DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE & SYLLABUS for

M.Tech

MACHINE DESIGN PROGRAMME

(Applicable for batches admitted from 2025-2026)

SREE VAHINI INSTITUTE OF SCIENEC AND TECHNOLOGY (AUTONOMOUS)

SREE VAHINI INSTITUTE OF SCIENCE AND TECHNOLOGY
(AN AUTONOMOUS INSTITUTION)
An ISO 9001 : 2015 Certified Institution
Diploma / B.Tech / M.Tech / BBA & BCA / MBA
Sai Vahini Nagar, NH-30, Tiruvuru-NTR Dist. A.P
College Code : VHNI

V25 I M. Tech I SEM Subject Codes

MACHINE DESIGN

S. No	Category	Subject Name	Subject Code	L	T	P	C
1	Professional Core	Mechanical Vibrations and Acoustics	V252111531	3	1	0	4
2	Professional Core	Advanced Mechanics of Solids	V252111532	3	1	0	4
3	Professional Core	AI&ML for Mechanical Engineering	V252111533	3	1	0	4
4	Program Elective-I	Advanced Finite Element Methods	V2521115D1	3	0	0	3
		Product Design &Development	V2521115D2				
		Geometric Modelling	V2521115D3				
		Numerical methods for Mechanical Engineering	V2521115D4				
5	Program Elective-II	Design for Manufacturing& Assembly	V2521115E1	3	0	0	3
		Multi Body Dynamics	V2521115E2				
		Vision Systems and Image Processing	V2521115E3				
		Engineering Tribology	V2521115E4				
6	Professional Core	Machine Dynamics Lab	V252111561	0	0	4	2
7	Professional Core	Design Practice Lab-I	V252111562	0	0	4	2
8	Seminar	Seminar-I	V25211CCN1	0	0	2	1
TOTAL				**15**	**3**	**10**	**23**

V25 I M. Tech II SEM Subject Codes

MACHINE DESIGN

S. No	Category	Subject Name	Subject Code	L	T	P	C
1	Professional Core	Advanced Mechanisms & Robotics	V252121531	3	1	0	4
2	Professional Core	Advanced Machine Design	V252121532	3	1	0	4
3	Professional Core	Signal Analysis and Condition Monitoring	V252121533	3	1	0	4
4	Program Elective-III	Theory of Plasticity	V2521215F1	3	0	0	3
		Advanced Optimization Techniques	V2521215F2				
		Computational Fluid Dynamics	V2521215F3				
		Mechanics of Composite Materials	V2521215F4				
5	Program Elective-IV	Experimental stress analysis	V2521215G1	3	0	0	3
		Fracture Mechanics	V2521215G2				
		Mechatronics	V2521215G3				
		Introduction to Quantum Technologies	V2521215G4				
6	Professional Core	Computational Mathematics Lab	V252121561	0	0	4	2
7	Professional Core	Design Practice Lab-II	V252121562	0	0	4	2
8	Seminar	Seminar-II	V25212CCN1	0	0	2	1
TOTAL				**15**	**3**	**10**	**23**

Note: Students are informed to complete Summer Internship (duration8-10weeks) at the end of the II Semester.

V25 II M. Tech I SEM Subject Codes

MACHINE DESIGN

S. No	Category	Subject Name	Subject Code	L	T	P	C
1	Professional Core	Research Methodology and IPR	V25221CC31	3	0	0	3
2	Internship	Summer Internship/ Industrial Training	V25221CC81	-	-	-	3
3	Value Addition Course	Comprehensive Viva	V25221CCK1	-	-	-	2
4	Project Work	Dissertation Part – A	V25221CCA1	-	-	20	10
TOTAL				**3**		**20**	**18**

V25 II M. Tech II SEM Subject Codes

MACHINE DESIGN

S. No	Category	Subject Name	Subject Code	L	T	P	C
1	Project Work	Dissertation Part – B	V25222CCA1	-	-	32	16
TOTAL				**0**	**0**	**32**	**16**

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

COURSE OUT COMES: 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.	Remember
CO2	Compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system	Apply
CO3	Evaluating the vibration parameters of continuous/elastic body systems for natural frequencies and subsequent mode shapes	Analyze
CO4	Make a practical experience of basics of sound, noise and vibration; as well as their measurement and control strategies.	Evaluate
CO5	Describe the vibration measurement by using transducers and vibration exciters and able to assess occupational and environmental noise problems.	Evaluate

