



GOVT. COLLEGE OF ENGINEERING AND TECHNOLOGY, JAMMU
(Autonomous College)

COURSE SCHEME

M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
(Batch 2025 & Onwards)

Contact Hours/Week: 24

Course Code	Course Type	Course Title	Credits	Load Allocation			Marks Distribution					Total
				L	T	P	CWA	PRS	MSE	ESE	PRE	
MMET11	Engineering Science Course	Research Methodology	4	3	1	0	20	-	20	60	-	100
MMET12	Engineering Science Course	Advanced Operations & Maintenance Engineering	4	3	1	0	20	-	20	60	-	100
MMET13	Engineering Science Course	Industrial AI	4	3	1	0	20	-	20	60	-	100
MMET14	Engineering Science Course	Advanced CAD Modelling and 3-D Printing	4	3	1	0	20	-	20	60	-	100
MMEY11	Engineering Science Course	Flexible Manufacturing Systems	4	3	1	0	20	-	20	60	-	100
MMEY12	Engineering Science Course	QualityControl and Reliability	4	3	1	0	20	-	20	60	-	100
MMEY13	Engineering Science Course	Condition Monitoring and Fault Diagnosis	4	3	1	0	20	-	20	60	-	100
MMEL11	Engineering Science Course	Advanced CAD Modeling Lab and 3-D Printing	1	0	0	2	-	40	-	-	60	100
MMEL12	Engineering Science Course	Industrial AI LAB	1	0	0	2	-	40	-	-	60	100
		Total	22	15	5	4	-	-	-	-	-	700

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M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
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Semester	1 st SEMESTER			
Name of the Course	Research Methodology			
Course Code	MMET11	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20	Class Work Assessment (CWA)		Max. Marks = 20
End Semester Examination	Max. Marks= 60	Max. Time- 3 Hrs.		

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.
CO4	Apply appropriate research methodologies to design and present a systematic research proposal or report.

Section A

Unit 1: Research Methodology: ~~As~~ 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 and Scales: Issues, Scaling of attitude, deterministic attitudes, measurement models, summative models, multidimensional scaling.

(10 hours)

Section B

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.

(14 hours)

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Unit 5: Basic Principles of design of experiments, ~~completely randomized and randomized block design, 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 ~~MATLAB~~, Report writing, preparation of thesis, use of software like MS Office.
MATLAB

(14 hours)

Recommended Books:

1. "Research Methodology", C.R. Kothari, Wiley Eastern.
2. "Formulation of Hypothesis", Wilkinson 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.

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

Sections II & III of the question paper will have three questions each from the respective sections (A & B) of the syllabus and each question will carry 12 marks. The candidate will have to attempt four questions, from sections (II&III) selecting two from each.

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M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
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Semester	1 st SEMESTER		
Name of the Course	ADVANCED OPERATIONS & MAINTENANCE ENGINEERING		
Course Code	MMET12	Credits-	4
Mid Semester Examination	Max. Marks = 20	Class Work Assessment (CWA)	L-3 , T- 1 , P-0 Max. Marks = 20
End Semester Examination	Max. Marks= 60	Max. Time- 3 Hrs.	

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.
CO4	Analyze maintenance performance using reliability, availability, and maintainability (RAM) concepts to optimize operational efficiency and resource utilization.

Section A

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.
(10 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.
(09 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.
(09 hours)

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Section B

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.

(14 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.

(14 hours)

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

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

Sections II & III of the question paper will have three questions each from the respective sections (A & B) of the syllabus and each question will carry 12 marks. The candidate will have to attempt four questions, from sections (II&III) selecting two from each.

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M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
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Semester	1 st SEMESTER			
Name of the Course	INDUSTRIAL AI			
Course Code	MMET13	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20	Class Work Assessment (CWA)		Max. Marks = 20
End Semester Examination	Max. Marks= 60	Max. Time- 3 Hrs.		

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, conversation and creativity in machines.
CO3	Use modern technology, techniques, software and methodologies.
CO4	Evaluate and implement AI-driven solutions to enhance industrial processes, optimize decision-making, and improve operational efficiency.

