DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE & SYLLABUS for
M.Tech
MACHINE DESIGN PROGRAMME

(Applicable for batches admitted from 2025-2026)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

M. Tech (MACHINE DESIGN)

I -SEMESTER

S.No	Course Code	Course Title		L	T	P	C
1	MD101 (Core-1)	Mechanical Vibrations and Acoustics		3	1	0	4
2	MD102 (Core-2)	Advanced Mechanics of Solids		3	1	0	4
3	MD103 (Core-3)	AI&ML for Mechanical Engineering		3	1	0	4
4	Programme Elective – I MD 104	MD 1041	Advanced Finite Element Methods	3	0	0	3
		MD 1042	Product Design & Development				
		MD 1043	Geometric Modeling				
		MD 1044	Numerical methods for Mechanical Engineering				
5	Programme Elective –II MD 105	MD 1051	Design for Manufacturing & Assembly	3	0	0	3
		MD 1052	Multi Body Dynamics				
		MD 1053	Vision Systems and Image Processing				
		MD 1054	Engineering Tribology				
6	MD106	Machine Dynamics Lab		0	0	4	2
7	MD107	Design Practice Lab-I		0	0	4	2
8	MD 108	Seminar I		0	0	2	1
		Total		**15**	**5**	**6**	**23**

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II -SEMESTER

S.No	Course Code	Course Title		L	T	P	C
1	MD 201 (Core-1)	Advanced Mechanisms & Robotics		3	1	0	4
2	MD 202 (Core-2)	Advanced Machine Design		3	1	0	4
3	MD 203 (Core-3)	Signal Analysis and Condition Monitoring		3	1	0	4
4	Programme Elective – III MD 204	MD 2041	Theory of Plasticity	3	0	0	3
		MD 2042	Advanced Optimization Techniques				
		MD 2043	Computational Fluid Dynamics				
		MD 2044	Mechanics of Composite Materials				
5	Programme Elective – IV MD 205	MD 2051	Experimental stress analysis	3	0	0	3
		MD 2052	Fracture Mechanics				
		MD 2053	Mechatronics				
		MD 2054	Introduction to Quantum Technologies				
6	MD 206	Computational Mathematics Lab		0	0	4	2
7	MD 207	Design Practice Lab-II		0	0	4	2
8	MD 208	Seminar II		0	0	2	1
		Total		**15**	**5**	**6**	**23**

Note: Students are informed to complete Summer Internship (duration 8-10 weeks) at the end of the II Semester.

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III- SEMESTER

S. No	Course Code	Course Title	L	T	P	C
1	MD 301	Research Methodology and IPR/Swayam 12 Week MOOC Course RM&IPR	3	0	0	3
2	MD 302*	Summer Internship/Industrial Training	-	-	-	3
3	MD 303	Comprehensive Viva	-	-	-	2
4	MD 304	Dissertation Part - A	-	-	20	10
TOTAL			3	-	20	18

IV –SEMESTER

S. No	Course Code	Course Title	L	T	P	C
1	MD 401	Dissertation Part - B	-	-	32	16
TOTAL			-	-	32	16

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I Semester	MECHANICAL VIBRATIONS AND ACOUSTICS	L	T	P	C
		3	1	0	4

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

		Knowledge Level (K)#
CO1	Explain and idealize the properties of complex structures into lumped parameter models for the overall vibration characteristics in design systems which require dynamical properties like damping, free and forced vibrations response.	
CO2	Compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system	
CO3	Evaluating the vibration parameters of continuous/elastic body systems for natural frequencies and subsequent mode shapes	
CO4	Make a practical experience of basics of sound, noise and vibration; as well as their measurement and control strategies.	
CO5	Describe the vibration measurement by using transducers and vibration exciters and able to assess occupational and environmental noise problems.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2			3	3		
CO3				3		
CO4			2			
CO5			3	3		

(Please fill the above with Levels of Correlation, viz., L, M, H)

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

UNIT	CONTENTS	Contact Hours
UNIT – 1	**INTRODUCTION** Relevance and need for vibrational analysis – Basics of SHM - Mathematical modelling of vibrating systems - Discrete and continuous systems - single-degree freedom systems - free and forced vibrations, damped and undamped systems	
UNIT – 2	**MULTI DEGREE FREEDOM SYSTEMS** Free and forced vibrations of multi-degree freedom systems in longitudinal, torsional and lateral modes - Matrix methods of solution- normal modes - Orthogonality Principle-Energy methods, Eigen values and Eigen vectors	
UNIT – 3	**CONTINUOUS SYSTEMS** Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams - Governing equations of motion - Natural frequencies and normal modes - Energy methods, Introduction to nonlinear and random vibrations.	
UNIT – 4	**BASICS OF ACOUSTICS** Speed of Sound, Wavelength, Frequency, and Wave Number, Acoustic Pressure and Particle Velocity, Acoustic Intensity and Acoustic Energy Density, Spherical Wave propagation, Directivity Factor and Directivity Index, Levels and the decibel, Addition and subtraction of Sound levels, Octave Bands, Weighted Sound pressure Levels.	
UNIT – 5	**NOISE MEASUREMENT AND CONTROL** Sound Level Meters, Intensity Level Meters, Octave Band Filters Acoustic Analyzers, Dosimeter, Measurement of Sound Power, Impact of noise on humans, Loudness, sound absorption and insulation and Noise control	
		Total

TEXT BOOKS:

1. S.S.Rao, “Mechanical Vibrations ", 5th Edition, Prentice Hall, 2011.
2. M.L.Munjal and B. Venkatesham, “Noise and Vibration Control”, Second Edition, World Scientific, 2024.

REFERENCES:

1. W.T. Thomson, M.D. Dahleh and C Padmanabhan, “Theory of Vibration with Applications”, 5th Edition,Pearson Education, 2008.
2 L.Meirovitch, “Elements of vibration Analysis", 2nd Edition, McGraw-Hill, New York, 1985.
3. Beranek and Ver, “Noise and Vibration Control Engineering: Principles and Applications”, John Wiley and Sons, 2006.
4. Randall F. Barron, “IndustrialNoiseControlandAcoustics”,Marcel Dekker, Inc., 2003.

Web Resources:

http://www.nptel.ac.in/courses/112103111
http://www.nptel.ac.in/courses/112103112

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I Semester	ADVANCED MECHANICS OF SOLIDS	L	T	P	C
		3	1	0	4

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Able to calculate stress in the machine components and analyze the failure modes.	
CO2	Able to identify the failure modes of different structural members and applying various energy methods for statically determinant and indeterminate structures	
CO3	Able to calculate bending stresses in curved beams and beams subjected to non-symmetrical bending	
CO4	Able to calculate torsional stresses in circular and non-circular cross section members and multi walled thin-walled tubes	
CO5	Able to calculate and analyze contact stress when two bodies are in contact.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			**1**	**1**		
CO2			**1**	**1**		
CO3			**1**	**1**		
CO4			**2**	**2**		
CO5			**1**	**1**		

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours

UNIT – 1	Theories of stress and strain, Definition of stress at a point, stress notation, principal stresses, other properties, differential equations of motion of a deformable body, deformation of a deformable body, strain theory, principal strains, strain of a volume element, small displacement theory. Stress –strain temperature relations, Elastic response of a solid, Hooke's Law, isotropic elasticity, Anisotropic elasticity, initiation of Yield, Yield criteria.	
UNIT – 2	**Failure criteria:** Modes of failure, Failure criteria, Excessive deflections, Yield initiation, fracture, Progressive fracture, (High Cycle fatigue for number of cycles $N > 10^6$, buckling. Application of energy methods: Elastic deflections and statically indeterminate members and structures: Principle of stationary potential energy, Castiglione's theorem on deflections, Castiglione's theorem on deflections for linear load deflection relations, deflections of statically determinate structures.	
UNIT – 3	**Unsymmetrical bending:** Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending. **Curved beam theory:** Winkler Bach formula for circumferential stress – Limitations – Correction factors –Radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.	
UNIT – 4	**Torsion :** Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section ;Hollow thin wall torsion members ,Multiply connected Cross Section.	
UNIT – 5	**Contact stresses:** Introduction; problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact, Normal and Tangent to contact area.	
	Total	