Based on suggested Revised BTL

Mapping of course out comes with program out comes

	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)

UNIT	CONTENTS	Contact Hours
UNIT– 1	**INTRODUCTION** Relevance and need for vibration analysis– Basics of SHM-Mathematical modelling of vibrating systems - Discrete and continuous systems - single-degree freedom systems - free and forced vibrations, damped and un damped systems.	
UNIT– 2	**MULTIDEGREEFREEDOMSYSTEMS** 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** Tensional 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	**BASICSOFACOUSTICS** 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	**NOISEMEASUREMENTANDCONTROL** 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	

TEXTBOOKS:

1. S.S.Rao,“MechanicalVibrations",5thEdition,PrenticeHall,2011.
2. M.L.MunjalandB.Venkatesham,“NoiseandVibrationControl”,SecondEdition,World Scientific, 2024.

REFERENCES:

1. W.T. Thomson, M.D. Dahleh and C Padmanabhan, “Theory of Vibration with Applications”, 5th Edition,Pearson Education, 2008.
2L.Meirovitch,“ElementsofvibrationAnalysis",2ndEdition,McGraw-Hill,NewYork,1985.
3. Beranek and Ver,“Noise and Vibration Control Engineering: Principles and Applications”,John Wiley and Sons, 2006.
4. RandallF.Barron,“IndustrialNoiseControlandAcoustics”,MarcelDekker,Inc.,2003.

Web Resources:

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

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

Pre-requisite:

Course Out comes: 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.	Remember
CO2	Able to identify the failure modes of different structural members and applying various energy methods for statically determinant and indeterminate structures	Apply
CO3	Able to calculate bending stresses in curved beams and beams subjected to non-symmetrical bending	Apply
CO4	Able to calculate torsional stresses in circular and non-circular cross section members and multi walled thin-walled tubes	Evaluate
CO5	Able to calculate and analyze contact stress when two bodies are in contact.	Evaluate

based on suggested Revised BTL

Mapping of course out comes with program out comes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**1**	**1**	**1**		
CO2	**1**	**1**	**1**	**1**		
CO3	**1**	**1**	**1**	**1**		
CO4	**2**	**2**	**2**	**2**		
CO5	**1**	**1**	**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 Determine ate structures.	
UNIT– 3	**Unsymmetrical bending:** Bending stresses in Beams subjected to Non symmetrical 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:** Line are 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	

TEXTBOOKS:

1. AdvancedMechanicsofmaterialsbyBoresi&Sidebottom-WielyInternational.
2. TheoryofelasticitybyTimoshenkoS.P.andGoodierJ.N.McGraw-HillPublishers3rd Edition
3. AdvancedMechanicsofSolids,L.SSrinath

REFERENCEBOOKS:

1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates–Timoshenko.
3. Strength of materials &Theory of structures (VolI&II)byB.CPunmia
4. Strength of materials by Sadhu singh

		L	T	P	C
I Semester	**AI&ML FOR MECHANICAL ENGINEERING**	**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 Behavior - 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, over fitting and under fitting.

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

UNIT–II:

Unsupervised Learning: Clustering**,** K-means, Dimensionality Reduction, PCA and Kernel.
BayesianandComputationalLearning: Bayestheorem,conceptlearning,maximum likely hood of normal,binomial,exponential,andPoissondistributions,minimumdescription length principle, Naïve Bayes Classifier, Instance-based Learning-K-Nearest neighbor learning.

UNIT–III:

Neural Networks and Genetic Algorithms: Neural network representation, problems, perception, multi layer networks and back propagation, steepest descent method, Convolution

Neural networks and they are applications, Local vs Global optima, Introduction to Genetic algorithms.

UNIT–IV:

Deep Learning: Recurrent Neural Networks and they are 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.

TEXTBOOKS:

1) Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach,2/e, Pearson Education, 2010.
2) TomM.Mitchell, Machine Learning,Mc GrawHill,2013.
3) Ethem Alpayd in, Introduction to Machine Learning (Adaptive Computation and Machine Learning), the MIT Press, 2004.

REFERENCEBOOKS:

1) ElaineRich,KevinKnight and ShivashankarB.Nair,ArtificialIntelligence,3/e,McGraw Hill Education, 2008.
2) Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems,PHILearning, 2012.