Section A

Unit 1: Introduction: Introduction to Industrial artificial intelligence, History of AI, Proposing and evaluating Industrial AI applications, Demonstration: AI Industrial Use cases. **(09 hours)**

Unit 2: Machine learning, Supervised, unsupervised learning, Regression -- linear, logistic, Classification – decision trees, SVM, Model performance evaluation, PCA, Clustering – k-means, hierarchical clustering, Semi-supervised methods. **(09 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. **(10 hours)**

Section B

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. **(14 hours)**

Unit 5: AI and the future Industrial work, Appropriate uses of AI, The future of AI: Emerging developments. **(14 hours)**

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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.

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

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M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
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1 st SEMESTER				
Semester				
Name of the Course	ADVANCED CAD MODELING & 3D-PRINTING			
Course Code	MMET14	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20	Class Work Assessment (CWA)		Max. Marks = 20
End Semester Examination	Max. Marks= 60	Max. Time- 3 Hrs.		

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.
CO4	Design and develop 3D CAD models for additive manufacturing applications using advanced modeling tools and techniques

Section A

Unit1: Advanced solid modeling operations, Modeling of parts with complex shapes and free form surfaces, Diverse and unconventional methodologies for CAD work, Mechanical Drawing Modeling operations for sheet metal parts. **(10hours)**

Unit 2: Modern CAD system for high quality CAD models with complex shapes, 3D CAD models, CAD models for additive manufacturing. **(09hours)**

Unit 3: Introduction & History of 3D- Printing, Need for the compression in Product development Growth of 3DPrinting Industry. **(09hours)**

Section B

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. **(14hours)**

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. **(14hours)**

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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

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

Sections II & III of the question paper will have three questions each from the respective sections (A & B) of the syllabus and each question will carry 12 marks. The candidate will have to attempt four questions, from sections (II&III) selecting two from each.

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M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
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Semester		1 st SEMESTER		
Name of the Course		FLEXIBLE MANUFACTURING SYSTEMS		
Course Code	MMEY11	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20		Class Work Assessment (CWA)	Max. Marks = 20
End Semester Examination	Max. Marks= 60		Max. Time- 3 Hrs.	

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 <i>learn the knowledge</i>	Learn the fundamentals of computer assisted numerical control programming and programming languages, the automated flow lines.
CO3 <i>Summarize the</i>	Summarize the concepts of modern manufacturing such as JIT, supply chain management and lean manufacturing etc.
CO4	Analyze and integrate various components of a flexible manufacturing system to improve productivity, efficiency, and automation in manufacturing operations.

Section A

Unit 1: Introduction: Introduction to Manufacturing Systems, Different types of manufacturing systems, Volume Variety relationships for understanding manufacturing systems. **(09 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. **(10 hours)**

Unit 3: Machining system of FMS: Horizontal machining Centers, Vertical machining Centers, Integrated Material Handling, Automated Guided Vehicles, Automatic Storage and Retrieved System. **(09 hours)**

Section B

Unit 4: Group technology: Part classification and coding, production flow analysis, Machine Cell design, Computer Aided Process Planning. **(14 hours)**

Unit 5: JIT System: Characteristics of JIT pull method, small lot sizes, workstation loads, flexible work force, line flow strategy. Supply chain management, Preventive maintenance - Kanban system, value engineering, MRP, JIT, lean manufacturing, quality concepts and management. **(14 hours)**

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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.

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

Sections II & III of the question paper will have three questions each from the respective sections (A & B) of the syllabus and each question will carry 12 marks. The candidate will have to attempt four questions, from sections (II&III) selecting two from each.

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**M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
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1 st SEMESTER				
Semester				
Name of the Course	QUALITY CONTROL & RELIABILITY			
Course Code	MMEY12	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20		Class Work Assessment (CWA)	Max. Marks = 20
End Semester Examination	Max. Marks= 60		Max. Time- 3 Hrs.	

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. Knowledge of Sampling Plans
CO3	Acquire basic knowledge of total quality management.
CO4	Apply reliability modeling and quality improvement techniques to evaluate system performance and enhance product reliability.

