PDM UNIVERSITY
DEPARTMENTOF MECHANICAL ENGINEERING
Master of Technology (Machine Design & Robotics)

SEMESTER - I

MODULE CODE	CATEGORY	MODULE	L	T	P	C	INTERNAL MARKS	EXTERNAL MARKS	TOTAL
MECH5101	PC	MECHANICAL BEHAVIOUR OF MATERIALS	3	1	0	3.5	50	100	150
MECH5102	PC	ARTIFICIAL INTELLIGENCE	4	0	0	4	50	100	150
MECH5103	PC	EXPERIMENTAL STRESS ANALYSIS	3	1	0	3.5	50	100	150
MECH5104	PC	EXPERIMENTAL STRESS ANALYSIS LAB	0	0	2	1	25	25	50
MECH5105	PC	COMPUTER INTEGRATED MANUFACTURING	4	0	0	4	50	100	150
MECH5106	SP	SPECIAL PROBLEM	0	0	2	1	25	25	50
	GE	ELECTIVE-A	4	0	0	4	50	100	150
TOTAL			**18**	**2**	**4**	**21**	**300**	**550**	**850**

L = Lecture
T = Tutorial
P = Practical
C = Credit Point

MODULE CODE	GENERIC ELECTIVE - A
SAPA0320	SAP (ABAP)ψ
SAPM0321	SAP (MM)ψ
SAPS0322	SAP (SD)ψ
SAPH0323	SAP (HCM)ψ
SAPF0324	SAP (FI)ψ
CCNA0325	CCNA ψ
MATH0302	NUMERICAL ANALYSIS & OPTIMISATION

ψAdditional fee, if any, shall be borne by the student.

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SEMESTER - I

MECHANICAL BEHAVIOUR OF MATERIALS

L	T	P
3	1	0

MODULE CODE	MECH5101
CREDIT POINTS	3.5
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To learn basic concepts of the structure of material over the effects of mechanical properties.
2. To acquire knowledge of the defects inside the structure and their defects on the mechanical properties.
3. To understand the failure mechanism.
4. To have an understanding the ways to improve the existing knowledge.

LEARNING OUTCOMES:

1. Able to understand the basic level knowledge of Materials Science and Engineering
2. Ability to utilizing state of the art techniques in the area of Materials Science and engineering.
3. Able to define and solving the engineering problems related with material characteristics and properties.
4. Enhance the knowledge of mathematics, science and engineering in order to apply them for the benefits of Materials Science and engineering.

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MODULE CONTENT:

Unit I: Introduction Modern materials in design- plastics, composites, smart materials and nanomaterial's, WSEVEN reduction using plastics and composites, Properties and uses of plastics, composites, smart materials and nanomaterial's in the design of mechanical equipment's. Estimation of factor of safety in design.
Unit II: Design of plastic components Analysis of various properties for plastic components, manufacturing techniques of plastics, Various design considerations for plastic components, Applications of plastics in design of mechanical equipment's, Mechanical properties of glass filled –polyphenylene, glass filled -polyethylene and glass filled-polyurethane.
Unit III : Design of composite structure Structure and specific properties of composites, polymer-composite properties and application in aircraft industry, Prediction of service life, Main stages in composite structure design, Technological concept and production structure, Application of composites in passengers aircraft structures, Types of composite joints and their applications, Mechanical –joint design, Stress concentration and hole geometry.
Unit IV: Smart Materials Design and various characteristics of smart materials, Application of smart materials for design of intelligent structures, Smart paint, Modeling analysis and design of simple mechanical systems using smart materials.
Unit V: Nano materials Nanotechnology, Nanoscale, Design applications, Nanotubes, Nano-sized particles in composites, Fabrication of nano-sized particles, Nano devices.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Composite manufacturing technology by A.G Bratukhin and V.S Bogolyubov chapman and hall publications 2. Machine Design by R.L Norton, pearson Asia publications
REFERENCE BOOKS	1. Introduction to Nanotechnology, Charles P Poole and Frank J.Owens, Wiley-Inderscience,2003

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METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4
Class Test	x		X	
Quiz			X	
Assignment	x	x		x

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	I	j	k
Course Learning Outcomes	2	3	2	2	4	3		3		2	

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EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

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ARTIFICIAL INTELLIGENCE

L	T	P
4	0	0

MODULE CODE	MECH5102
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To have an appreciation for and understanding of both the achievements of AI and the theory underlying those achievements.
2. To have an appreciation for the engineering issues underlying the design of AI systems.
3. To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate Programs and an ability to understand code written in that language.
4. To have a basic understanding of some of the more advanced topics of AI such as learning, natural language Processing, agents and robotics, expert systems, and planning.

LEARNING OUTCOMES:

1. Ability to acquire knowledge of what constitutes "Artificial" Intelligence and how to identify systems with Artificial Intelligence.
2. Exposure to implement classical Artificial Intelligence techniques, such as search algorithms, minimax algorithm, neural networks, tracking, and robot localisation.
3. Ability to apply artificial intelligence techniques for problem solving.
4. Able to understand the limitations of current artificial intelligence techniques.

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Module Content:

Unit I: Introduction: Intelligent agents; Agents and environments; Good behavior; The nature of environments; Structure of agents ; Problem solving agents, example problems; Searching for solutions ; Uniformed search strategies; Avoiding repeated states; Searching with partial information.
Unit II: Searching Techniques: Informed search and exploration; Informed search strategies; Heuristic function; Local search algorithms and optimistic problems; Local search in continuous spaces; Online search agents and unknown environments; Constraint satisfaction problems (CSP); Backtracking search and Local search for CSP; Structure of problems; Adversarial Search; Games; Optimal decisions in games; Alpha; Beta Pruning; Imperfect real time decision; Games that include an element of chance.
Unit III: Knowledge representation: First order logic; Representation revisited; Syntax and semantics for first order logic; Using first order logic; Knowledge engineering in first order logic; Inference in First order logic; prepositional versus first order logic; Unification and lifting; Forward chaining; Backward chaining; Resolution; Knowledge representation; Ontological Engineering; Categories and objects; Actions; Simulation and event; Mental events and mental objects.
Unit IV: Learning Learning from observations; Forms of learning; Inductive learning; Learning decision trees; Ensemble learning; Knowledge in learning; Logical formulation of learning; Explanation based learning; Learning using relevant information.
Unit V: Inductive logic programming Statistical learning methods- learning with complete data, learning with hidden variable; EM algorithm; Instance based learning; Neural networks; Reinforcement learning; Passive reinforcement learning; Active reinforcement learning; Generalization in reinforcement learning.
Unit VI: Applications Communication; Communication as action; Formal grammar for a fragment of english; Syntactic analysis; Augmented grammars; Semantic interpretation; Ambiguity and disambiguation; Discourse understanding; Grammar induction; Probabilistic language processing; Probabilistic language models; Information retrieval; Information extraction; Machine translation.

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RECOMMENDED BOOKS:

TEXT BOOKS	1. Artificial Intelligence – A Modern Approach: Stuart Russell, Peter Nervi Pearson Education, New Delhi 2. Artificial Intelligence: Elaine Rich and Kevin Knight Tata McGraw-Hill, New Delhi
REFERENCE BOOKS	1. Artificial Intelligence: A new synthesis: Nils J. Nilsson Harcourt Asia Pvt. Ltd, Singapore. 2. Artificial Intelligence-Structures and Strategies for Complex Problem Solving: George F. Luger Pearson Education, New Delhi

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4
Class Test	x		x	
Quiz			x	
Assignment	x	x		x

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MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	H	i	j	k
Course Learning Outcomes	4	3	2	2		3	4			2	3

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
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EXPERIMENTAL STRESS ANALYSIS

L	T	P
3	1	0

MODULE CODE	MECH5103
CREDIT POINTS	3.5
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To learn various strain measurement techniques and various instrumentation for strain measurement and data collection.
2. To design and build different types of strain gauges.
3. To learn various strain analysis methods.
4. To understand the concept of photo elastic stress analysis methods.