TEXT BOOKS:

1.Advanced Mechanics of materials by Boresi& Sidebottom-Wiely International.
2. Theory of elasticity by Timoshenko S.P. and Goodier J.N. McGraw-Hill Publishers 3rd Edition
3. Advanced Mechanics of Solids, L.S Srinath

REFERENCE BOOKS:

1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates – Timoshenko.
3. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia
4. Strength of materials by Sadhu singh

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I Semester	AI&ML FOR MECHANICAL ENGINEERING	L	T	P	C
		3	1	0	4

Course objectives:

1) To impart the basic concepts of artificial intelligence and the principles of knowledge representation and reasoning.
2) To introduce the machine learning concepts and supervised learning methods
3) To enable the students gain knowledge in unsupervised learning method and Bayesian algorithms.
4) To make the students learn about neural networks and genetic algorithms.
5) To understand the machine learning analytics and applications of deep learning techniques to mechanical engineering.

UNIT– I:

Introduction: Definition of Artificial Intelligence, Evolution, Need, and applications in real world. Intelligent Agents, Agents and Environments; Good Behaviour - concept of rationality, the nature of environments, structure of agents.

Introduction to Machine Learning (ML): Definition, Evolution, Need, applications of ML in industry and real-world, regression and classification problems, performance metrics, differences between supervised and unsupervised learning paradigms, bias, variance, overfitting and under fitting.

Supervised Learning: Linear regression, logistic regression, Distance-based methods, Nearest-Neighbours, Decision Trees, Support Vector Machines, Nonlinearity and Kernel Methods.

UNIT– II:

Unsupervised Learning: Clustering**,** K-means, Dimensionality Reduction, PCA and Kernel.

Bayesian and Computational Learning: Bayes theorem, concept learning, maximum likelihood of normal, binomial, exponential, and Poisson distributions, minimum description length principle, Naïve Bayes Classifier, Instance-based Learning- K-Nearest neighbour learning.

UNIT– III:

Neural Networks and Genetic Algorithms: Neural network representation, problems, perceptron, multilayer networks and backpropagation, steepest descent method, Convolutional neural networks and their applications, Local vs Global optima, Introduction to Genetic algorithms.

UNIT– IV:

Deep Learning: Recurrent Neural Networks and their applications, LSTM,Deep generative models, Deep auto-encoders, Applications of Deep Networks.

Machine Learning Algorithm Analytics: Evaluating Machine Learning algorithms, Model, Selection, Ensemble Methods - Boosting, Bagging, and Random Forests.

UNIT– V

Overview of Applications to Mechanical Engineering: Introduction to Machine learning packages, preparation of dataset for machine learning (cleansing and featuring)
Design of1D mechanical structures, Crack detection, fatigue life and creep estimation, Defect detection in casting and welding, Tool wear and Surface roughness prediction in CNC machining, Heat exchanger design optimization, fault classification.

TEXT BOOKS:

1) Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
2) Tom M. Mitchell, Machine Learning, McGraw Hill, 2013.
3) EthemAlpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2004.

REFERENCE BOOKS:

1) Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008.
2) Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI Learning, 2012.

ONLINE RESOURCES:

https://www.tpointtech.com/artificial-intelligence-ai
https://www.geeksforgeeks.org/

Course outcomes: At the end of the course, student will be able to

CO1: Explain the basic concepts of artificial intelligence
CO2: Learn about the principles of supervised learning methods
CO3: Gain knowledge in unsupervised learning method and Bayesian algorithms
CO4: Get knowledge about neural networks and genetic algorithms.
CO5: Understand the machine learning analytics and apply deep learning techniques to mechanical engineering applications.

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I Semester	ADVANCED FINITE ELEMENT METHODS	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Understand the methodology, applications and types of finite element method.	
CO2	Solve the problems of bars, trusses, beams and frames using finite element method	
CO3	Apply the finite element method to plates and axisymmetric problem	
CO4	Understand the isoparametric formulation and requirements for convergence.	
CO5	Solve the dynamic problems and learn about the commericial finite element packages.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2			**3**	**3**		
CO3			**3**	**3**		
CO4			**2**	**3**		
CO5			**3**	**3**		

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Formulation Techniques:** Methodology, Engineering problems and governing differential equations, finite elements., Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.	

UNIT – 2	**One-dimensional elements:** Bar, trusses, beams and frames, displacements, stresses and temperature effects.	
UNIT – 3	**Two dimensional problems:** CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.	
UNIT – 4	Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration, Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, Pascal's triangle, Patch test. Finite elements in Structural Analysis: Static and dynamic analysis, eigen value problems, and their solution methods, case studies using commercial finite element packages.	
UNIT – 5	Introduction to Non-linear finite element Analysis (Syllabus from Ref. 3) Nonlinear Material Problems (Syllabus from Ref. 2): Introduction, General procedure for solutions of Non- linear Discrete Problems, Nonlinear Constitutive problems in solid mechanics. Non-linear elasticity, Plasticity. Geometrically Non-linear problems(Syllabus from Ref. 2): General considerations	
	Total	

TEXT BOOKS:

1. Chandrubatla & Belagondu ,Finite element methods .
2. S.S. Rao,The Finite Element Method in Engineering, Fifth Edition

REFERENCES:

1.J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press, 1994.
2. Zienkiewicz O.C. Finite Element Method, McGraw-Hill, Third Edition, 1977.
3. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996.

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

I Semester	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

CO	Outcomes	Knowledge Level (K)#
CO1	Apply creative thinking skills for idea generation	
CO2	Translate conceptual ideas into clear sketches	
CO3	Present ideas using IT application software and physical model	
CO4	Able to identify causes of failure through fault free analysis and perform failure analysis	
CO5	To carryout perform product testing under thermal, vibration, electrical and combined environments.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

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UNIT	CONTENTS	Contact Hours
UNIT – 1	Product Design Process: Design Process Steps, Morphology of Design. Problem Solving and Decision Making: Problem-Solving Process, Creative Problem Solving, Invention, Brainstorming, Morphological Analysis, Behavioural Aspects of Decision Making, Decision Theory, Decision Matrix, Decision Trees. Modelling and Simulation: Triz, Role of Models in Engineering Design, Mathematical Modelling, Similitude and Scale Models, Computer Simulation, Geometric Modelling on Computer, Finite-Element Analysis.	
UNIT – 2	Product management: The operation of product management: Customer focus of product management, product planning process, Levels of strategic planning, Wedge analysis, Opportunity search, Product life cycle Life cycle theory and practice. Product development: Managing new products, generating ideas, Sources of product innovation, Selecting the best ideas, The political dimension of product design, Managing the product launch and customer feedback. Product managers and manufacturing: The need for effective relationships, The impact of manufacturing processes on product decisions, Prototype planning, Productivity potentials, Management of product quality, Customer service levels.	
UNIT – 3	Risk and Reliability: Risk and Society, Hazard Analysis, Fault Tree Analysis. Failure Analysis and Quality: Causes of Failures, Failure Modes, Failure Mode and Effect Analysis, FMEA Procedure, Classification of Severity, Computation of Criticality Index, Determination of Corrective Action, Sources of Information, Copyright and Copying. Patent Literature.	
UNIT – 4	Product Testing; thermal, vibration, electrical, and combined environments, temperature testing, vibration testing, test effectiveness. Accelerated testing and data analysis, accelerated factors. Weibull probability plotting, testing with censored data.	
UNIT – 5	Design For Maintainability: Maintenance Concepts and Procedures, Component Reliability, Maintainability and Availability, Fault Isolation in design and Self-Diagnostics. Product Design for Safety, Product Safety and User Safety Concepts, Examples of Safe Designs. Design Standardization and Cost Reduction: Standardization Methodology, Benefits of Product Standardization; International, National, Association and Company Level Standards; Parts Modularization	

	Total	

TEXT BOOKS:

1. Engineering Design, George E. Dieter, McGraw-Hill
2. Product Integrity and Reliability in Design, John W. Evans and Jillian Y. Evans, Springer Verlag

REFERENCES:

1. The Product Management Handbook, Richard S. Handscombe, McGraw-Hill
2. New Product Design, Ulrich Eppinger
3. Product Design, Kevin Otto.