ONLINERESOURCES:

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

Course out comes: 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 UN supervised 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.

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.	Remember
CO2	Solve the problems of bars, trusses, beams and frames using finite element method	Apply
CO3	Apply the finite element method to plates and ax symmetric problem	Analyze
CO4	Understand the is parametric formulation and requirements for Convergence.	Evaluate
CO5	Solve the dynamic problems and learn about the commercial finite Element packages.	Evaluate

based on suggested Revised BTL

Mapping of course out comes with program out comes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1				
CO2	1	1	3	3		
CO3	1	1	3	3		
CO4	2	2	2	3		
CO5	1	1	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, Galerk in 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 nodded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Ax symmetric Problems: Ax symmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two Dimension all fin.	
UNIT–4	Isoperimetric 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(SyllabusfromRef.2):General Considerations	
	Total	

TEXTBOOKS:

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, CR Cpress,1994.
2. Zien kiewiczO.C. Finite Element Method, Mc Graw-Hill, Third Edition, 1977.
3. K.J.Bathe,Finite element procedures,Prentice-Hall,1996.

		L	T	P	C
I Semester	**PRODUCT DESIGN AND DEVELOPMENT**	**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	Remember
CO2	Translate conceptual ideas in to clear sketches	Apply
CO3	Present ideas using IT applications of ware and physical model	Analyze
CO4	Able to identify causes of failure through fault free analysis and Perform failure analysis	Evaluate
CO5	To carry out perform product testing under thermal, vibration, electrical and combined environments.	Evaluate

based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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, Roleof 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, Customers vice 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. Wei bull 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	

TEXTBOOKS:

1. Engineering Design, George E.Dieter, McGraw-Hill
2. Product Integrity and Reliability in Design, JohnW. EvansandJillianY.Evans, Springer Verlag

REFERENCES:

1. The Product Management Handbook, Richard S.Hands combe, McGraw-Hill
2. New Product Design, Ulrich Eppinger
3. Product Design,KevinOtto.

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.	Remember
CO2	Develop equations for Bezier curve.	Apply
CO3	Develop equations for B-Spline curve	Analyze
CO4	Develop parametric representation of analytic and synthetic surfaces	Evaluate
CO5	Understand and implement various schemes used for construction of solid models	Evaluate

Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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, re parameterization, 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:** Bi cubic 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:** Tri cubic solid, Algebraic and geometric form. **Solid modeling concepts:** Wire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.	
	Total	

*Note:

TEXTBOOKS:

1. CAD/CAM by IbrahimZeid,Tata Mc GrawHill.
1. Elements of Computer Graphics by Roger&AdamsTataMcGrawHill.

REFERENCES:

1. Geometric Modeling by MichealE.Mortenson,McGrawHillPublishers
2. Computer Aided Design and Manufacturing, K.LalitNarayan,
   K. Mallikarjuna Rao, MMM Sarcar, PHI Publishers

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 solving 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 non linear equations,
3. Aqua in with fitting at with 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	**1**	**1**	**1**	**1**	1	
CO2	**2**	**2**	**1**	**2**	1	
CO3	**2**	**3**	**2**	**1**		
CO4	**1**	**2**	**2**	**2**		
CO5	**3**	**2**	**3**	**3**		

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

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, non linear 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 trans form, 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-Nickels on 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	

TEXTBOOKS:

1. StevenC.Chapra,RaymondP.Canale“NumericalMethodsforEngineers”TataMc-Graw Hill
2. 2.CurtisF.Gerald,Partick.O.Wheatly,”Appliednumericalanalysis”Addison-Wesley,1989
3. 3.DouglasJ.Faires,RichedBurden”Numericalmethods”,Brooks/Colepublishing
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 BenceS.J,”Mathematical methods for physics and engineering”, Cambridge University press,1999.
3. Kreysis, Advanced Mathematics

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

Pre-requisite:

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

		Knowledge Level (K)#
CO1	Understand the basic concepts of DFMA and the applications. Apply Design rules to manual assembly.	Remember
CO2	Apply design rules for ease machining and understand the design recommendations for machined parts	Apply
CO3	Understand the selection, simulation and design rules of casting processes. Also to understand the design considerations for extruded sections and Various forming processes.	Analyze
CO4	Understand the design consider at ion sand effect of thermal stresses in Welded joints. Understand the design factors for forging.	Evaluate
CO5	Understand the design considerations for automatic assembly and to do Quantitative analysis of assembly systems.	Evaluate

based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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 Comb in actions of Factors, Application of the DFA	
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 recommend actions for	
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 elements – 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, and single station assembly lines.	
	Total	

