control circuits.

(9 hours)

Unit 3: Basis of automated work piece handling - working principles and techniques, job orienting and feeding devices. Transfer mechanisms- automated feed cut of components, performance analysis.

(9 hours)

Unit 4: Assembly automation, automated packaging and automatic inspection. Computer aided retrieval type process planning systems, generative process planning systems, benefit and CAPP, machinability data systems. Computer generated time standards.

(9 hours)

Unit 5: Introduction to robot technology- robot physical configuration and basic robot motions. Types of manipulators- constructional features, servo and non-servo manipulators. Feedback systems and sensors- encoders and other feedback systems, vision, ranging systems, tactile sensors. Programming languages- description of VAL and other languages.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entiresyllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Reference Books:

1. CAD/CAM- Groover, M.P. & Zimmer, E.W Prentice Hall 1987
2. Robotics for Engineers- Yoram Koren McGraw Hill 1992
3. Robot Manipulators- Paul, R.P. MIT Press 1993
4. Numerical Control and CAM-Pressman, R.S. &Williams, John Wiley 1993
5. Fluid Power Control Shearer P. John Wiley

M. Tech Mechanical Engineering 3rd Semester Examinations to be held in the Year December 2024, 2025, 2026

CLASS: M. TECH 3rd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: MECHATRONICS
COURSE NO.: MTME323
DURATION OF EXAM: 3 HOURS

CREDITS: 04

L	T	P	Marks	
			External	Internal
3	1	0	75	25

Course Overview: Mechatronics is a multidisciplinary engineering field that combines systems design, computer, electronic, mechanical, and control engineering. This course covers electrical engineering basics, such as sensors, logic gates, op-maps, controllers and microprocessors and analog and digital electronics which enable the learners todesign a mechatronic system.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO31C.1:	Install, troubleshoot, maintain and repair mechatronic systems using industry- standard tools,practices and procedures.
CO31C.2:	Follow, develop and troubleshoot manufacturing processes and procedures.
CO31C.3:	Work with pneumatic and hydraulic systems and assist in design and rebuilding projects.

Detailed Syllabus

Unit 1: Introduction: Definitions, trends, control systems, microprocessor / micro controller based controllers, PC based controllers, applications: SPM, robot, CNC machine, FMS, CIM. **Sensor Technology:** Sensor and transducers, terminology, displacement, position, proximity - encoders, velocity – tacho generators, force - strain gauges, pressure, temperature-thermocouples, RTDs, thermistors, light sensors - photoelectric sensors, IR sensors, sensor selection.

(9 hours)

Unit 2: Signal Conditioning: Introduction, the operational amplifier, protection, filtering, Wheatstone bridge, digital signals, multiplexers, data acquisition, digital signal processing, pulse-modulation.

(9 hours)

Unit 3: Precision Mechanical Actuation: Pneumatic actuation systems, electro-pneumatic actuation systems, hydraulic actuation systems, electro-hydraulic actuation systems, mechanical systems, types of motion, kinematics, inverse kinematics, timing belts, ball screw and nut, linear motion guides, linear bearings, harmonic transmission, bearings, motor / drive selection.

(9 hours)

Unit 4: Electronic Devices and Circuits: Semiconductor devices, diodes and LEDS, zener diodes and voltage regulator,inductive kick, bandwidth, frequency % & response of a measurement system, bipolar transistor circuits, amplifiers. **Electromechanical Drives:** Relays and solenoids, stepper motors, DC brushed and brushless motors, DC servo motors,AC / DC motors for non-servo motion drives, braking methods, pulse width modulated, Bipolar driver, Mosfet drives, SCR drives, variable frequency drives.

(9 hours)

Unit 5: Microprocessors: Control, microcomputer structure, microcontrollers, digital interfacing, analog interfacing, DAC, ADC, applications. **Input / Output Systems:** Interfacing, input / output ports, interface requirements, peripheralinterface adapters, serial communication interface, direct memory access.

(9 hours)

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Books recommended:

1. Understanding Electro-Mechanical Engineering - An Introduction to Mechatronics by Kamm, Prentice-Hall of India.
2. Computer Control of Manufacturing system by, Koren, McGraw Hill.
3. Production Systems and CIM, Groover, PHI.
4. Flexible Manufacturing systems, by Maleki, Prentice Hall.

M. Tech Mechanical Engineering 3rd Semester Examinations to be held in the Year December 2024, 2025, 2026

CLASS: M. TECH 3rd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: DISSERTATION-I
COURSE NO.: MTME311

CREDITS: 10

L	T	P	Marks
			Internal
0	0	20	250

Course overview: The dissertation is an yearlong activity, to be carried out and evaluated in two phases i.e.

Phase–I: July/August to December/January and

Phase-II: January/February to June/July.

Detailed Syllabus

Dissertation work-I is by far the most important single piece of work in the post graduate program. It provides the opportunity for the students to demonstrate independence and originality of providing the solutions to emerging industrial/technical problems. The dissertation topic should be chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between industry and academics. The dissertation topic must involves a combination of sound background research, a solid implementation and a thorough evaluation of dissertation outputs in both absolute and relative terms. Interdisciplinary dissertation proposals and innovative dissertations are encouraged and more appreciable.

Student should complete the following: Literature Review, Problem Definition, Motivation for study, Objectives of study, Approach for conducting study/research, Implementation, Report and Presentation. Also, student should figure out the methodology, resources required and timeline of work.