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I Semester	GEOMETRIC MODELING	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Develop parametric equations for simple geometric entities, formulate algebraic and geometric form of a cubic spline.	
CO2	Develop equations for Bezier curve.	
CO3	Develop equations for B-Spline curve	
CO4	Develop parametric representation of analytic and synthetic surfaces	
CO5	Understand and implement various schemes used for construction of solid models	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1				1		
CO2			2	2		
CO3			3	2		
CO4			3	2		
CO5			3	3	3	

(Please fill the above with Levels of Correlation, viz., L, M, H)

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UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction:** Definition, Explicit and implicit equations, parametric equations.	
UNIT – 2	**Cubic Splines-1:** Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four point form, reparametrization, truncating and subdividing of curves. Graphic construction and interpretation, composite pc curves.	
UNIT – 3	**Bezier Curves:** Bernstein basis, equations of Bezier curves, properties, derivatives. **B-Spline Curves:** B-Spline basis, equations, knot vectors, properties, and derivatives.	
UNIT – 4	**Surfaces:** Bicubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.	
UNIT – 5	**Solids:** Tricubic solid, Algebraic and geometric form. **Solid modeling concepts:** Wire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.	
	Total	

*Note:

TEXT BOOKS:

1. CAD/CAM by Ibrahim Zeid, Tata McGraw Hill.
1. Elements of Computer Graphics by Roger & Adams Tata McGraw Hill.

REFERENCES:

1. Geometric Modeling by Micheal E. Mortenson, McGraw Hill Publishers
2. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.MallikarjunaRao, MMM Sarcar, PHI Publishers

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I Semester	NUMERICAL METHODS FOR MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Objectives:

1. The objective is to teach students how to apply computational methodologies to solve engineering problems when closed-form and analytical solution does not exist.
2. To learn numerical techniques for solving sets of linear and non- linear equations, fitting data by regression, solution to boundary value problems, Solution to elliptic, parabolic ad hyperbolic partial differential equations by finite difference method.
3. Able to perform transformations between time and frequency domains in terms of Fourier transforms, FFT and Laplace transforms.
4. To implement algorithms and comp. Programs for sloving complicated problems using numerical methods.

COURSE OUTCOMES:

After completing the course, the student will be able to:

1. Use numerical methods in engineering analysis and computing,
2. Familiar with numerical solutions of linear and nonlinear equations,
3. Aquaint with fitting data with a function (having error) by linear, multiple linear and polynomial regression.
4. Familiar with the solution techniques of boundary value and characteristic value problems,
5. Apply Fourier and Laplace transforms and perform transformations between time and frequency domains.
6. Solve partial differential equations (one dimensional and two dimensional) (Elliptic, parabolic, hyperbolic) by finite difference method,
7. Implement algorithms and programming for solving complicated problems using numerical methods

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

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UNIT	CONTENTS	Contact Hours
UNIT – 1	**Numerical methods applied to engineering problems:** Examples, solving sets of equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations. Least square approximation fitting of non-linear curves by least squares –regression analysis- multiple linear regression, nonlinear regression - computer programs.	
UNIT – 2	**Boundary value problems and characteristic value problems:** Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.	
UNIT – 3	**Transformation Techniques:** Continuous Fourier series, frequency and time domains, Laplace transform, Fourier integral and transform, discrete Fourier transform (DFT), Fast Fourier transform (FFT).	
UNIT – 4	**Numerical solutions of partial differential equations:** Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – Poisson equation – Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.	
UNIT – 5	**Partial differential equations:** Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria. Solving wave equation by finite differences-stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs	
	Total	

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale "Numerical Methods for Engineers" Tata Mc-Graw Hill
2. 2.Curtis F.Gerald, Partick.O.Wheatly,"Applied numerical analysis" Addison-Wesley,1989
3. 3.Douglas J.Faires, Riched Burden" Numerical methods", Brooks/Cole publishing
4. company,1998.Second edition.

REFERENCES:

1. Ward Cheney and David Kincaid “Numerical mathematics and computing” Brooks/Cole publishing company1999, Fourth edition.
2. Riley K.F,. M.P.Hobson and Bence S.J,”Mathematical methods for physics and engineering”, Cambridge University press,1999.
3. Kreysis, Advanced Mathematics

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

I Semester	DESIGN FOR MANUFACTURING AND ASSEMBLY	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Understand the basic concepts of DFMA and their applications. Apply design rules to manual assembly.	
CO2	Apply design rules for ease of machining and understand the design recommendations for machined parts	
CO3	Understand the selection, simulation and design rules of casting processes. Also to understand the design considerations for extruded sections and various forming processes.	
CO4	Understand the design considerations and effect of thermal stresses in welded joints. Understand the design factors for forging.	
CO5	Understand the design considerations for automatic assembly and to do quantitative analysis of assembly systems.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1				2		
CO2				2	2	
CO3			1	2	2	
CO4			1	2	2	
CO5				1		

(Please fill the above with Levels of Correlation, viz., L, M, H)

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

UNIT	CONTENTS	Contact Hours
UNIT – 1	Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design?, Typical DFMA Case Studies, Overall Impact of DFMA on Industry, ISO Standards. Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology.	
UNIT – 2	Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.	
UNIT – 3	Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting. **Extrusion & Sheet metal work:** Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.	
UNIT – 4	Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.	
UNIT – 5	Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, single station assembly lines.	
	Total	

TEXT BOOKS:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for manufacture, James Bralla

REFERENCE:

ASM Hand book Vol.20

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

I Semester	MULTI BODY DYNAMICS	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

UNIT	CONTENTS	Contact Hours
UNIT – 1	Review of kinematics and dynamics of point mass and rigid body - types of constraints - constraints for revolute joints, translational joints, composite joints	
UNIT – 2	Formulation of planar multi-body systems, kinematics and dynamics in point coordinates, body coordinates, and joint coordinates	
UNIT – 3	Numerical methods for solution - analysis of planar multi-body systems, kinematic analysis in various formulations.	
UNIT – 4	Inverse dynamic analysis, forward dynamic analysis, constraint stabilization - case studies, McPherson strut suspension, Double A-arm suspension, planar robot manipulator	
UNIT – 5	Spatial multi-body systems-formulation- joints: - revolute, prismatic, cylindrical, spherical, universal-case studies.	
	Total	

TEXT BOOKS:

1. Planar Multibody Dynamics Formulation, Programming and Applications by Parviz E. Nikravesh, CRC Press
2. Dynamics of Multibody Systems by Ahmed A. Shabana, Cambridge University Press.