LEARNING OUTCOMES:

1. Able to understand concept of stress and strain.
2. Ability to understand underlying principles in using strain gages.
3. Mount strain gages, take measurements and analyze the obtained data.
4. Exposure to design strain gage-based transducers for measuring specific loads.
5. Able to understand basic principles of photo elasticity, and use it as an analysis tool.
6. Able to use sources outside the class notes and text.

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Module Content:

Unit I: Strain measurement Ideal strain gauge; Mechanical, optical, acoustical, pneumatic, dielectric and electrical strain gauges; Differential transformer and piezoelectric transducers.
Unit II: Electrical wire resistance strain gauges Bonded type gauges; Bonding agents; Foil gauges; Gauge materials; Weldable gauges; Strain gauge adhesive; Fixing of gauges; Temperature effects in bonded gauges; Gauge factor and gauge sensitivity; Measurement of stress and stress gauge.
Unit III: Measuring circuits and strain gauge rosette Potentiometer circuit; Wheatstone bridge circuit, sensitivity and output; Temperature compensation and signal addition; Rectangular, delta and tee- delta rosette; Application of strain gauge in practical problems.
Unit IV: Whole field methods Photo elasticity; Stress loci, isoclinics, isostatics and isochromatic; Stress optic law and strain optic law; Photo elastic materials; Polarization of light; Plane polarized and elliptically polarized light; Brittle coating; Crack pattern and crack detection in coating; Moire Fringe geometry.
Unit V: Analysis of photo elasticity Data polariscope; Fringes due to principal stress direction and difference; Model making; Interpretation of isoclinics and isochromatic and fractional fringe order; Calibration through tension; Beam and disc models.
Unit VI: Reflection polariscopy Application to stress concentration and stress intensity factor; Separation of stresses.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Experimental Stress Analysis: Abdul Mubeen Dhanpat Rai and Sons, New Delhi 2. Experimental Stress Analysis: J W Dally and W F Riley McGraw-Hill, New York

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REFERENCE BOOKS	1. The Strain Gage Primer: C C Perry and H R Lissner McGraw-Hill, New York 2. Moire Fringes in Strain Analysis: P S Theocaris Pergammon Press, New York

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x	x			x	
Quiz			x			x
Assignment	x		x	X	x	

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MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	H	i	j	k
Course Learning Outcomes	4,5	3,5	2	2	6	3,4	4			2	3

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery.
- Suggested remedies / corrective measures.
- Approved refinement decisions due for implementation.
- Actions taken based on previous course review; and
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EXPERIMENTAL STRESS ANALYSIS LAB

L	T	P
0	0	2

MODULE CODE	MECH5104
CREDIT POINTS	1
FORMATIVE ASSESSMENT MARKS	25
SUMMATIVE ASSESSMENT MARKS	25
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

OBJECTIVES:

1. To get familiar with laboratory testing equipment used in experimental mechanics.
2. To understand the use laboratory equipment to demonstrate the mechanical behavior of common engineering materials and mechanisms.
3. To develop computer-based models to describe the theoretical behavior of mechanisms.
4. To enhance technical report writing and data presentation skills.

LEARNING OUTCOMES:

1. Ability to apply knowledge of mathematics, science and engineering.
2. Able to design and conduct experiments as well as to analyze and interpret data.
3. Ability to function on multidisciplinary teams.
4. Exposure to identify, formulate and solve engineering problems.

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LIST OF EXPERIMENTS

1.	Experiments using strain gauges.
2.	Measurement of strain, temperature effects.
3.	Fixing of gauges on surfaces.
4.	Experiments using photo elastic bench.
5.	Setting of polar scope and calibration of disc, beam and tension model.
6.	Application of strain gauge techniques: Lecture on strain gauge based methods, Cantilever beam and Portal frame experiments.
7.	Application of Strain Gauge techniques: experiment on combined bending and torsion.
8.	Applications of photo elasticity: demonstration of photo elastic techniques.
9.	Applications of photo elasticity: Calibration of the photo elastic constant, Determination of the stress field in a beam under bending.
10.	Applications of Digital Image Correlation: Demonstration of DIC techniques, determination of strain fields in the gauge section of a polymeric dog-bone specimen under tension.
11.	Experiments using strain gauges.
12.	Measurement of strain, temperature effects.

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 50 marks for practical.

Practical:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1	Internal Assessment	2	25
2	External Assessment	1	25

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MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	3	2	2,3	1	1,2		4		3		

EVALUATION

At the end of semester, Subject teacher will submit an evaluation report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the subject with respect to its strengths as well as those areas which could be improved. The review report contains the following:

- Approved refinement decisions due for implementation,
- Actions taken based on previous subject review,
- Problems encountered in the subject delivery,
- Suggested remedies / corrective measures, and
- Report discussed and analysed, actions taken as a result of this process and are communicated to the main stakeholders.

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COMPUTER INTEGRATED MANUFACTURING

L	T	P
4	0	0

MODULE CODE	MECH5105
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To understand different types of manufacturing systems available today such as the Special manufacturing system, the Manufacturing Cell, and the Flexible manufacturing system (FMS).
2. To learn the concepts of Computer integrated manufacturing and management system and automated flow lines.
3. To learn the guidelines and criteria for implementing CAD/CAM Systems and associated software for design, manufacturing, and a common CAD/CAM data base organized to serve both design and manufacturing.
4. Get idea of current research trends and possible future development.

LEARNING OUTCOMES:

1. Able to apply underpinning natural, physical and engineering sciences, mathematics, statistics, computer and information sciences.
2. Able to understand the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the Demonstrate effective team membership and team leadership
3. Exposure to demonstrate professional use and management of information.
4. Exposit legal, social, economic, ethical and environmental interests, values, requirements and expectations of key stakeholders.

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MODULE CONTENT:

Unit I: Introduction to CIM The meaning and origin of CIM; The changing manufacturing and management scene; External communication; Islands of automation and software; Dedicated and open systems; Manufacturing automation protocol; Product related activities of a company; Marketing engineering; Production planning; plant operations; Physical distribution; Business and financial management.
Unit II: Group technology History of group technology; Role of group technology(GT) in CAD/CAM integration; Part families; Part classification and coding; DCLASS and MICLASS and OPITZ coding systems; Facility design using G T; Benefits of G T; Cellular manufacturing.
Unit III: Computer aided process planning Role of process planning in CAD/CAM integration; Approaches to computer aided process planning; Variant approach and generative approaches; Computer aided process planning (CAPP) systems.
Unit IV: Shop floor control and introduction of FMS Shop floor control- phases, factory data collection system, automatic identification methods, bar code technology, automated data collection system. FMS - components of FMS, types, FMS workstation, material handling and storage systems, FMS layout, computer control systems, application and benefits.
Unit V: CIM implementation and data communication CIM and company strategy; System modeling tools; IDEF models; Activity cycle diagram CIM open system architecture (CIMOSA); Manufacturing enterprise wheel; CIM architecture; Product data management; CIM implementation software; Communication fundamentals; Local area network; Topology; Local area network implementations; Network management and installations.
Unit VI: Open system and database for CIM Open systems- open system inter connection, manufacturing automations protocol and technical office protocol (MAP /TOP); Development of databases; Database terminology; Architecture of database systems; Data modeling and data associations; Relational data bases; Database operators; Advantages of data base and relational database.