TEXTBOOKS:

1. Design formanufacture,Johncobert,AdissonWesley.1995
2. Design for Manufacture by Boot hroyd,
3. Design for manufacture, James Bralla

REFERENCE:

ASMH and bookVol.20

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	Students will be able to apply basic particle dynamics and 2-dimensional rigid body mechanics to 3-dimensional rigid bodies.	Understand
CO2	Students will be able to analyze inter connected bodies in a multi-body system	Understand
CO3	Students will be able to use numerical methods for the analysis of multi-body system.	Apply
CO4	Inverse dynamic analysis, forward dynamic analysis, constraint stabilization - case studies.	Understand
CO5	Spatial multi-body systems-formulation-joints.	Apply

based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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	

TEXTBOOKS:

1. Planar Multi body Dynamics Formulation, Programming and Applications by ParvizE. Nikravesh, CRC Press
2. Dynamics of Multi body Systems by Ahmed A. Shabana, Cambridge University Press.

REFERNCES:

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

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	Machine vision: Vision sensors-Comparison with other types of sensors	Understand
CO2	Image representation: Application of image processing	Understand
CO3	Spatialdomaintechniques:Convolution,Correlation.Frequencydomainoperations	Apply
CO4	Image enhancement: Filtering, Restoration, Histogram equalization	Understand
CO5	Image compression: Edge detection- Thresholding- Spatial smoothing	Apply

based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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 equalization, 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	

TEXTBOOKS:

1. Digital Image Processing by Gonzalez, R.C. and Woods, R.E., Addison Wesley Publications.2RobotVisionbyProf.AlanPugh(Editor),IFSLtd.,U.K.3.DigitalImage Processingby A. Rosenfled and A. Kak, Academic Press.

REFERENCES:

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

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.	Understand
CO2	To must be able to select rolling element bearing based on the static and Dynamic load carrying capacity and must be able to understand condition monitoring procedures of the bearing.	Apply
CO3	To must be able to design hydro static thrust and journal bearings for Different applications.	Understand
CO4	To must be able to understand to evaluate load carrying capacity and life of Hydrodynamic thrust and journal bearing.	Understand
CO5	To describe different type of seals and select suitable seals forgiven Application and illustrate the failures of different types of bearing.	Apply

Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	3			
CO2	**2**	**2**	3	2	2	
CO3	**1**	**2**	3	3	3	
CO4	**2**	**2**	2	2		
CO5	**1**	**3**	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 to pography- friction and wear mechanisms, wear maps, effect of	

	Lubricants- methods of fluid film formation. **Lubrication:** Choice of lubricants, EHL (Elastic 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, preloading 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; Hydro dynamic journal bearings – Sommer field 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	

TEXTBOOKS:

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

REFERENCES:

1. Neale MJ,(Editor)"Tribology hand Book"Neumann Butterworths,1975.
2. Connor and Boyd JJO (Editors) " Standardhand book of lubrication engineers " ASLE, McGraw Hill Book & Co.,1968
3. ShigleyJ, ECharles," Mechanical Engineering Design", Mc GrawHillCo.,1989

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

Pre-requisite:

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.	Understand
CO2	Perform free and forced vibration analysis of discrete and continuous Systems using measurement instruments	Evaluate
CO3	Practice the experimental mod a analysis on different beams and plates with Variable boundary condition.	Apply
CO4	Practice the measurement of sound pressure and directivity	Remember
CO5	Learn the measurement methodologies of acoustic material characterization	Analyze

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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 velocityof 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

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	To compute the surface modeling techniques	Understand
CO2	To understand the Structural Analysis using any FEA Package, like static & model analysis	Evaluate
CO3	To understand the Thermal Analysis using any FEA Package of steady state & transient conditions	Apply
CO4	To compute the transient analysis using any FEA for different structures that can be discredited with 1-D, 2-D & 3-D elements	Remember
CO5	To understand the experiment Experimental modal analysis of Beams on evaluation of stress intensity factor	Analyze