REFERNCES:

1. Planar Multibody Dynamics Formulation, Programming and Applications – Parviz E. Nikravesh, CRC Press
2. Computer-Aided Analysis of Mechanical Systems – Parviz E. Nikravesh, Prentice Hall, 1988
3. Dynamics of Multibody Systems – A. A. Shabana, Cambridge University Press, 1998

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

I Semester	VISION SYSTEMS AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Machine vision:** Vision sensors - Comparison with other types of sensors - Image acquisition and recognition - Recognition of 3D objects - Lighting techniques - Machine vision applications.	
UNIT – 2	**Image representation:** Application of image processing - Image sampling, Digitization and quantization - Image transforms.	
UNIT – 3	**Spatial domain techniques:** Convolution, Correlation. Frequency domain operations - Fast Fourier transforms, FFT, DFT, Investigation of spectra. Hough transform	
UNIT – 4	**Image enhancement**: Filtering, Restoration, Histogram equalisation, Segmentation, Region growing.	
UNIT – 5	**Image compression:** Edge detection - Thresholding - Spatial smoothing - Boundary and Region representation - Shape features - Scene matching and detection - Image classification.	
	Total	

TEXT BOOKS:

1. Digital Image Processing by Gonzalez, R.C. and Woods, R.E., Addison Wesley Publications.
2 Robot Vision by Prof. Alan Pugh (Editor), IFS Ltd., U.K. 3. Digital Image Processing by A.Rosenfled and A. Kak, Academic Press.

REFERENCES:

1. The Psychology of Computer Vision by P. Winstan, McGraw-Hill.
2. Algorithms for Graphics and Image Processing by T. Pavidis, Springer Verlag.

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

I Semester	ENGINEERING TRIBOLOGY	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	To must be able to understand friction and wear mechanism and the effects of lubrication. To must be able to describe lubrication systems and their selection criteria.	
CO2	To must be able to select rolling element bearing based on their static and dynamic load carrying capacity and must be able to understand condition monitoring procedures of the bearing.	
CO3	To must be able to design hydrostatic thrust and journal bearings for different applications.	
CO4	To must be able to understand to evaluate load carrying capacity and life of hydrodynamic thrust and journal bearing.	
CO5	To describe different type of seals and select suitable seals for given application and illustrate the failures of different types of bearing.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2			3	2	2	
CO3			3	3	3	
CO4			2	2		
CO5			3	1		

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction:** History of Tribology, Nature of surfaces and contact-Surface topography-friction and wear mechanisms, wear maps, effect of lubricants-methods of fluid film formation.	

	Lubrication: Choice of lubricants,EHL(Elasto Hydrodynamic Lubrication), types of oil, Grease and solid lubricants- additives- lubrication systems and their selection.	
UNIT – 2	**Selection of rolling element bearings:** Nominal life, static and dynamic capacity-Equivalent load, probabilities of survival- cubic mean load-bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulse method.	
UNIT – 3	**Hydrostatic Bearings:** Thrust bearings – pad coefficients- restriction-optimum film thickness - journal bearings – design procedure –Aerostatic bearings; Thrust bearings and Journal bearings – design procedure.	
UNIT – 4	**Hydrodynamic bearings:** Fundamentals of fluid formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfield number-performance parameters – optimum bearing with maximum load capacity – Friction – Heat generated and Heat dissipated. Hydrodynamic thrust bearings; Raimondi and Boyd solution for hydrodynamic thrust bearings-fixed tilting pads, single and multiple pad bearings-optimum condition with largest minimum film thickness.	
UNIT – 5	**Seals:** Different type-mechanical seals, lip seals, packed glands, soft piston seals, Mechanical piston rod packing, labyrinth seals and throttling bushes, oil flinger rings and drain grooves – selection of mechanical seals. **Failure of Tribological components**: Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using soap and Ferrography. **Dry rubbing Bearings**: porous metal bearings and oscillatory journal bearings – qualitative approach only.	
	Total	

TEXT BOOKS:

1. Rowe WW& O' Dionoghue,"Hydrostatic and Hybrid bearing design " Butterworths& Co.Publishers Ltd,1983.
2. Collacott R.A," Mechanical Fault diagnosis and condition monitoring", Chapman and Hall, London 1977.
3. Bernard J.Hamrock, " Fundamentals of fluid film lubricant", McGraw-Hill Co.,1994.

REFERENCES:

1. Neale MJ, (Editor) " Tribology hand Book"NeumannButterworths, 1975.
2. Connor and Boyd JJO (Editors) " Standard hand book of lubrication engineers " ASLE,Mc Graw Hill Book & Co.,1968
3. Shigley J, E Charles," Mechanical Engineering Design", McGraw Hill Co., 1989

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

I Semester	MACHINE DYNAMICS LAB	L	T	P	C
		0	0	4	2

Course Outcomes: At the end of the course, students will be able to

		Knowledge Level (K)#
CO1	Practically observe the phenomenon of damping on structures under various vibration excitations.	
CO2	Perform free and forced vibration analysis of discrete and continuous systems using measurement instruments	
CO3	Practice the experimental modal analysis on different beams and plates with variable boundary condition.	
CO4	Practice the measurement of sound pressure and directivity	
CO5	Learn the measurement methodologies of acoustic material characterization	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

COURSE OBJECTIVES

1. Calculate natural frequency, mode shapes and balancing (static and dynamic) of mechanical systems.
2. Understand the dynamic system response with and without damping.
3. Get exposed to sound characteristics and its measurements.

LIST OF EXPERIMENTS:

1. Determination of damped natural frequency of the vibrating system with different viscous oils.
2. Determination of steady state amplitude of a vibratory system with base excitation.
3. Determination of natural frequency and mode shape of multi degree freedom system.
4. Field balancing of the thin rotors using vibration pickups using MFS.
5. Determination of the magnitude of gyroscopic couple, angular velocity of procession and representation of vectors.
6. Experimental modal analysis of Beams.
7. Experimental modal analysis of plates.
8. Source directivity measurement.
9. Sound power and intensity measurement.
10. Sound absorption measurement by impedance tube.
11. Sound transmission loss measurement by impedance tube.
12. Outdoor Noise Measurements and hemispherical divergence

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

I Semester	DESIGN PRACTICE LAB - 1	L	T	P	C
		0	0	4	2

Course Outcomes: At the end of the course, students will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

COURSE OBJECTIVES

1. Inculcate a culture of research among faculty and students alike
2. Fabricate a variety of composites using different matrix, reinforcement and filler materials through hand layup technique or other methods
3. Characterize the mechanical and tribological behaviour of a variety of composites
4. Investigate the significance of reinforcement on the mechanical and tribological characteristics of composites
5. Conduct fractographic studies to understand the mechanism of failure under different loading conditions and mechanism of wear for different types of wear mode
6. Recommend optimal conditions for the desired performance level and explore commercial application

LIST OF EXPERIMENTS

PART-A: Fabrication and Specimen Preparation Experiments

The Crafting, Creation and Construction of objects, parts, items of a product using proposed materials and systematic procedure.

1. Fabrication of PMC by
   a) Hand Layup Open Moulding
   b) Vacuum Bag Moulding
2. Fabrication of MMC by
   a) Muffle Furness and Stir Casting Process
3. Fabrication of CMC by
   a) Milling, Blending and Sintering Techniques
4. Test Specimen Preparation for Characterization as per ASTM Standards

PART-B: Characterization Experiments

The *process of measuring and determining physical, chemical, mechanical and microstructural* properties of materials using a variety of analytical methods, techniques and tools under various operational conditions and environments.