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RECOMMENDED BOOKS:

TEXT BOOKS	1. Automation, Production Systems and computer integrated manufacturing: Mikell.P GrooverPearson Education, New Delhi 2. Computer Integrated Manufacturing System: Yorem McGraw-Hill Inc., New York
REFERENCE BOOKS	1. Computer Integrated Design and Manufacturing: David D Bedworth, Mark R Hendersan, Phillip

METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4
Class Test	x	x		
Quiz	x		x	
Assignment		x		x

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MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	2	3	2	2	4	3		3		2	

EVALUATION

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SPECIAL PROBLEM

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NUMERICAL ANALYSIS & OPTIMIZATION

L	T	P
4	0	0

MODULE CODE	MATH0302
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems.
2. To develop and promote research interest in applying optimization techniques in problems of engineering and technology.
3. To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems.

LEARNING OUTCOMES:

1. Able to understand the bases of linear programming, unconstrained optimization, and constrained optimization.
2. Able to analyze the behaviour of these numerical methods and in particular to be able to discuss their stability, their order of convergence and their conditions of application.
3. Able to analyze a problem and identify the computing requirements appropriate for its solution.
4. Ability to acquire knowledge of mathematics and computing to the design and analysis of optimization methods.

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***MODULE* CONTENT:**

Unit I: ERRORS IN NUMERICAL CALCULATIONS Introduction, Numbers and their accuracy, Absolute, relative and percentage errors and their analysis, General error formula.
Unit II: INTERPOLATION AND CURVE FITTING Taylor series and calculation of functions, Introduction to interpolation, Lagrange approximation, Newton Polynomials, Chebyshev Polynomials, Least squares line, curve fitting, Interpolation by spline functions.
Unit III: NUMERICAL DIFFERENTIATION AND INTEGRATION Approximating the derivative, Numerical differentiation formulas, Introduction to Numerical quadrature, Newton-Cotes formula, Gaussion- Quadrature. Direct methods, Gaussian elimination and pivoting, Matrix inversion, UV factorization, iterative methods for linear systems, Bracketing methods for locating a root, Initial approximations and convergence criteria, Newton- Raphson and Secant methods.
Unit IV: SOLUTION OF DIFFERENTIAL EQUATIONS Introduction to differential equations, Initial value problems, Euler s methods, Runge-Kutta methods, Taylor series method, Predictor- Corrector methods, Finite-difference method. Solution of hyperbolic, parabolic and elliptic equations, Eigen value problem, Power and inverse power methods, Jacobi s method for Eigen value problems.
Unit V: OPTIMIZATION METHODS Optimal problem formulation, Engineering optimization problems; optimization algorithms: Single-variable optimization algorithms, optimality criteria, Bracketing methods, Region-elimination methods, Point estimation method.
Unit VI: MULTI- VARIABLE OPTIMIZATION ALGORITHMS Optimality criteria, Uni-directional search, Direct search methods: Evolutionary methods, Simplex search method, Gradient based methods: Cauchy s method, Newton's method, Application to Mechanical Engg. Problems, Non- traditional optimization algorithms, Genetic algorithms (GA), GA for constrained optimization, other GA operators, Multi objective Optimization, Concept of Pareto Optimality, Global optimization.

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RECOMMENDED BOOKS:

TEXT BOOKS	1. Numerical Methods for Mathematics, Science and Engineering by John H.Mathews, PHI New Delhi. 2 Applied Numerical Methods Carnahan, B.H., Luthar, H.A. and Wilkes, J.O., Pub.- J. Wiley, New york
REFERENCE BOOKS	1. Numerical Solution of Differential Equations, by M.K. Jain, Published by Wiley Eastern, New York. 2. Introductory Methods of Numerical Analysis by S.D. Sastry, Published by Prentice Hall of India

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

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MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4
Class Test		x		x
Quiz	x		x	
Assignment	x			x

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	4	3	2	3		3		3		2	1

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
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SEMESTER - II

MODULE CODE	CATEGORY	MODULE	L	T	P	C	INTERNAL MARKS	EXTERNAL MARKS	TOTAL
MECH5107	PC	FINITE ELEMENT METHOD	4	0	0	4	50	100	150
MECH5108	PC	PRINCIPLE OF MACHINE DESIGN	3	0	0	3	25	75	100
MECH5109	PC	PRINCIPLE OF MACHINE DESIGN LAB	0	0	2	1	25	25	50
MECH5110	PC	ROBOTICS & AUTOMATION	4	0	0	4	50	100	150
MECH5111	SP	SEMINAR	0	0	2	1	25	25	50
RESM0101	PC	RESEARCH METHODOLGY	4	0	0	4	50	100	150
	PE	ELECTIVE-I	4	0	0	4	50	100	150
TOTAL			**19**	**0**	**4**	**21**	**275**	**525**	**800**

L = Lecture
T = Tutorial
P = Practical
C = Credit Point

ELECTIVES

MODULE CODE	PROGRAM ELECTIVE I
MECH5212	DYNAMIC OF ROAD VEHICLE
MECH5213	FRACTURE MECHANICS

FINITE ELEMENT METHOD **L T P**

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4 0 0

MODULE CODE	MECH5107
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To get familiar with the Finite Element Analysis fundamentals.
2. To generate element stiffness matrices for fem problems.
3. To formulate the design problems into FEA.
4. To perform engineering simulations using Finite Element analysis software (ANSYS & LS- DYNA).

LEARNING OUTCOMES:

1. Have an understanding of the principles and concepts related to finite element methods.
2. Able to implement finite element methods for simple 1-D problems such as truss analysis and 1-D heat conduction either by hand calculation or by programming.
3. Able to numerically solve for stresses, strains and deformation of a structural component due to axial load, torsion, and bending, acting individually or in combination.
4. Able to numerically solve for stresses, strains and deformation of a structure under either plane-stress or plane-strain conditions.
5. Have a basic knowledge about finite element methods for solving time-dependent and/or non-linear problems.

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MODULE CONTENT:

Unit-I: Introduction Fundamentals; Description of method; Matrix techniques; Large system of algebraic equations; Basics of solid mechanics; Stress and strain relationships in elastic behavior - linear and non linear.
Unit-II: Variational methods Variational methods in solid mechanics; Minimum potential energy and minimum complementary energy; Application to FE methods.
Unit-III: Theory of Finite Element Method Element shapes – one, two, three dimensional and axisymmetric elements; Displacement models in generalized coordinates; Convergence; Nodal degrees of freedom; Interpolation displacement models.
Unit-IV: Elements of FEM Element stresses and strains; Element stiffness and loads; Lumped loads; Variational formulation of element stiffness and lumped load; Numerical integration; Condensation of internal degrees of freedom.
Unit-V: Solution of FEM problem Assemblage of Elements; Discretization of a body or structure; Effect of element aspect ratio; Infinite bodies; Higher order elements and refinement of mesh; Nodal compatibility and interface displacement compatibility; Assembly stiffness matrix; Boundary conditions; Solution for element stress or strain.
Unit-VI: Application of Finite Element Method Application of FEM to problems in structure mechanics; Fluid flow and heat transfer; Making Computer Codes for FEM solutions.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Introduction to the Finite Element Method: CS Desai and JF Abel Van Nostrand Reinhold Co., New York. 2. Finite Element: OC Zienkiewicz Butterworth-Heinemann, London.
REFERENCE BOOKS	1. Finite Element Procedure: Klaus-Jurgen Bathe Prentice Hall, New York. 2. Concept and Applications of Finite Element Analysis: R Cook, D Malkus, M Plesha and R Witt M. Wiley, New York.