Students have to submit a project proposal to Mechanical Engineering Department comprising of proposed tittle of problem, Literature review and objectives of work, proposed methodology and application of study, references and timeline of work.

The project proposal submitted by the student will be reviewed by a committee of HOD and faculty members formulated by the department on the basis of report, presentation and viva-voce. After reviewing the feasibility of the proposal, supervisors are allotted to the student. While submitting the project proposal, student should keep in mind that pure survey reports with no supporting implementation or theory are not acceptable. In case of unsatisfactory performance, student is recommended to repeat the Dissertation-I work.

Note: Dissertation-I will be evaluated on Internal scheme with following components:

1. **Performance or work done:** **30% of total internal marks.**
2. **Seminar** : **25% of total internal marks.**
3. **Viva** : **25% of total internal marks.**
4. **Report** : **20% of total internal marks.**

M. Tech Mechanical Engineering 3rd Semester Examinations to be held in the Year December 2024, 2025, 2026

CLASS: M. TECH 2ND SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: DESIGN OF EXPERIMENT LAB
COURSE NO.: MTME312

CREDITS: 02

L	T	P	Internal
0	0	4	100

Course Overview: Design of experiments (DOE) applies to many different investigation objectives, but can be especially important early on in a screening investigation to help you determine what the most important factors are. The DOE lab enables the students with understanding the implications of different design of experiments. Learners who complete this lab course will be able to have knowledge of different DOE techniques, thus helpful in applying the strategies in research.

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO1	To understand the how to plan, design and conduct experiments efficiently and effectively.
CO2	To summarize the different methods of design of experiments.
CO3	To apply the design of experiments in the real-life problems.

Detailed Syllabus

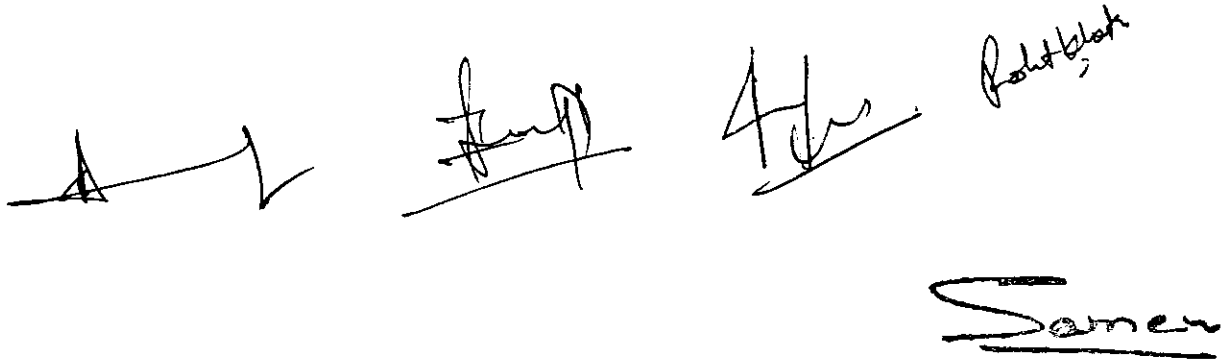
List of Experiments:

1. To understand the experimentation strategy with implications on guidelines for designing experiments.
2. To study the different types of distributions.
3. To study and understand the factorial design.
4. To analyze a mathematical problem using simple linear regression.
5. To implement the Taguchi method of experiment in real time problem.

Note:

1. **Additional lab/experiment can be performed based on course content requirement.**
2. **Simulation/virtual labs can be used to enhance the practical ability of students.**
3. **Laboratory work will be evaluated on internal scheme with following components:**

(i) Lab. Work (Continuous Assessment)	**70%**
(ii) Viva	**30%**



M. Tech Mechanical Engineering 4th Semester Examinations to be held in the Year May 2025, 2026, 2027

CLASS: M. TECH 4th SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITTLE: DISSERTATION-II
COURSE NO.: MTME411

CREDITS: 19

L	T	P	Internal	External
0	0	38	300	150

Course overview: Research and development projects based on problems of practical and theoretical

Interest. Problem definition, background research, development of overall project plan. Evaluation will be based on student seminars, written reports, and evaluation of the developed system and/or theories.

At least one publication in a journal of repute is mandatory for the final evaluation of Dissertation.

Detailed Syllabus

Dissertation work-II is generally a continuation of the Dissertation work-I and it is a student's effort to reach at the optimum solution of the problem. Dissertation-II is based on a report prepared by students on dissertation allottedto them. In this, student should perform the design, development and testing of the proposed work as per the schedule.

Students have to submit a dissertation report which consists of following sections:

1. Introduction.
2. Literature Review.
3. Research Gap
4. Problem Statement.
5. Methodology.
6. Results and Discussion.
7. Conclusion.
8. References.

This work will be evaluated by the guide along with external examiner on the basis of report, presentation and viva-voce. If the work of the student is found to be insufficient and consist of plagiarism, the committee may recommend for extension or repeating of work. Plagiarism up to 10% is acceptable. Students have to publish the research work in at least one reputed journal or conference.

Note: Dissertation-II will be evaluated for internal and external evaluation.Internal evaluation will be done based on following components:

1. **Presentation/ Demonstration:** **40% of total internal marks.**
2. **Report** : **40% of total internal marks.**
3. **Viva-voce** : **20% of total internal marks.**