5. Characterization of PMC test specimens on Tensile Tester, Fatigue Tester, TMA and FFT
6. Characterization of MMC test specimens on Tensile Tester, Fatigue Tester, Pin on Disc and FFT
7. Characterization of CMC test specimens on Tensile Tester, Fatigue Tester, Pin on Disc and FFT

COURSE OUTCOMES (CO's)

Upon successful completion of the course, a student

1. Understands the purpose and the ways to develop new composite materials upon proper combination of known materials.
2. Is able to b)predict a wide range of mechanical and other properties of materials as a function of parameters such as volume fraction, orientation & regularity arrangement and particle aspect ratio.
3. Is capable of comparing/evaluating the relative merits of using alternatives (corresponding to various simple and composite materials) for important engineering and other applications.
4. Perform research to identify new dimensional scope and application of composite materials.

TOOLS/EQUIPMENTS AND APPARATUS

The essential tools/equipments required for students to conduct experimentation includes

1. Test Specimen Preparation Kit
2. Micro Tensile/Impact/Hardness Testers
3. Dry Wear Test Rig (Pin Disc Apparatus/)
4. Fatigue Testing
5. Thermo Mechanical Analyzer
6. FFT Analyzer and ME-Scope Simulation
7. Furness and Stir Casting Apparatus
8. Millers and Sintering Equipments

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

I Semester	**SEMINAR - 1**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	ADVANCED MECHANISMS AND ROBOTICS	L	T	P	C
		3	1	0	4

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Develop the mobility criteria and use the criteria to find the degree of freedom of various mechanisms.	
CO2	Develop the Eulery savary equations using Hartmanns construction to determine the centre of curvature	
CO3	To locate the relative roto centre using the function generation approach for 2-positions and 3-positions scenarios.	
CO4	Design the Freudenstein's equation to find the lengths of the links in a four bar mechanism	
CO5	To study the kinematics of different manipulators in daily life applications	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			**3**	**1**		
CO2			**3**	**3**		
CO3			**3**	**3**		
CO4			**3**	**3**		
CO5			**3**	**3**		

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Advanced Kinematics of plane motion:** The Inflection circle; Euler – Savary Equation; Analytical and graphical determination of d_i; Bobillier's Construction; Collineastion axis ; Hartmann's Construction.	

	Polode curvature; Hall's Equation; Polode curvature in the four bar mechanism; coupler motion; relative motion of the output and input links; Determination of the output angular acceleration and its Rate of change.	
UNIT – 2	**Synthesis-Graphical Methods:** The Four bar linkage; Guiding a body through Two distinct positions; Guiding a body through Three distinct positions; The Rotocenter triangle ; Guiding a body through Four distinct positions; Burmester's curve. Function generation and Path generation: Overlay's method, Roberts's theorem.	
UNIT – 3	**Synthesis - Analytical Methods:** Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation; Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition; Method of components; Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link; Method of components.	
UNIT – 4	**Manipulator Kinematics:** D-H transformation matrix; Direct and Inverse kinematic analysis of Serial manipulators: Articulated, spherical & industrial robot manipulators- PUMA, SCARA,STANFORD ARM, MICROBOT	
UNIT – 5	**Differential motions and Velocities:** Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.	
	Total	

TEXT BOOKS:

1. Jeremy Hirschhorn, Kinematics and Dynamics of plane mechanisms,McGraw-Hill,1962.
2. L.Sciavicco and B.Siciliano, Modelling and control of Robot manipulators, Second edition , Springer -Verlag,London,2000.
3. Amitabh Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines. E.W.P.Publishers.

REFERENCES:

1. Allen S.Hall Jr., Kinematics and Linkage Design, PHI,1964.
2. J.E Shigley and J.J . Uicker Jr., Theory of Machines and Mechanisms , McGraw-Hill, 1995.
3. Joseph Duffy, Analysis of mechanisms and Robot manipulators, Edward Arnold,1980

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	ADVANCED MACHINE DESIGN	L	T	P	C
		3	1	0	4

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	An ability to carry out and analyze various design models and product design.	
CO2	Able to identify the failure modes and various fatigue mechanisms of different machine components and life estimation.	
CO3	Ability to design the machine components against cyclic loads and their estimation	
CO4	Ability ro design the machine components against surface fatigue failures.	
CO5	Ability to design the machine components against human ergonomic factors.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			2	1		
CO2			2	1		
CO3			1	1		
CO4			1	1		
CO5			1	1		

(Please fill the above with Levels of Correlation, viz., L, M, H)

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Design philosophy**: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity and Creative techniques, Material selection in machine design, design for safety and Reliability, concept of product design	
UNIT – 2	**Failure theories**: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory., Fatigue mechanisms, Fatigue failure models, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles,	
UNIT – 3	**Fatigue failures**: cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation	
UNIT – 4	**Surface failures**: Surface geometry, mating surfaces, oil film and their effects, design values and procedures, adhesive wear, abrasive wear, corrosion wear, surface fatigue, different contacts, dynamic contact stresses, surface fatigue failures, surface fatigue strength.	
UNIT – 5	Human engineering considerations, Ergonomics, Modern approaches in design, Ethics in engineering design, Ethical issues considered during engineering design process Creep and damping, creep phenomenon, creep curve, creep parameters, time temperature parameters and life estimate, energy dissipation in materials.	
	Total	

*Note:

TEXT BOOKS:

1. Machine Design An Integrated Approach by Robert L. Norton, Prentice-Hall New Jersey, USA.
2. Mechanical Engineering Design by J.E. Shigley and L.D. Mitchell published by McGrawHill International Book Company, New Delhi.
3. Mechanical Behaviour of Materials- NormanE.Dowling, Stephen L. Kampe, Milo V.Kral Pearson publishers, 5th edition.

REFERENCES:

1. Fundamentals of machine elements by Hamrock, Schmid and Jacobian, 2nd edition, McGraw- Hill International edition.
2. Product design and development by Karl T. Ulrich and Steven D. Eppinger. 3rd edition, Tata McGraw Hill.
3. Product Design and Manufacturing by A.K. Chitale and R.C. Gupta, Prentice Hall
4. Engineering Design / George E Dieter / McGraw Hill /2008
5. Fundamentals of machine elements/ Hamrock, Schmid and Jacobian/ 2nd edition /McGrawHill International edition.

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	**SIGNAL ANALYSIS AND CONDITION MONITORING**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Analyze the signals from rotating and reciprocating machines	
CO2	Apply condition monitoring methods for fault diagnosis in machines	
CO3	Analyze the vibration signals from rotating and reciprocating machines	
CO4	Illustrate the faults in rotating and reciprocating machines	
CO5	Apply fault detection techniques for fault diagnosis in rotating and reciprocating machines	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

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UNIT	CONTENTS	Contact Hours
UNIT – 1	**SIGNAL ANALYSIS OF CONTINUOUS STATIONARY SIGNALS:** Introduction, Basic concepts, Signal types, Time domain Signal analysis, Data Acquisition, Filtering, Fourier Series, FFT, Modulation and Sidebands	
UNIT – 2	**SIGNAL ANALYSIS OF CONTINUOUS NON-STATIONARY SIGNALS:** Instrumentation, Data Recording, Order Analysis, Orbits, Envelope, Cepstrum, Short Term Fourier Analysis (STFT), Introduction to wavelets, Choice of window type, Choice of window length, Choice of incremental step, Practical details of signal processing.	
UNIT – 3	**CONDITION MONITORING METHODS:** Vibration Analysis, oil Analysis, wear debris analysis, thermography, performance analysis, noise monitoring, temperature monitoring, wear behaviour monitoring, Signals generated by rotating and reciprocating shafts.	
UNIT – 4	**VIBRATION CONDITION MONITORING IN REAL SYSTEMS**: Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan, Field balancing of rotors. ISO standards on vibrations, active, passive hybrid methods of condition monitoring	
UNIT – 5	**FAULT DIAGNOSIS:** Signal based fault classification, signals generated by rotating and reciprocating machines, low shaft orders and subharmonics, vibrations from gears, rolling element bearings and electrical machines. Introduction to machine learning for signal interpretation, Pattern recognition and clustering methods, Feature extraction and dimensionality reduction, Health Index and Remaining Useful Life (RUL) estimation	
	Total	