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METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5
Class Test	x		x		
Quiz		x	x		x
Assignment	x			x	x

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k

Course Learning Outcomes	2,4		5	2	4,5	3		3	4	2	

EVALUATION

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PRINCIPLE OF MACHINE DESIGN

L	T	P
3	0	0

MODULE CODE	MECH5108
CREDIT POINTS	3
FORMATIVE ASSESMENT MARKS	25
SUMMATIVE ASSESMENT MARKS	75
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To understand and to interpret tolerance on a dimension.
2. Acquaintance with ISO system of tolerances.
3. To acquire knowledge of various multidimensional static failure criteria for different materials.
4. To apply multidimensional static failure criteria in the design and analysis of machine components.
5. Acquaintance with spring terminology and different types of springs.
6. To understanding of safety and reliability concepts in the design of machine elements.

LEARNING OUTCOMES:

1. Awareness of the influence of science and technology on civilizations and an ability to explain how science and technology have been applied to the betterment of humankind.
2. Ability to evaluate ethical issues that may occur in professional practice.
3. Ability to use mathematics, experimentation and computation in solving engineering problems.
4. Fluency in both English and SI units and an ability to translate between them.
5. Familiarity with the use of graphical techniques in problem formulation and solution and an ability to effectively use graphical methods in communication.

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MODULE CONTENT:

Unit-I: Engineering Design Steps in designing, tasks and activities, varieties of engineering, design process and role of designer, iteration, decision making, resource conversion, systems and devices and variety of needs, need analysis, feasibility study, preliminary design, detail design, revision. Information for need and problems. Associated with information, variety of information.
Unit-II: Fundamentals of Technical Systems System approach fundamentals, assemblies and components, interrelationships, creativity as means to synthesis of alternatives, estimating the order of magnitude, design records.
Unit-III: Product Planning and Development Life cycle from production to consumption and disposal, description of tasks, description of design specification and activities.
Unit-IV: Conceptual Design Abstraction, modelling of an engineering problem; iconic, analog and symbolic models; determination of dimensions, graphics, visualization and synthesis, characteristics of a good model, value system and criterion function.
Unit-V: Embodiment Design Steps, rules and principles, mechanical connections, modular products, design for quality and cost. Optimization, optimum vs. optimal. Optimum and robust design.
Unit-VI: Communication and reporting Preparing and presenting the report, oral vs. written communication, aids. Brainstorming, Fits and tolerance, Hole base system, shaft base system.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Introduction to Engineering Design by T T Woodson; McGraw-Hill Book Co., Kogakusha Co. Ltd. 2. Mechanical Design Process by DJ Ullman; McGraw-Hill Book Co. 3. Engineering Design by GE Dieter; McGraw-Hill Book Co.
REFERENCE BOOKS	1. Conceptual Design for Engineers by Micha

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METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 75 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	05
2.	Sessional Test	2	10
3.	Group Discussion	4	05
4.	End Semester Exam	1	75

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x		x			x
Quiz		x	x		x	
Assignment	x			x		x

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1		2	2	1,5	3	2	3		2	

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
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PRINCIPLE OF MACHINE DESIGN LAB

L	T	P
0	0	2

MODULE CODE	MECH5109
CREDIT POINTS	1
FORMATIVE ASSESSMENT MARKS	25
SUMMATIVE ASSESSMENT MARKS	25
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

OBJECTIVES:

1. To develop and evaluate alternatives for mechanical systems.
2. To estimate fatigue strengths of steel parts.
3. Apply techniques of combined stress and Mohr's circle in machine design situations
4. To determine suitable material and size for structural components in machines, including effects of fatigue and stress concentration.
5. To apply iterative techniques in design, including making estimate of unknown values for first computation and checking or revising and recomputing.
6. Logically choose and defend choice of design factor.
7. Select belts, chains, gears, bearings, power screws.

LEARNING OUTCOMES:

1. Ability of understanding of design, selection and evaluation of mechanisms.
2. Ability of understanding of stress analysis related to mechanical design.
3. Students will have the confidence to apply engineering solutions in global and societal contexts.
4. Students will demonstrate an understanding of their professional ethical responsibilities.
5. Students will demonstrate the ability to design and conducts experiments, Interpret and analyze data, and report results.

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LIST OF EXPERIMENTS

1.	Introduction to design of machine element.
2.	Stress measurement and concentration.
3.	Press and shrink fits.
4.	Gear lab.
5.	Flexible components.
6.	Bearing lab.
7.	Bolt lab.

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 50 marks for practical.

Practical:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1	Internal Assessment	2	25
2	External Assessment	1	25

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	3,4	2	3,5	1	1,2		1		4		

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EVALUATION

At the end of semester, Subject teacher will submit an evaluation report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the subject with respect to its strengths as well as those areas which could be improved. The review report contains the following:

- Approved refinement decisions due for implementation,
- Actions taken based on previous subject review,
- Problems encountered in the subject delivery,
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ROBOTICS & AUTOMATION

L	T	P
4	0	0

MODULE CODE	MECH5110
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To understand and appreciate the importance of basic principles of Robotic Systems.
2. To understand the application of those principles in practice.
3. To appreciate the different programming languages used in robots.
4. To learn the control techniques for robots.

LEARNING OUTCOMES:

1. Students will be equipped with the automation and brief history of robot and applications.
2. Students will be familiarized with the kinematic motions of robot.
3. Students will have good knowledge about robot end effectors and their design concepts.
4. Students will be equipped with the Programming methods & various Languages of robots.
5. Students will be equipped with the principles of various Sensors and their applications in robots.

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MODULE CONTENT:

Unit-I: Introduction Automation and robotics –History of robotics, Robot anatomy ,Robot configurations, Robot Components, Types of Robot drives – pneumatic, hydraulic and electrical drive systems, Applications - Material handling – Manufacturing Processes – Welding, Machining, Assembly and Inspection, CIM and hostile environments - safety considerations.
Unit-II: Direct and inverse kinematics Rotation matrices; Composite rotation matrices; Euler angle representation.
Unit-III: Robot Programming and AI Methods - Languages -Computer control and Robot Software - VAL Language – Trajectory Planning, Basic robot motions - Point to point control & continuous path control and interpolations AI – Basics – Goals-AI Techniques – AI & Robotics.
Unit-IV: Sensory Devices Non optical and optical position sensors - Velocity and Acceleration - Range - Proximity -touch - Slip - Force -Torque - Machine vision - Image components - Representation -Hardware - Picture coding - Object recognition and categorization - Software consideration.
Unit-V: Energy equations Lagrange and Euler formulation; Joint velocities; Kinetic energy; Potential energy and motion equations; Generalized D'Alembert equations of motion.
Unit-VI: PID control computed, torque technique Near minimum time control; Variable structure control; Non-linear decoupled feedback control; Resolved motion control and adaptive control.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002
REFERENCE BOOKS	1. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition,2000 2. K.S. Fu., R.C.Gonalez, C.S.G.Lee, "Robotics Control Sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.