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

COURSEOBJECTIVES1

1. In calculate a culture of research among faculty and students alike
2. Fabricate a variety of composites using different matrix, rein for cement and filler materials through hand layup technique or other methods
3. Characterize the mechanical and tribological behavior of a variety of composites
4. Investigate the significance of reinforcement on the mechanical and tribological characteristics of composites
5. Conduct franc to graphic studies to unrest and 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 micro structural* 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)

Up on 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 experiment at ion 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

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

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.	Understand
CO2	Develop the Eulery savory equations using Hartmann's construction to Determine the centre of curvature	Understand
CO3	To locate the relative rotor centre using the function generation approach For 2-positions and 3-positions scenarios.	Apply
CO4	Design the Freudenstein' equation to find the length so for the links in a Four bar mechanism	Understand
CO5	To study the kinematics of different manipulators in daily life Applications	Understand

#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–Savory Equation; Analytical and graphical determination of d_i; Bobillier's Construction; Collimation 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 Rotor center triangle ; Guiding a body through Four distinct positions; Burmese'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,STANFORDARM,MICROBOT	
UNIT–5	**Differential motions and Velocities:** Introduction, differential relationship, Jacobean, 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 Jacobean and the differential operator, Inverse Jacobian.	
	Total	

TEXTBOOKS:

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

REFERENCES:

1. AllenS.HallJr., Kinematics and LinkageDesign,PHI,1964.
2. J.EShigley and J.J.UickerJr., Theory of Machines and Mechanisms,McGraw-Hill,1995.
3. Joseph Duffy, Analysis of mechanisms and Robotmanipulators,EdwardArnold,1980

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.	Understand
CO2	Able to identify the failure modes and various fatigue mechanisms of Different machine components and life estimation.	Understand
CO3	Ability to design the machine components against cyclic loads and their Estimation	Apply
CO4	Ability rode sign the machine components against surface fatigue failures.	Understand
CO5	Ability to design the machine components against human ergonomic Factors.	Understand

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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. CreativityandCreativetechniques,Materialselectioninmachinedesign, 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,designforfluctuatingstresses,designforlimitedcycles,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:

TEXTBOOKS:

1. Machine Design an Integrated Approach by Robert L. Norton, Prentice-Hall New Jersey, USA.
2. MechanicalEngineeringDesignbyJ.E.ShigleyandL.D.MitchellpublishedbyMcGrawHill International Book Company, New Delhi.
3. Mechanical Behaviour of Materials-Norman E. Dowling, Stephen L. Kampe, MiloV.Kral Pearson publishers, 5th edition.

REFERENCES:

1. Fundamentals of machine elements by Hamrock,Schmidand Jacobian,2ndedition,McGraw-Hill International edition.
2. Product design and development by KarlT.UlrichandStevenD.Eppinger.3rdedition, Tata McGraw Hill.
3. Product Design and Manufacturing by A.K.Chitale and R.C.Gupta,PrenticeHall
4. Engineering Design/George ED ieter/Mc Graw Hill/2008
5. Fundamentals of machine lements/Hamrock, Schmidand Jacobian/2ndedition /Mc Graw Hill International edition.

II-Semester	SIGNALANALYS IS 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	Understand
CO2	Apply condition monitoring methods for fault diagnosis in machines	Understand
CO3	Analyze the vibration signals from rotating and reciprocating machines	Apply
CO4	Illustrate the faults in rotating and reciprocating machines	Understand
CO5	Apply fault detection techniques for fault diagnosis in rotating and reciprocating machines	Understand

Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

UNIT	CONTENTS	Contact Hours
UNIT–1	**SIGNALANALYSIS OF CONTINUOUS STATIONARY SIGNALS:** Introduction, Basic concepts, Signal types, Time domain Signal analysis, Data Acquisition, Filtering, Fourier Series, FFT, Modulation and Sidebands	
UNIT–2	**SIGNALANALYSIS OF CONTINUOUS NON-STATIONARY SIGNALS:** Instrumentation, Data Recording, Order Analysis, Orbits, Envelope, Cestrum, 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, the rmography, performance analysis, noise Monitoring, temperature monitoring, wear behavior monitoring, Signals generated by rotating and reciprocating shafts.	
UNIT–4	**VIBRATION CONDITION MONITORING INREAL SYSTEMS**: Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Pre heater 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 sub harmonics, 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	

TEXTBOOK:

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,1stEdition, 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