TEXT BOOK:

1. Condition Monitoring of Mechanical Systems / Colcote.
2. Amiya Ranjan Mohanty, Machinery Condition Monitoring: Principles and Practices, 1st Edition, CRC press, 2014

REFERENCES:

1. John S. Mitchell, Introduction to Machinery Analysis and Monitoring, 1st Edition, Penn Well Books,1993
2. R. C. Mishra, K. Pathak, Maintenance Engineering and Management, 1st Edition, Prentice Hall of India Pvt. Ltd., 2002.
3. Robert Bond Randall, Vibration-Based Condition Monitoring: Industrial, Aerospace and Automotive applications, 1st Edition, John Wiley & Sons Ltd., 2011

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	**THEORY OF PLASTICITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Describe the elastic and plastic behaviour from stress-strain curves for materials;	
CO2	Recognize typical plastic yield criteria established in constitutive modelling	
CO3	Understand the physical interpretation of material constants in mathematical formulation of constitutive relationship	
CO4	solve analytically the simple boundary value problems with elasto-plastic properties	
CO5	Develop constitutive models based on experimental results on material behaviour	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction:** Modeling Uniaxial behavior in plasticity. Index notation, Cartesian tensors.Yield and failure criteria Stress, stress deviator tensors.Invariants, principal, mean stresses, Elastic strain energy, Mohr's representation of stress in 2 & 3 dimensions, Haigh-Westergaard stress space, Equilibrium equations of a body. Yield criteria: Tresca's, von Mises rules, Drucker-Prager criterion, anisotropic yield criteria. **Strain at point:** Cauchy's formulae for strains, principal strains, principal shear strains, derivative strain tensor. Strain-displacement relationships. Linear elastic stress strain relations, Generalized Hooke's law, nonlinear elastic stress strain relations	
UNIT – 2	**Principle of virtual work and its rate forms:** Drucker's stability postulate, normality, convexity and uniqueness for an elastic solid. Incremental stress strain relations. **Criteria for loading and unloading:** Elastic and plastic strain increment tensors, Plastic potential and flow rule associated with different Yield criteria, Convexity, normality and uniqueness considerations for elastic–plastic materials. Expansion of a thick walled cylinder.	
UNIT – 3	**Incremental stress strain relationships:** Prandtl-Reuss material model. J_2 deformation theory, Drucker-Prager material, General Isotropic materials. **Deformation theory of plasticity:** Loading surface, Hardening rules. Flow rule and Druckers stability postulate. Concept of effective stress and effective strain, mixed hardening material. Problems.	
UNIT – 4	**Finite element formulation for an elastic plastic matrix:** Numerical algorithms for solving non linear equations, Convergence criteria, Numerical implementations of the elastic plastic incremental constitutive relations	
UNIT – 5	**Bounding surface theory:** Uniaxial and multiaxial loading anisotropic material behaviour **Theroms of limit analysis**: Statically admissible stress field and kinematically admissible velocity field. Upper and lower bound theorems, examples and problems.	
	Total	

*Note:

TEXT BOOK:

1. Theory of Elasticity by S.P. Timoshenko & J.K Goodier, MGH

REFERENCES:

1. Plasticity for structural engineering W.F.Chen s and D.J.Han, Springer verlag-1987.
2. Mechanics of Materials –II, Victor E. Saouma.
3. Theory of plasticity, Sadhu Singh

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	ADVANCED OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Classical optimization techniques:** Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.	
UNIT – 2	**Numerical methods for optimization:** Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.	
UNIT – 3	**Genetic algorithm (GA) :** Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA, **Multi-Objective GA:** Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems	
UNIT – 4	**Genetic Programming (GP):** Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.	
UNIT – 5	**Non-Traditional optimization techniques:** Goal programming, simulated annealing, Neural Networks based optimization	
	Total	

TEXT BOOKS:

1. Optimal design – JasbirArora, McGraw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers

REFERENCES:

1.Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Understand classification of PDEs and differential solutions and methods for elliptical, parabolic and hyperbolic equations.	
CO2	Understand basic principles and governing equations of CFD	
CO3	Apply finite differential method for incompressible viscous flow problems and compressible flow problems.	
CO4	Understand finite volume formulations for two dimensional and three dimensional problems	
CO5	Apply finite element methods for steady state and transient fluid flow problems	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1				3		
CO2				3		
CO3			2		3	
CO4				3		
CO5			2		3	

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction**: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Derivation of finite difference equations. **Solution methods**: Solution methods of elliptical equations – finite difference formulations, interactive solution methods, direct method with Gaussian elimination.	

UNIT – 2	**Parabolic equations**-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm. **Hyperbolic equations:** explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.	
UNIT – 3	**Formulations of incompressible viscous flows**: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods. **Formulations of compressible flows**: potential equation, Eluer equations-Central schemes, Navier-stokes system of equations, boundary conditions, example problems.	
UNIT – 4	**Finite volume method**: Finite volume method via finite difference method, formulations for two and three-dimensional problems.	
UNIT – 5	**FINITE ELEMENT METHODS:** Introduction to Finite Element Methods, Finite Element Interpolation Functions, Linear Problems-Steady-State Problems – Standard Galerkin Methods, Transient Problems – Generalized Galerkin Methods, Example Problems.	
	Total	

TEXT BOOK:

1. Computational fluid dynamics, T. J.Chung, Cambridge University press, 2002.

REFERENCE:

1. Text book of fluid dynamics, Frank Chorlton, CBS Publishers &distributors, 1985.
2. Patankar, S. V., 2017, Numerical Heat Transfer and Fluid Flow, Special Indian ed., CRC Press.
3. Muralidhar K., and Sundararajan T. (Editors), 2017, Computational Fluid Flow and Heat Transfer, 2nd ed. tenth reprint, Narosa.
4. Anderson Jr., J. D., 2017, Computational Fluid Dynamics: The Basics with Applications, Indian ed., McGraw Hill Education.
5. Donea, J., and Huerta, A., 2003, Finite Element Methods for Flow Problems, John Wiley & Sons, Ltd.
6. Zienkiewicz, O. C, Nithiarasu, P., and Taylor, R. L, 2013, The Finite Element Method for Fluid Dynamics, 7th ed., Butterworth-Heinemann Ltd.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	**MECHANICS OF COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite:

COURSE OBJECTIVES

The objective of the course is to

1. Provides students a background in modern composite materials which are being used in an ever-increasing range of applications and industries.
2. Basic knowledge of composite materials will allow engineers to understand the issues associated with using these materials
3. Gain insight into how their usage differs from conventional materials such as metals, and ultimately be able to use composites to their fullest potential.