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METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5
Class Test	x			x	
Quiz		x	x		x
Assignment	x			x	x

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	3		2	2,5	1,5	3	2	3		4	

EVALUATION

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SEMINAR

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Research Methodology

L	T	P
4	0	0

MODULE CODE	RESM0101
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

The aim of teaching this subject is to impart knowledge primarily related to research methodology so that learner will be able to understand the research design and represent the research work. Some of the objectives of the course are:

1. To acquire basic knowledge research.
2. To get familiar with different types of research design.
3. To understand the basic of data collection.
4. To get familiar with the different techniques of data analysis.
5. To acquire basic knowledge of technical writing.
6. To get the knowledge of using tools and techniques in research.

LEARNING OUTCOMES:

1. Able to understand importance of research and its type.
2. Able to understand research papers and type of research design.
3. Able to formulate the research problem.
4. Able to choose the appropriate data analysis tool.
5. Able to justify with the type of research by publishing it at appropriate platform.
6. Able to use different types of softwares and techniques in research writing.

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MODULE CONTENTS:

Unit I: Introduction to Research and Problem Definition Meaning, Objective and importance of research, Types of research, steps involved in research, defining research problem.
Unit II: Research Design Research Design: Concept and Importance in Research, Features of a good research design, Exploratory Research Design: concept, types and uses, Descriptive Research Designs: concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. Literature Survey.
Unit III: Data collection Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research Problem Identification & Formulation: Hypothesis, Qualities of a good Hypothesis, Null Hypothesis & Alternative.
Unit IV: Data analysis Statistical techniques and choosing an appropriate statistical technique, Data processing softwares (e.g. SPSS etc.), Interpretation of results Data Preparation: Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis (Cross tabulations and Chi-square test)
Unit V: Technical Writing and reporting of research Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles. Research Journals, Indexing and citation of Journals, Impact factor of Journals, Ethical issues related to publishing, Intellectual property Plagiarism and Self-Plagiarism.
Unit VI: Use of Tools and Techniques for Research Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases. methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.

RECOMMENDED BOOKS:

TEXT BOOKS	1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age International publishers, Third Edition. 2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005 3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition

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REFERENCE BOOKS	1. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, 2013. 2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press. 3. Select references from the Internet

METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x	x	x			
Quiz	x	x				x
Assignment		x	x	x	x	x

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MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	3,4	5	3,5						4		

EVALUATION

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DYNAMIC OF ROAD VEHICLE

L	T	P
4	0	0

MODULE CODE	MECH5212
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To introduction to engineering analysis of the automobile and its sub-systems.
2. Application of engineering principles to automotive design.
3. Familiarization with modeling and analysis methods.
4. Familiarization with the automotive industry and its terminology.

LEARNING OUTCOMES:

1. Ability to understand the dynamics of vehicle ride.
2. Ability to calculate and refer the loads and forces associated to the vehicles.
3. Ability to analyse the behavior of the vehicles under acceleration, ride and braking.

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MODULE CONTENT:

Unit-I: Performance Characteristics of Vehicle SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system, Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, power limited and traction limited acceleration, braking performance, Brake proportioning, braking efficiency.
Unit-II: Aerodynamics Mechanics of Air Flow Around a Vehicle, Pressure Distribution on a Vehicle, Aerodynamic Forces, Drag Components, Aerodynamics Aids.
Unit-III: Tire Mechanics Tire Construction, Size and Load Rating, Terminology and Axis System, Tractive Properties, Cornering Properties, Camber Thrust, Aligning Moment, Combined Braking and Cornering, Conicity and Ply Steer, Slip, Skid, Rolling Resistance, Elastic Band Model for longitudinal slip, Simple model for lateral slip, Combined longitudinal/lateral slip (friction ellipse), Taut string model for lateral slip, Magic Tire Formula.
Unit-IV: Suspensions Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Center Analysis, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points
Unit-V: Rollover Quasi-Static Rollover of a Rigid Vehicle, Quasi-Static Rollover of a Suspended Vehicle, Transient Rollover.
Unit-VI: Motorcycle Dynamics Kinematic structure of motorcycle, geometry of motorcycles, importance of trail, Resistance forces acting on motorcycle (tyre rolling resistance, Aerodynamic resistance forces, resistant force caused by slope), Location of motor cycle's centre of gravity (C.G), Moments of inertia on Motorcycle. Introduction to Front & Rear suspensions of Motorcycle.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Vittore Cossalter, Motorcycle Dynamics, 2nd Edition, Publisher: LULU.com 2. R N Jazar, Vehicle Dynamics: Theory and Application, Springer.

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REFERENCE BOOKS	1. Hans Pacejka, Tire and Vehicle Dynamics, Elsevier, 2012. 2. Thomas D Gillespie, "Fundamentals of Vehicle dynamics", SAE USA 1992.

METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3
Class Test	x		
Quiz		x	x
Assignment	x		

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MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	3		2	2	1	3	2	3		1	

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
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FRACTURE MECHANICS

L	T	P
4	0	0

MODULE CODE	MECH5213
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. Students can do an examination of the concept of failure in members with pre-existing flaws.
2. Students will get physical understanding of linear elastic and elastic-plastic fracture mechanics, and the application of those concepts to design and assessment of structures.
3. Students can examine failure of structural components from both the mechanics and micro structural points of view.

LEARNING OUTCOMES:

1. Have a solid foundation in the theory, concepts and principles of fracture mechanics.
2. Be gaining the physical intuition necessary to idealise a complicated practical problem.
3. Possess the analytical and computational tools needed to solve the idealised problem.
4. Have an ability to acquire the judgment required to interpret the results of these solutions.
5. Ability to use these solutions to guide a corresponding design, manufacture, or failure analysis.

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MODULE CONTENT:

Unit-I: Introduction History of failure by Fracture; Failure of structures – bridges, pressure vessels and ships; Brittle fracture; Development of testing for failure; Identification of reasons for failure; Existence of crack; Griffith crack and experiment; Energy release rate and stress for failure in presence of crack.
Unit-II: A Stress analysis in cracks Stress Field around Crack Tip; Revision of theory of elasticity; Conformal mapping; Airy's stress function for crack tip stress field with crack emanating from straight boundary; Stress state in crack tip vicinity; Modes of crack face deformation; Stress intensity factor and Irwin's failure criterion; Fracture toughness.
Unit-III: Methods of determining stress intensity factor Determination of Stress Intensity Factor; Different specimen configuration; Numerical techniques - boundary collocation and boundary integral; Finite element method; Experimental method - reflection and refraction polariscopy; Determination of fracture toughness.
Unit-IV: Energy consideration Energy Consideration; Potential energy; Surface energy; Plastic deformation around crack tip; Energy release rate; Compliance and correlation with fracture toughness.
Unit-V: Crack opening displacement (COD) Crack opening displacement (COD); COD as fracture criterion; experimental determination of COD; Use of fracture toughness and COD as design criteria.
Unit-VI: Crack Propagation Crack Propagation; Law of fatigue crack propagation; Life calculation when a crack is present and loaded; Microscopic aspects of crack propagation; Elastic crack and plastic relaxation at crack tip.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Elementary Engineering Fracture Mechanics: David and Bruck Norelco, United States 2. Fracture and Fatigue Control in Structure: S T Rolfe and J M Barson Prentice Hall Inc, New York
REFERENCE BOOKS	1. Fracture Mechanics Fundamentals and Applications: T L Anderson CRC Press, India 2. Fracture of Structural Materials: A S Tetelman and A J McEvily John Wiley and sons, New York

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METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5
Class Test		x		x	X
Quiz		x	x		X
Assignment	x			x	

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	K
Course Learning Outcomes	4		2,5	2	1	3	2,4	3		2	

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EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
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SEMESTER - III