Section A

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. **(09 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. **(10 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. **(09 hours)**

Section B

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. **(14 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. **(14 hours)**

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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.

INSTRUCTIONS (End Semester Examinations)

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by

Prof. P. S. Singh

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**M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
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Semester	1st SEMESTER			
Name of the Course	CONDITION MONITORING AND FAULT DIAGNOSIS			
Course Code	MMEY13	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20	Class Work Assessment (CWA)		Max. Marks = 20
End Semester Examination	Max. Marks= 60	Max. Time- 3 Hrs.		

COURSE OUTCOMES: At the end of the course student will be able to:	
CO1	Understand the domain knowledge of Fault Diagnosis of different machine components
CO2	Understand data Acquisition, Vibration instrumentation and transducers, Fluid Film and Rolling Element Bearing With Condition Monitoring.
CO3	Perform condition Monitoring of Machines & Case studies.
CO4	Analyze machine condition data to identify faults, predict failures, and recommend appropriate maintenance actions for improved system reliability.

Section A

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

(09 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.

(10 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.

(09 hours)

Section B

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 fault diagnosis Wear monitoring and lubricant, Spectrometric Oil Analysis Procedure (SOAP) and ferrography. **(14 hours)**

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Unit 5: Nondestructive testing techniques: Measurement of surface and subsurface flaws – liquid penetrant inspection, eddy current inspection, radiographic inspection, ultrasonic inspection. (14 hours)

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 of India 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.

INSTRUCTIONS (End Semester Examinations)

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M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
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Semester	1 st SEMESTER		
Name of the Course	ADVANCED CAD MODELING LAB		
Course Code	MMEL11	Credits-	1
Practical Sessional (PRS)	L-0 , T- 0 , P-2		
Practical Examination (PRE)	Max. Marks= 40		
	Max. Marks=60		

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-sized models for the functional testing applications.
CO3	Identify and correct the problems in STL files during modelling.
CO4	Operate 3D printing equipment and perform post-processing techniques such as support removal, surface finishing, and post-curing to obtain final prototypes.

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)

2. Viva

**70%
30%**

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M.Tech. 1st SEMESTER MECHANICAL ENGINEERING
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1 st SEMESTER			
Semester			
Name of the Course	INDUSTRIAL AI LAB		
Course Code	MMEL12	Credits-	1
Practical Sessional (PRS)	Max. Marks= 40		
Practical Examination(PRE)	Max. Marks=60		
			L-0 , T- 0 , P-2

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.
CO4	Apply AI and machine learning techniques to solve real-world industrial problems, analyze data, and improve decision-making and operational efficiency.

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%

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**M.Tech 2nd SEMESTER MECHANICAL ENGINEERING
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Contact Hours/Week: 23

Course Code	Course Type	Course Title	Credits	Load Allocation			Marks Distribution					Total
				L	T	P	CWA	PRS	MSE	ESE	PRE	
MMET21	Engineering Science Course	Industrial Tribology	4	3	1	0	20	-	20	60	-	100
MMET22	Engineering Science Course	Quantitative Methods and Operations Research	4	3	1	0	20	-	20	60	-	100
MOCM21	Engineering Science Course	NPTEL	3	3	0	0	-	-	-	100	-	100
MMEY21	Engineering Science Course	Advanced Engineering Materials	4	3	1	0	20	-	20	60	-	100
MMEY22	Engineering Science Course	Additive Manufacturing	4	3	1	0	20	-	20	60	-	100
MMEY23	Engineering Science Course	Tool and Cutter Design	4	3	1	0	20	-	20	60	-	100
MMEL21	Engineering Science Course	e-Maintenance Lab	2	0	0	4	-	40	-	-	60	100
MMES21	Engineering Science Course	Research Seminar	2	0	0	4	-	-	50	-	-	50
Total			19	12	3	8	-	-	-	-	-	550

by

Dr. Basu

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GOVT. COLLEGE OF ENGINEERING AND TECHNOLOGY, JAMMU
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M.Tech 2nd SEMESTER MECHANICAL ENGINEERING
(Batch 2025 & Onwards)

Semester	2 nd SEMESTER		
Name of the Course	INDUSTRIAL TRIBOLOGY		
Course Code	MMET21	Credits-	4
Mid Semester Examination	Max. Marks = 20	Class Work Assessment (CWA)	L-3 , T- 1 , P-0 Max. Marks = 20
End Semester Examination	Max. Marks= 60	Max. Time- 3 Hrs.	