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	1. Describe what are composite materials and their differences with respect to conventional materials such as metals.	
CO2	2. Understands mechanical behavior various materials under different choices made for using certain types of compoites in certain applications.	
CO3	3. Analyze the micromechanical properties of fibre reinforced composites i.e Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials	
CO4	4. Derive the mathematical expressions for the various stiffness parameters which govern the design and analysis of the composites.	
CO5	5. Apply constitutive equations of composite materials to predict the macro mechanical behavior composite laminates. Also appreciate the practical applications of structural composites.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**UNIT I** **COMPOSITE MATERIALS:** History and evolution of basic concept of composite, Definition and Classification of Composites, Roles of constituents in composite, Interface and interphase, Matrix Resins: Thermoplastics and thermosetting matrix resins and advanced matrix-polyethylene(UHMWPE). Composite Reinforcements: Particle, short fiber, continuous fibers, Natural fibres: cellulose, jute, coir etc, Manmade fibers: boron, carbon, ceramic, glass and aramids, advanced reinforcement-polybenzthiazoles.	
UNIT – 2	**MECHANICS OF GENERIC MATERIALS:** Mechanical behavior various material systems, Hookes law for general anisotropic materials, Stress-Strain relations for various kinds of materials behavior, Derivation of the engineering constants of constitutive matrices using mechanics of materials approach for orthotropic material. Fundamental terms to understand composite structural members, Coordinates systems for analysis of composite structures.	
UNIT – 3	**MICRO-MECHANICS OF COMPOSITES:** Lamina, Calculation of fiber, matrix and void weight and volume fractions, Micromechanical analysis of composite lamina-Evaluation of four effective elastic moduli-Analytical rule of mixtures, Empirical models-Halpin-sai model, Chamis Model, Introduction to advanced micromechanical models (Numerical).	

UNIT – 4	**MECHANICS OF COMPOSITE LAMINATE:** Derivation for the strength of unidirectional lamina, Lamina stiffness matrix [Q], Designation and configuration of composite laminate-Laminate code, Transformation matrices, On-axis stiffness and off-axis stiffness, Laminate stiffness matrix [$\bar{Q}$], Classical lamination theory (CLT)-Assumptions, [A][B][D] matrices, Effect of lamination schemes on [A][B][D] matrices	
UNIT – 5	**ANALYSIS OF COMPOSITES:** Analysis of inter-laminar stresses and strains with various lamination schemes, Coefficients of thermal and moisture expansions, Effect of hydrothermal environment on stresses and strains, First order shear deformation theory (FSDT), Introduction to analysis of sandwiched composite structures. Applications-Industrial, aerospace, automobile, sports, medical and house hold etc.	
	Total	

TEXT BOOKS

1. Isaac M. Daniel, Ori Ishai, Mechanics of Composite Materials, 2006 by Oxford University Press; 2nd edition.
2. Autar K. Kaw, Mechanics of Composite Materials, 2006 by Taylor & Francis Group, LLC, 2nd edition.
3. Robert M. Jones, Mechanics of composite materials. 1998, McGraw-Hill, New York. 2nd edition.

REFERENCE TEXT BOOKS

1. Michael W. Hyer, 1998 by McGraw-Hill, New York. International Edition
2. Mechanics of Laminated Composite Plates and Shells, Theory and Analysis, Second Edition McGraw-Hill, New York. 2nd edition
3. Bhagwan D. Agarwal, Lawrence J. Broutman, Analysis and Performance of Fiber Composites, 2012 by John Wiley, 3rd Edition

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	EXPERIMENTAL STRESS ANALYSIS	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**UNIT – I** **Introduction**: Stress, strain, Plane stress and plane strain conditions, Compatibility conditions. Problems using plane stress and plane strain conditions, stress functions, mohrs circle for stress strain, Three-dimensional stress strain relations.	
UNIT – 2	**Strain Measurement and Recordings:** Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain	

	gauge circuits. Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.	
UNIT – 3	**Photo elasticity:** Photo elasticity – Polariscope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials – Isochromatic fringes – Isoclinics **Three dimensional Photo elasticity :** Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method, Digital Image correlation.	
UNIT – 4	**Brittle coatings**: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data. **Moire Methods:** Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement field approach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-Fringes, experimental procedure and techniques.	
UNIT – 5	**Birefringent Coatings** Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe-order determinations in coatings, stress separation methods.	
	Total	

TEXT BOOKS :

1. Theory of Elasticity by Timoshenke and Goodier Jr
2. Experimental stress analysis by Dally and Riley,Mc Graw-Hill

REFERENCES:

1. A treatise on Mathematical theory of Elasticity by LOVE .A.H
2. Photo Elasticity by Frocht
3. Experimental stress analysis, Video course by K.Ramesh / NPTEL

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	FRACTURE MECHANICS	L	T	P	C
		3	0	0	3

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction:** Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile behaviour. Fracture in brittle and ductile materials – characteristics of fracture surfaces; inter-granular and intra-granular failure, cleavage and micro-ductility, growth of fatigue cracks, ductile/brittle fracture transition temperature for notched and unnotched components. Fracture at elevated temperature.	
UNIT – 2	**Griffiths Analysis:** Concept of energy release rate, G, and fracture energy, R. Modification for ductile materials, loading conditions. Concept of R curves. **Linear Elastic Fracture Mechanics, (LEFM).** Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, stress intensity factor and the material parameter the critical stress intensity factor, crack tip plasticity, effect of thickness on fracture toughness.	
UNIT – 3	**Elastic-Plastic Fracture Mechanics; (EPFM).**The definition of alternative failure prediction parameters, Crack Tip Opening Displacement, and the J integral. Measurement of parameters and examples of use.	
UNIT – 4	**Fatigue:** Definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, mean stress R ratio, strain and load control. S-N curves. Good mans rule and Miners rule. Micro mechanisms of fatigue damage, fatigue limits and initiation and propagation control, leading to a consideration of factors enhancing fatigue resistance. Total life and damage tolerant approaches to life prediction	
UNIT – 5	**Creep deformation:** The evolution of creep damage, primary, secondary and tertiary creep. Micro-mechanisms of creep in materials and the role of diffusion. Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters. Creep-fatigue interactions. Examples.	
	Total	

TEXT BOOKS:

1. T.L. Anderson, Fracture Mechanics Fundamentals and Applications, 2nd Ed. CRC press, (1995)
2. B. Lawn, Fracture of Brittle Solids, Cambridge Solid State Science Series 2nd ed1993.

REFERENCES:

1. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths (1973)
2. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.
3. H.L.Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold, (1984).
4. S. Suresh, Fatigue of Materials, Cambridge University Press, (1998)
5. L.B. Freund and S. Suresh, Thin Film Materials Cambridge University Press,(2003).
6. Prashant Kumar, Elements of Fracture Mechanics, McGraw Hill Education; 1st edition (1 July 2017)

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	MECHATRONICS	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

UNIT	CONTENTS	Contact Hours
UNIT – 1	Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion , force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.	
UNIT – 2	Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.	
UNIT – 3	Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems: Mechanical actuating systems and electrical actuating systems.	
UNIT – 4	Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.	
UNIT – 5	System and interfacing and data acquisition, DAQS , SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.	
	Total	

TEXT BOOKS:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.

REFERENCES:

1 Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2 Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
3 Mechatronics System Design / Devdas shetty/Richard/Thomson.
4 Mechatronics/M.D.Singh/J.G.Joshi/PHI.

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	INTRODUCTION TO QUANTUM TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce fundamental concepts of quantum mechanics and its mathematical formalism.
2. To explore quantum computing and communication principles and technologies.
3. To understand the physical implementation and limitations of quantum systems.
4. To enable students to relate quantum theory to practical applications in computing, cryptography, and sensing.
5. To familiarize students with the emerging trends in quantum technologies.

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Explain core principles of quantum mechanics and their technological implications.	
CO2	Analyze quantum phenomena like superposition and entanglement.	
CO3	Apply mathematical tools to model and solve quantum systems.	
CO4	Demonstrate understanding of quantum algorithms and quantum circuits.	
CO5	Evaluate potential applications and challenges in quantum communication and sensing.	