MODULE CODE	CATEGORY	MODULE	L	T	P	C	INTERNAL MARKS	EXTERNAL MARKS	TOTAL
MECH6101	PC	ROBOTIC SENSORS	4	0	0	4	50	100	150
MECH6102	PC	THEORY OF ELASTICITY	4	0	0	4	50	100	150
MECH6103	PC	MECHANICAL VIBRATIONS	3	0	0	3	25	75	100
MECH6104	PC	MECHANICAL VIBRATIONS LAB	0	0	2	1	25	25	50
MECH6105	DI	LITERATURE SURVEY (DISSERTATION STAGE 1)*	0	0	0	2	50	50	100
	PE	ELECTIVE-II	4	0	0	4	50	100	150
	GE	ELECTIVE- B	4	0	0	4	50	100	150
TOTAL			**19**	**0**	**2**	**22**	**300**	**550**	**850**

L = Lecture

T = Tutorial

P = Practical

C = Credit Point

ELECTIVES

MODULE CODE	PROGRAM ELECTIVE II
MECH6206	INDUSTRIAL TRIBOLOGY
MECH6207	TOTAL QUALITY MANAGEMENT
MODULE CODE	**GENERIC ELECTIVE B**
SAPA0320	SAP (ABAP)ψ
SAPM0321	SAP (MM)ψ
SAPS0322	SAP (SD)ψ
SAPH0323	SAP (HCM)ψ
SAPF0324	SAP (FI)ψ
CCNA0325	CCNAψ
MGMT0306	ORGANISATIONAL BEHAVIOUR

ψ Additional fee, if any, shall be borne by the student.

*** Students are to earn 2 credits on review of litrature in 3rd semester out of 12 credits in total assigned to dissertation, to be completed in 4th semester.**

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ROBOTIC SENSOR

L	T	P
4	0	0

MODULE CODE	MECH6101
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To understand and appreciate the importance of basic principles of Robotic Systems.
2. To understand the application of those principles in practice.
3. Appreciate the different programming languages used in robots.
4. To learn the control techniques for robots.

LEARNING OUTCOMES:

1. Able to understand the importance of robotics in today and future goods production.
2. Exposure to robot configuration and subsystems.
3. Principles of robot programming and handle with typical robot.
4. Ability to acquire knowledge of working of mobile robots.

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MODULE CONTENT:

Unit-I: Introduction General considerations in Robot material handling, material transfer application, machine loading and unloading; CNC machine tool loading; Robot centered cell.
Unit-II: Application of robots Application of robots in continuous arc welding, spot welding, spray coating, other processing operation; Limitation of usage of robots in processing operation.
Unit-III: Robot assembly Robot assembly, Automation parts presentation methods, Assembly operation; Remote center compliance (RCC) Device.
Unit-IV: Inspection systems Assembly system configurations; Adaptable programmable assembly system; Designing for robotic inspection in automation; Vision inspection system; Robot manipulated inspection.
Unit-V: Application in hazardous environments and service industries Robot in hazardous and inaccessible manufacturing environments - Construction, underground coal mining, fire fighting operations, under sea operations, space operations; Robots in service industries - teaching, security and household robots.
Unit-VI: Safety and performance of robots Factors influencing the choice of a robot; Robot performance testing- path/point accuracy and repeatability, maximum working envelop, kinematic and state values; Robot safety Considerations and factors affecting robot safety measures - safety features built into industrial robot, safety barriers and other devices.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Introduction to Robotics: Critchlow and J Arthur Macmillan Publishing Company, New York 2. Robotics Technology and Flexible Automation: S R Deb Tata McGraw Hill, India
REFERENCE BOOKS	1. Industrial Robotics Technology, Programming and Applications: Mikell P Groover, Mitchell Weiss, Roger N Nagel and Nicholas G Odrey McGraw Hill Book Company, New York 2. Industrial Robotics: Bernard Hodges Jaico Publishing House, Delhi

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METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4
Class Test		x		x
Quiz		x	x	
Assignment	x			x

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	D	e	f	g	H	i	j	k
Course Learning Outcomes	4		2	2,3	1	3		3		2	

EVALUATION

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THEORY OF ELASTICITY

L	T	P
4	0	0

MODULE CODE	MECH6102
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. Define the stress, strains and their relation in detail.
2. To apply different compatible equations to solve cantilever and simply supported beam problems.
3. To understand the two dimensional elasticity problems.
4. To understand the torsion in straight bars.

LEARNING OUTCOMES:

1. Ability to understand the basic concepts in continuum mechanics of solids, including of strain, internal force, stress and equilibrium in solids.
2. Ability to use analytical techniques to predict deformation, internal force and failure of simple solids and structural components.
3. Ability to apply principles of continuum mechanics to design a structure or component to achieve desired performance under realistic constraints.

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MODULE CONTENT:

Unit-I: Concept of stress State of stress at a point; Stress notations; State of strain at a point and notations; States of plane stress and plane strain; Hooke's law and generalized statement of Hooke's law; Stress-strain relationships; Concept of principal stress and strain; Mohr's circle.
Unit-II: Cantilevers and beams Compatibility equations; Stress function; Use of stress function in solution of two dimensional problems in Cartesian coordinates; Boundary conditions; Problems of cantilever; Supported beam under distributed load of uniform and uniformly variable intensity; Use of Fourier series.
Unit-III: Two dimensional problems Two dimensional elasticity problems in polar coordinates; Equation of equilibrium; Axi-symmetric problems; Thick cylinder; Curved bars; Hole in a plate problem; Idea of an edge dislocation.
Unit-IV: Torsion Torsion of straight bars; Elliptic and circular section; Membrane analogy; Torsion of thin rectangular section; Application of energy method to torsion problem; Torsion of thin tubes.
Unit-V : Complex analysis Complex variables for curvilinear coordinates; Laplace's equation; Complex stress function and corresponding displacements; Curvilinear coordinates and stress components; Elliptic hole in a uniformly stressed plate.
Unit-VI: Waves and vibrations Propagation of waves in elastic solid media; Use of elastic waves; Wave equation; Time harmonic solution,; Boundary conditions; Reflection and rarefaction; Rayleigh waves; Vibration of rods and plates.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Theory of Elasticity: S P Timoshenko McGraw-Hill International, New York
REFERENCE BOOKS	1. Applied Elasticity: Zhilun Xu Wiley Eastern Ltd, New Delhi 2. Applied Elasticity: Chi-Teh Wan McGraw-Hill, New York

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METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3
Class Test	x	x	
Quiz		x	x
Assignment	x		

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	D	e	f	g	h	i	j	k
Course Learning Outcomes	3		2,3		1	3		3		2	

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

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MECHANICAL VIBRATIONS

L	T	P
3	0	0

MODULE CODE	MECH6103
CREDIT POINTS	3
FORMATIVE ASSESMENT MARKS	25
SUMMATIVE ASSESMENT MARKS	75
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. Students will learn how to develop vibration models for mechanical systems using mass, stiffness and damping of mechanical systems.
2. Students will be able to model a vibrating mechanical system, develop and solve its governing equations in order to obtain the response of the system under various types of excitation conditions.
3. Students will learn how to interpret the response of a mechanical system and use the response information in its design and testing.
4. Students will learn about the various vibration measuring instruments.

LEARNING OUTCOMES:

1. Ability to analyze the mathematical model of a linear vibratory system to determine its response.
2. Ability to obtain linear mathematical models of real life engineering systems.
3. Ability to use Lagrange's equations for linear and nonlinear vibratory systems.
4. Ability to determine vibratory responses of SDOF and MDOF systems to harmonic, periodic excitation.
5. General notion on frequency and time response of vibratory system.