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-day life.
CO4	Analyze friction, wear, and lubrication problems in mechanical systems to propose effective solutions for enhancing performance and durability.

Section A

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.

(13 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 of miscellaneous 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.

(15 hours)

Section B

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.

(10 hours)

Unit 4: Bearing Design: Clearance in journal bearing, minimum film thickness, Sommerfeld Number. Oil grooves and flow 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.

(09 hours)

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

(09 hours)

Recommended Books:

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

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

Sections II & III of the question paper will have three questions each from the respective sections (A & B) of the syllabus and each question will carry 12 marks. The candidate will have to attempt four questions, from sections (II&III) selecting two from each.

Use of scientific calculators (non-programmable), ~~steam table, standard data/ log books~~ are permitted, wherever required.

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M.Tech 2nd SEMESTER MECHANICAL ENGINEERING
(Batch 2025 & Onwards)

Semester	2 nd SEMESTER			
Name of the Course	QUANTITATIVE METHODS & OPERATIONS RESEARCH			
Course Code	MMET22	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20	Class Work Assessment (CWA)		Max. Marks = 20
End Semester Examination	Max. Marks= 60	Max. Time- 3 Hrs.		

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 critical thinking and objective analysis of decision problems.
CO4	Apply quantitative and optimization techniques to analyze complex industrial problems and support effective managerial decision-making.

Section A

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.

(09 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.

(09 hours)

Unit 3: Linear programming, formulation of mathematical models, solution of linear programming problems involving design 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.

(10 hours)

Section B

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.

(15 hours)

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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.

(13 hours)

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

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

Sections II & III of the question paper will have three questions each from the respective sections (A & B) of the syllabus and each question will carry 12 marks. The candidate will have to attempt four questions, from sections (II&III) selecting two from each.

Use of scientific calculators (non-programmable), ~~steam table, standard data, log Books~~ are permitted, wherever required.

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M.Tech 2nd SEMESTER MECHANICAL ENGINEERING
(Batch 2025 & Onwards)

Semester	2 nd SEMESTER			
Name of the Course	NPTEL			
Course Code	MOCM21	Credits-	3	L-3 , T- 0 , P-0
End Semester Examination	Max. Marks= 100		Max. Time- 3 Hrs.	

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.~~

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M.Tech 2nd SEMESTER MECHANICAL ENGINEERING
(Batch 2025 & Onwards)

Semester	2 nd SEMESTER			
Name of the Course	ADVANCED ENGINEERING MATERIALS			
Course Code	MMEY21	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20		Class Work Assessment (CWA)	Max. Marks = 20
End Semester Examination	Max. Marks= 60		Max. Time- 3 Hrs.	

COURSE OUTCOMES: At the end of the course student will be able to:

CO1	Recognize the conventional methods for processing of advanced composite materials
CO2	Understand the different types of phase diagrams and distinguish between the available reinforcing fibre performances.
CO3	Describe the different imperfections and strengthening mechanisms in solids.
CO4	Analyze and select advanced engineering materials for specific applications based on their mechanical, thermal, and chemical properties.

Section A

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.

(14 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.

(14 hours)

Section B

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.

(09 hours)

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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.

(09 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.

(10 hours)

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.

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

Sections II & III of the question paper will have three questions each from the respective sections (A & B) of the syllabus and each question will carry 12 marks. The candidate will have to attempt four questions, from sections (II&III) selecting two from each.

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**M.Tech 2nd SEMESTER MECHANICAL ENGINEERING
(Batch 2025 & Onwards)**

Semester	2nd SEMESTER			
Name of the Course	ADDITIVE MANUFACTURING			
Course Code	MMEY22	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20	Class Work Assessment (CWA)	Max. Marks = 20	
End Semester Examination	Max. Marks= 60	Max. Time- 3 Hrs.		