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Fundamentals of Quantum Mechanics:** Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrodinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle; Quantum postulates and measurement theory; Eigenvalues, eigenfunctions.	
UNIT – 2	**Quantum Information Theory:** Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantum entanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; CNOT;	

	Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem; Quantum state tomography (introductory)	
UNIT – 3	**Quantum Computing:** Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Oracle and amplitude amplification; Shor's factoring algorithm (overview and significance); Quantum Fourier Transform (QFT); Quantum error correction: Bit-flip, phase-flip, Introduction to quantum programming: Qiskit(overview)	
UNIT – 4	**Quantum Communication:** Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); Eavesdropping and security of QKD; Quantum teleportation (circuit and protocol); Quantum dense coding; Quantum networks and entanglement swapping; Role of quantum repeaters; Single-photon sources and detectors; Implementation challenges (loss, decoherence, noise)	
UNIT – 5	**Quantum Technologies and Applications:** Quantum sensors: magnetometry, gravimetry; Quantum metrology: standard time, atomic clocks; Quantum imaging and lithography; Quantum materials: topological insulators, graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era.	
	Total	

Text Books:

1. **"Quantum Computation and Quantum Information"** by Michael A. Nielsen and Isaac L. Chuang
2. **"Quantum Mechanics: Concepts and Applications"** by Nouredine Zettili

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	COMPUTATIONAL MATHEMATICS LAB	L	T	P	C
		0	0	4	2

Pre-requisite

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	1. Develop codes in MATLAB and PYTHON.	
CO2	2. Develop programmes to solve system of linear equations.	
CO3	3. Understand various curve fitting methods.	
CO4	4. Write various codes to solve differential and partial differential equations.	
CO5	5. Understand and implement Fourier transformations.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1		3	2	2	3	
CO2				2	3	
CO3			2	2	3	
CO4			2	2	3	
CO5			2	2	3	

(Please fill the above with Levels of Correlation, viz., L, M, H)

Part: 1 Numerical Methods

1. Generate a MATLAB / Python code for solving a system of linear equation (Gauss Elimination Method.LU Decomposition (Factorization),Jacobi Iteration)
2. Generate a MATLAB / Python code for Euler's method, Runge – Kutta method to solve differential equations
3. Generate a MATLAB / Python code for Matrices and Eigen values
    i. Eigen values and Eigen vectors
    ii. Jacobi method
4. Generate a MATLAB / Python code to solve Partial Differential equations
    i. Elliptical PDE
    ii. Parabolic PDE
    iii. The Crank – Nicholson method
    iv. Two dimensional parabolic PDE

Part: 2 Finite Element Methods

1. Generate a MATLAB / Python code to solve 1D Bar problem
2. Generate a MATLAB / Python code to solve Plane Truss problem
3. Generate a MATLAB / Python code to solve Beam problem
4. Generate a MATLAB / Python code to solve 2D Plate problem (Plane Stress/Strain).
5. Generate a MATLAB / Python code to solve Free Vibration Problem.

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	DESIGN PRACTICE LAB - II	L	T	P	C
		0	0	4	2

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

(Please fill the above with Levels of Correlation, viz., L, M, H)

ROBOTICS LAB

Experiments :

1. To demonstrate Forward and inverse Kinematics of articulated robot
2. To program and perform the following operation by using an articulated robot.
   - Pick and place operation
   - To traverse given path (for arc welding)

Design the following mechanisms and simulate using CATIA Software /ADAMS Software

1. a RRRR mechanism whose coupler curve will pass through 3 given point.
2. a RRRR mechanism whose coupler will guide a straight line segment through at least three given positions.
3. a RRRR mechanism whose input and output motion is coordinated at at least three given positions.
2. a RRRP mechanism whose coupler will guide a straight line segment through at least three given positions.
3. a RRRP mechanism whose input and output motion is coordinated at at least two given positions
4. a RRRP mechanism whose input and output motion is coordinated at at least three given positions.
5. a RRRR mechanism whose input and output motion is coordinated at at least two given positions.
6. a RRRR mechanism whose coupler curve will pass through 4 given points.
7. a RRRR mechanism whose coupler curve will pass through 3 given points.

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

II Semester	**SEMINAR - II**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

III Semester	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the knowledge on basics of research and its types.
- To impart the concept of Literature Review, Technical Reading, Attributions and Citations.
- To know the Ethics in Engineering Research.
- To know the concepts of Intellectual Property Rights in Engineering.

COURSE OUTCOMES:

Upon successful completion of this course, the student will be able to:

	Course Outcome	*BTL (K#)*
CO1	Explain the meaning of engineering research and apply to develop an appropriate framework for research studies.	K2& K3
CO2	Identify the procedure of Literature Review, Technical Reading, etc. and apply to develop a research design during their project work.	K2 & K3
CO3	Explain and apply the fundamentals of patent laws and drafting procedure in their research works.	K2& K3
CO4	Demonstrate the copyright laws, subject matters of copyrights, designs etc. to apply in patent filing.	K2 & K3
CO5	Identify the new developments in IPR and employ the applications of computer software in writing/filing patents in future.	K2 & K3

 # Based on suggested Revised Blooms Taxonomy Level (BTL)

K1: ***Remember*** **K2:** ***Understand*** **K3:** ***Apply***
K4: ***Analyse*** **K5:** ***Evaluate*** **K6:** ***Create***

Unit Description *Contact Hrs.*

UNIT – I: **[10]**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT – II: **[10]**

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT – III: **[10]**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT – IV: **[10]**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT – V: **[09]**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR.

TEXTBOOKS:

1. C.R. Kothari , 2nd Edition, “Research Methodology: Methods and Techniques”.
2. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step-by-Step Guide for beginners”

REFERENCE BOOKS:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students.
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”.
3. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
4. Mayall, “Industrial Design”, McGraw Hill, 1992.
5. Niebel, “Product Design”, McGraw Hill, 1974.
6. Asimov, “Introduction to Design”, Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
8. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

WEB REFERENCES:

- Please include hyperlinks related to NPTEL/VLabs etc.,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

III Semester	SUMMER INTERNSHIP/INDUSTRIAL TRAINING	L	T	P	C
		0	0	0	3

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

Note: Students are informed to complete Summer Internship duration 8-10 weeks at the end of the II Semester.

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

III Semester	COMPREHENSIVE VIVA	L	T	P	C
		0	0	0	2

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						

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DEPARTMENT OF MECHANICAL ENGINEERING

R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

III Semester	DESSERTATION PART -A	L	T	P	C
		0	0	20	10

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Identify a topic in advanced areas of machine design.	
CO2	Review literature to identify gaps and define objectives and scope of the work.	
CO3	Employ the ideas from literature and develop research methodology.	
CO4	Develop a model experimental setup and/or computational techniques necessary to meet the objectives.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	1		3
CO2	3	2	3	1		3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3

Description:

Students are expected to choose real world contemporary problem and apply the engineering principles learned, to solve the probem through building prototypes or simulations or writing codes or establishing processes/synthesis/correlations etc. The department constituted panel will decide the suitability and worthyness of the project.

Dissertation Evaluation:

i. **The dissertation shall be submitted as per the schedule given in the academic calendar.**

ii. The dissertation supervisor will periodically review the progress of the student and finally give his/her assessment of the work done by the student.

iii. The dissertation part –A will be evaluated for 100, marks with the following weightages.

Sub-component	Weightage
a)Periodic evaluation by guide	40 marks
b)Mid-term review	20 marks
C)End sem viva –voce examination	40 marks

Evaluation criteria:

The student will be evaluated by the panel based on the below criteria. Weightage for each criterion will be determined by the panel and will be informed to the students.

Criteria	Description	Weightage
I	Selection of Topic	
II	Literature Survey	
III	Defining the Objectives and Solution Methodology	
IV	Performance of the Task	

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R25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

IV Semester	DESSERTATION PART -B	L	T	P	C
		0	0	32	16

Pre-requisite:

Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1		
CO2		
CO3		
CO4		
CO5		

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						
CO2						
CO3						
CO4						
CO5						