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MODULE CONTENT:

Unit-I: Fundamentals of vibration Review of single degree freedom system; Response to arbitrary periodic excitation; Duhamel's integral impulse response function; Lagrange's equation.
Unit-II: Single degree freedom forced Vibration with elastically coupled viscous dampers; System identification from frequency response; Laplace formulation.
Unit-III: Two degree of freedom system Free vibration of spring-mass coupled system; Bending vibration of two degree of freedom system; Forced vibration; Vibration absorption and isolation.
Unit-IV: Multi degree of freedom system Normal mode of vibration; Flexibility matrix and stiffness matrix; Eigen values and vectors; Orthogonal properties modal matrix analysis; Matrix inversion method; Modal damping in forced vibration; Numerical methods.
Unit-V : Vibration of continuous systems Systems governed by wave equations; Vibration of strings and rods; Euler equation for beams; Effect of rotary inertia and shear deformation; Vibration of plates.
Unit-VI: Experimental methods Vibration exciters and measuring devices; Vibration tests and analysis; Tests on free and forced vibration with examples; Vibration monitoring and diagnosis; Case studies.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Theory and Practice of Mechanical Vibration: J S Rao and K Gupta New Age Publications, New Delhi 2. Mechanical Vibrations: Den Hartog Dover Publications, United States
REFERENCE BOOKS	1. Theory of Vibration with Applications: W T Thomson CBS Publishers, New Delhi 2. Theory of Machines: T Bevan Pearson education, India

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METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 75 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	05
2.	Sessional Test	2	15
3.	Group Discussion	4	05
4.	End Semester Exam	1	75

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	X			x		x
Quiz		x	x		x	
Assignment	X			x		x

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	D	e	f	g	h	i	j	k
Course Learning Outcomes	5,6		2,3		4	3,4		2,5		2	

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
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MECHANICAL VIBRATION LAB

L	T	P
0	0	2

MODULE CODE	MECH6104
CREDIT POINTS	1
FORMATIVE ASSESSMENT MARKS	25
SUMMATIVE ASSESSMENT MARKS	25
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

OBJECTIVES:

1. Comprehensive, theory based understanding of the underpinning natural and physical sciences.
2. Fluent application of engineering techniques, tools and resources.
3. For understanding of specialist bodies of knowledge within the engineering discipline.

LEARNING OUTCOMES:

1. Have an in-depth understanding of the principles of vibrations.
2. Able to understand the concepts of vibration modes and natural frequencies and their measurement and estimation for multi-degree-of-freedom systems.
3. Have an in-depth understanding of System Modelling via use of Energy Analysis and its application to complex vibrating systems.
4. Have an understanding of vibration analysis concepts and experimental techniques including modal analysis.
5. Be familiar with the use of different numerical techniques and its application to vibration design.
6. To understand the fundamentals of flow-induced vibrations.

LIST OF EXPERIMENTS

1.	Simple Pendulum
2.	Mass-Spring Systems

3.	Torsional Vibrations
4.	Forced Vibration with Negligible Damping
5.	Two Degree of Freedom Torsional Vibration
6.	Whirling of Shafts

METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 50 marks for practical.

Practical:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1	Internal Assessment	2	25
2	External Assessment	1	25

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	3,6	2		1	2		4,5		3		2

EVALUATION

At the end of semester, Subject teacher will submit an evaluation report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the subject with respect to its strengths as well as those areas which could be improved. The review report contains the following:

- Approved refinement decisions due for implementation,
- Actions taken based on previous subject review,
- Problems encountered in the subject delivery,
- Suggested remedies / corrective measures, and
- Report discussed and analysed, actions taken as a result of this process and are communicated to the main stakeholders.

LITERATURE SURVEY (DISSERTATION STAGE 1)*

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INDUSTRIAL TRIBOLOGY

L	T	P
4	0	0

MODULE CODE	MECH6206
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To learn about the principles of lubrication, lubrication regimes, and theories of hydrodynamic, elasto hydrodynamic and mixed / boundary lubrication.
2. To learn about the contact of solid surfaces and their interactions.
3. To understand the genesis of friction, the theories/laws of sliding and rolling friction.
4. To learn about lubrication mechanism of different bearings for different applications.

LEARNING OUTCOMES:

1. Apply/develop solutions or to do research in the areas of Design and simulation in Mechanical Engineering.
2. Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.
3. Ability to review and document the knowledge developed by scholarly predecessors and critically assess the relevant technological issues.
4. Ability to formulate relevant research problems; conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.
5. Ability to design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work.

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MODULE CONTENT:

Unit-I: Study of various parameters Flow of fluids - viscosity, viscosity and its variation, absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers; Recycling of used oil & oil conservation; Disposal of scrap oil & oil emulsions; Friction - Introduction, laws of friction, kinds of friction, causes of friction, friction measurement, theory of friction.
Unit-II: Hydrostatic lubrication Hydrostatic step bearing - application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.
Unit-III: Hydrodynamic theory of lubrication Various theories of lubrication; Petroff's equation; Reynolds's equation - two dimensions, effects of side leakage, in three dimensions; Friction in sliding bearing; Hydro dynamic theory applied to journal bearing; Minimum oil film thickness; Oil whip and whirl; Anti-friction bearing.
Unit-IV: Friction and power losses in journal bearings Calibration of friction loss; Friction in concentric bearings; Bearing modulus; Summerfield number; Heat balance; Practical consideration of journal bearing; Design considerations of journal bearing.
Unit-V : Air lubricated bearing Advantages, disadvantages and application of hydrodynamic journal bearings; Hydrodynamic thrust bearings; Hydrostatic bearing analysis including compressibility effect; Study of current concepts of boundary friction and dry friction.
Unit-VI: Types of bearing oil pads Hydrostatic bearing; Wick oiled bearings; Oil rings; Pressure feed bearing; Partial bearing; Externally pressurized bearings; Bearing materials - general requirements of bearing materials, types of bearing materials.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Fundamentals of Tribology: Basu, Sen Gupta and Ahuja PHI, New Delhi 2. Tribology in Industry: Srivastava and Sushil Kumar S Chand & Co, New Delhi
REFERENCE BOOKS	1. Theory and Practice of Lubrication for Engineers: D D Fuller John Wiley and Sons, New York 2. Principles of Tribology: J Halling McMillan Press Ltd, New York

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METHODS OF TEACHING AND STUDENT LEARNING

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ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5
Class Test	x			X	
Quiz		x	x		x
Assignment	x			X	x

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	D	e	f	g	h	i	j	k
Course Learning Outcomes	5	5	2,3		2	4		2		2	1

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
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TOTAL QUALITY MANAGEMENT

L	T	P
4	0	0

MODULE CODE	MECH6207
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES:

1. To understand the philosophy and core values of Total Quality Management (TQM).
2. To determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization.
3. To apply and evaluate best practices for the attainment of total quality.

LEARNING OUTCOMES:

1. Ability to select and apply appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQM methodologies.
2. Ability to measure the cost of poor quality and process effectiveness and efficiency to track performance quality and to identify areas for improvement.
3. Able to understand proven methodologies to enhance management processes, such as benchmarking and business process reengineering.
4. Able to choose a framework to evaluate the performance excellence of an organization, and determine the set of performance indicators that will align people with the objectives of the organization.