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 for design.
CO4	Apply additive manufacturing techniques to fabricate functional prototypes and components, evaluating their performance and suitability for real-world applications.

Section A

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. **(09 hours)**

Unit 2: Vat Photo polymerization AM Processes: Stereo lithography (SL), Materials, Process Modeling, SL resin curing process, SL scan patterns, Micro-stereo lithography, Mask Projection Processes, Two-Photon vat photo polymerization, Process Benefits and Drawbacks, Applications of Vat Photo polymerization, Material Jetting and Binder Jetting AM Processes. **(10 hours)**

Unit 3: Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, and 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. **(09 hours)**

Section B

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



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property relationship.

(14 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.

(14 hours)

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.

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

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~~Use of scientific calculator (non programmable), steam table, standard data/ log books are permitted, wherever required.~~

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**M.Tech 2nd SEMESTER MECHANICAL ENGINEERING
(Batch 2025 & Onwards)**

Semester	2nd SEMESTER			
Name of the Course	TOOL AND CUTTER DESIGN			
Course Code	MMEY23	Credits-	4	L-3 , T- 1 , P-0
Mid Semester Examination	Max. Marks = 20	Class Work Assessment (CWA)	Max. Marks = 20	
End Semester Examination	Max. Marks= 60	Max. Time- 3 Hrs.		

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.
CO4	Design and select appropriate cutting tools and machining parameters to optimize performance, efficiency, and surface quality in manufacturing processes.

Section A

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).

(09 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.

(10 hours)

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

(09 hours)

Section B

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

(14 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

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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.

(14 hours)

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, Donaldson.

INSTRUCTIONS (End Semester Examinations)

The question paper shall consist of three sections (I, II & III). Section-I will be compulsory, it consists of conceptual/analytical/objective type and shorty type questions with maximum 12 marks, will cover the entire syllabus.

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Use of scientific calculators (non-programmable), ~~steam table, standard data/ log books~~ are permitted, wherever required.

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M.Tech 2nd SEMESTER MECHANICAL ENGINEERING
(Batch 2025 & Onwards)

Semester	2 nd SEMESTER			
Name of the Course	e-Maintenance LAB			
Course Code	MMEL21	Credits-	2	L-0 , T- 0 , P-4
Practical Sessional (PRS)	Max. Marks= 40			
Practical Examination(PRE)	Max. Marks=60			

COURSE OUTCOMES: At the end of the course student will be able to:

CO1	To implement the understanding of e-Maintenance concepts.
CO2	To summarize basic knowledge of e-Maintenance on the basis of advanced context adaptation, visualization & Simulation capability.
CO3	To optimize the effectiveness of maintenance strategies, policies and resources for innovation and education.
CO4	Apply e-Maintenance tools and techniques to monitor, diagnose, and improve real-time equipment performance and reliability.

Lists 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% |



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M.Tech 2nd SEMESTER MECHANICAL ENGINEERING
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Semester	2 nd SEMESTER		
Name of the Course	RESEARCH SEMINAR		
Course Code	MMES21	Credits-	2
Mid Semester Examination	Max. Marks = 50		L-0 , T- 0 , P-4

COURSE OUTCOMES: At the end of the course student will be able to:

CO1	Able to work in actual working environment, identify, and compare technical and practical issues related 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.
CO4	Critically evaluate research literature, formulate research objectives, and propose innovative solutions in the chosen area of specialization.

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 give a 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 the guidelines below.

- General Report Format:** The report has to be typewritten on white A4 size paper, font-size of 12 points with typeface of Times New Roman has to be used throughout the report, with line spacing of 1. The report has to be properly bound with 'spiral bound'.
- Abstract/Preface:** This section of the report should contain brief description of summary of the Report
- Table of Contents:** This section of the report should consist of: i. Titles ii. Sub-titles iii. Page numbers every appendix must have a title and each page must be numbered accordingly.
- References:** Provided that there are important resources that are used as references while preparing the report, a complete list of the titles of references concern must be included.
- 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.
- List of Notations and Symbols:** If the report contains notations and symbols, the full



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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% |

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3. *Handwritten signature in a circle*
4. *Basu*
5. *Handwritten signature*