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MODULE CONTENT:

Unit-I: Introduction Definition, Basic Approach, Guru's of TQM, Defining Quality, Historical Review. Leadership: Definitions, Characteristics of Quality Leaders, Leadership Concepts, Seven habits of highly effective people, The Deming Philosophy, Role of TQM Leaders, Implementation, Quality Council, Core values, Concepts and Framework, Strategic planning, Communications.
Unit-II: Customer Satisfaction and Employee Involvement Introduction, Customer perception of Quality, Feedback, Using Customer Complaints, Service Quality, Translating Needs into Requirement, Customer Retention, Motivation, Employee Surveys, Empowerment, Suggestion System, Recognition and Reward, Gain sharing, Performance Appraisal, Unions and Employee Involvements, Benefits of Employee Involvement.
Unit-III: Process Improvement and Benchmarking Process The Juran Trilogy, Improvement Strategies, PDSA Cycle, Kaizen, Re-engineering, Six Sigma. Benchmarking: Definition, Reasons to benchmark, Understanding current Performance, Planning, Pitfalls and Criticisms of Benchmarking
Unit-IV: Tools and Techniques Information Technology: Computers and the Quality Function, Internet and Electronic Media, Technologies of the Future. Quality Management System: ISO, benefits of Registration, Sector Specific Standards, Documentation, Internal Audits. Environmental Management System: ISO 14000, Requirements of ISO 14000, Relationship to Health and Safety.
Unit-V : Failure Mode and Effect Analysis Reliability, Requirements of Reliability, Failure Rate, FMEA: Team and Documentation, Stages of FMEA, Design and Process of FMEA, Products Liability: Product Safety Law, Products Liability Law
Unit-VI: Statistical Process Control Cause and Effect Diagram, Process Capability, Control Charts for Attributes. Experimental Design: Hypothesis, t Test, F Test, Orthogonal Design, Two Factors, Full Factorials, Fractional Factorials.

RECOMMENDED BOOKS:

TEXT BOOKS	1. Total Quality Management by Besterfield Dale H; Pearson Education. 2. Managing for total quality from Deming to Taguchi and SPC by N Logothetis; Prentice Hall.
REFERENCE BOOKS	1. Total Quality Control by AV Feigenbaum; McGraw Hill. 2. Total Quality Management by Oakland; Butterworth - Heinamann Ltd. 3. A slice by slice guide to TQM by John Gilbert; Affiliated East West Press.

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METHODS OF TEACHING AND STUDENT LEARNING

The subject is delivered through lectures, on-line support, text book / course material reading and practical exercises. Some videos will be shown to demonstrate certain concepts and research areas will be discussed. Resource material is provided with the help of PDM Educational Directory Services (PEDS).

ASSESSMENT METHODOLOGIES:

This subject will be evaluated for a total of 150 marks for theory.

Theory:

Assessment #	Type Of Assessment	Per Semester	Maximum Mark
1.	Class Test	4	10
2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4
Class Test	X			x
Quiz		x	x	
Assignment	X			x

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	D	e	f	g	h	i	j	k
Course Learning Outcomes	4		2,3		2	4		2	3	2	1

EVALUATION

At the end of semester, course faculty will submit an evaluation / review report. The purpose of this report is to identify aspects that will be highlighted by students and faculty's feedback for the course with respect to its strengths as well as those areas which could be improved. The review report contains the following areas:

- Problems encountered in the content delivery;
- Suggested remedies / corrective measures;
- Approved refinement decisions due for implementation;
- Actions taken based on previous course review; and
- Report discussed and analysed; actions taken as a result of this process and are communicated to the main stakeholders.

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ORGANIZATIONAL BEHAVIOUR

L	T	P
4	0	0

MODULE CODE	MGMT0306
CREDIT POINTS	4
FORMATIVE ASSESMENT MARKS	50
SUMMATIVE ASSESMENT MARKS	100
END SEMESTER EXAM DURATION	3 hrs.
LAST REVISION DATE	

INSTRUCTIONS: The Question paper will comprise of seven questions distributed over three sections A, B and C. Section A comprises of very short answer type questions and is compulsory. Section B and Section C Comprise of short answer type and Long answer type questions and will have internal choices.

OBJECTIVES :

1. To develop knowledge and understanding of behaviour of individual and groups in the organization.
2. To enable them to grasp concept of diversity in the organization.
3. To develop skills to differentiate among people with respect to perception, motivation and need recognition.
4. To involve themselves in continuous learning and developing favorable attitude while maintain values
5. To identity value of group involvement and team building.
6. To maintain the organizational culture and socialized environment for the work.
7. To describe the process of initiating change and effective organizational development.

LEARNING OUTCOMES:

1. Acquaint themselves to apply organizational theory as it relates to management practices, employee relations, and structure of the organization.
2. Able to analyze perceptual distortions and attitude formation.
3. Able to identify value of motivation, emotional intelligence and stability in resolving organizational problems.
4. Able to describe the impact of corporate culture on employee behavior.
5. Able to analyze group formations, team dynamics, team building strategies and cultural diversity.
6. Appraise the requirement of change and continuous development being a part of the organization while maintaining organizational culture.

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MODULE CONTENT

Unit I: Concepts of OB Conceptual foundation, importance and scope, need of studying OB, Levels of analysis of OB, Models of OB, Emerging challenges for OB.
Unit II: Individual behaviour Individual behaviour in organization, Perception-Process and errors; Values; Attitude- Formation, Theories, Organization related attitude, Relationship between attitude and behaviour, Personality- determinants and traits, Learning- Theories and reinforcement schedules.
Unit III: Group behaviour & Team Development Concept of Group and Group Dynamics; Types of Groups; Formal and Informal Groups; Stages of Group Development, Theories of Group Formation; Group Norms, Group Cohesiveness; Group Think and Group Shift. Group Decision Making; Inter Group Behaviour.
Unit IV: Organizational processes Organizational structure and design: Organization structure, Centralization and Decentralization of authority, Organization charts.
Unit V: Organizational culture Concept, functions, socialization, creating and sustaining culture, improving organization climate, managing across cultures.
Unit VI: Organizational Change Change: concept and nature of change, resistance to change, planned change, empowerment and participation, Organization development.

RECOMMENDED BOOKS

TEXT BOOK	1. Organizational Behaviour : K Aswathappa Tata McGraw Hill, New Delhi 2. Organizational Behaviour: S P Robbins Pearson Education, New Delhi
REFERENCE	1. Organizational Behaviour: F Luthans Tata McGraw Hill, New Delhi 2. Understanding Organizational Behaviour: Udai Pareek Oxford University Press, New Delhi

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Assessment #	Type Of Assessment	Per Semester	Maximum Mark
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2.	Sessional Test	2	30
3.	Group Discussion	4	10
4.	End Semester Exam	1	100

MAPPING OF ASSESSMENT METHODS AGAINST THE LEARNING OUTCOMES

Theory:

Assessments	1	2	3	4	5	6
Class Test	x			x		
Quiz			x			x
Assignment	x	x		x		

MAPPING OF COURSE LEARNING OUTCOMES

Program Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Learning Outcomes	1.5		2		4	1,3		6	3.4		2

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EVALUATION

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SEMESTER - IV

MODULE CODE	CATEGORY	MODULE	L	T	P	C	External Marks	Internal Marks	Total
MECH6108	DI	DISSERTATION and VIVA (DISSERTATION STAGE 2)	-	-	-	10	250	250	500
TOTAL			**0**	**0**	**0**	**10**	**250**	**250**	**500**

L = Lecture
T = Tutorial
P = Practical
C = Credit Point

- **Students have to publish a research paper in a journal/conference of the research work done in the semester.**

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