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 behavior from stress-strain curves for materials	Understand
CO2	Recognize typical plastic yield criteria established in constitutive Modeling	Understand
CO3	Understand the physical interpretation of material constants in Mathematical formulation of constitutive relationship	Apply
CO4	Solve an elliptically the simple boundary value problems with elastic-plastic properties	Understand
CO5	Develop constitutive models based on experimental results on material Behavior	Understand

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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-Wester guard stress space, Equilibrium equations of a body. Yield criteria: Teresa's, von Mises rules, Ducker- Pager criterion, anisotropic yield criteria. **Strain at point:** Cauchy's formulae for strains, principal strains, and principal shear strains, derivative strain tensor. Strain-displacement relationships. Linearelasticstressstrainrelations,GeneralizedHooke'slaw,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_2deformation theory, Drucker-Prager material, General Isotropic materials. **Deformation theory of plasticity:** Loading surface, Hardening rules. Flow rule and Duckers 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, Numericalimplementationsoftheelasticplasticincrementalconstitutive Relations	
UNIT–5	**Bounding surface theory:** Uniaxial and multi axial loading an isotropic material behaviour **Thermo so film it analysis**: Statically admissible stress field and kinematic ally admissible velocity field. Upper and lower bound theorems, Examples and problems.	
	Total	

*Note:

TEXTBOOK:

1. Theory of Elasticity by S.P.Timoshen ko&J.KGoodier,MGH

REFERENCES:

1. Plasticity for structural engineering W.F.ChensandD.J.Han, Springerverlag-1987.
2. Mechanics of Materials–II,Victor E.Saouma.
3. Theory of plasticity, Sadhu Singh

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	To apply the Classical optimization techniques	Apply
CO2	Analyze the optimization of numerical methods	Analyze
CO3	Create the Genetic algorithm and Multi-Objective GA	Create
CO4	Students will be develop the Principles of genetic programming	Understand
CO5	Applications Of Optimization In Design And Manufacturing Systems	Understand

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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	

TEXTBOOKS:

1. Optimal design–JasbirArora,Mc GrawHill (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

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 PDE sand differential solutions and methods for Elliptical, parabolic and hyperbolic equations.	Solve
CO2	Understand basic principles and governing equations of CFD	Analyze
CO3	Apply finite differential method for incompressible viscous flow problems And compressible flow problems.	Understand
CO4	Understand finite volume formulations for two dimensional and three Dimensional problems	Apply
CO5	Apply finite element methods for steady state and transient fluid flow Problems	Analyze

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1		1		3		
CO2	2	2		3		
CO3	2	1	2		3	
CO4		2		3		
CO5		1	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 tri diagonal 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 Galerk in Methods, Transient Problems –Generalized Galerk in Methods, Example Problems.	
	Total	

TEXTBOOK:

1. Computational fluid dynamics,T.J.Chung, CambridgeUniversitypress,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, 2^{nd} 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.,andTaylor,R. L,2013,The Finite Element Method for Fluid Dynamics, 7^{th} ed., Butterworth-Heinemann Ltd.

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 allowing infers 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	Describe what are composite materials and the it differences With respect to conventional materials such as metals.	Understand
CO2	Understands mechanical behavior various materials under different choices made for using certain types of composites in Certain applications.	Understand
CO3	Analyze the micro mechanical properties of fibered in forced composites i.e. Identify, describe and evaluate the properties of Fiber reinforcements, polymer matrix materials	Apply
CO4	Derive the mathematical expressions for the various stiffness parameters which govern the design and analysis of the composites.	Understand
CO5	Apply constitutive equations of composite materials to predict the macro mechanical behavior composite laminates. Also Appreciate the practical applications of structural composites.	Analyze

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

UNIT	CONTENTS	Contact Hours
UNIT–1	**UNITI** **COMPOSITE MATERIALS:** History and evolution of basic concept of composite, Definition and Classification of Composites, Roles of constituents in composite, Interface and inter phase, 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 rein for cement-poly benzthiazoles.	
UNIT–2	**MECHANICS OF GENERIC MATERIALS:** Mechanical behavior various material systems, Hooks 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 analysisofcompositelamina-Evaluationoffoureffectiveelasticmoduli-Analytical rule of mixtures, Empirical models-Hal pin-sai model, Chamois	

	Model, Introduction to advanced micro mechanical 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 [Q¯], Classical lamination theory (CLT)-Assumptions,[A][B][D]matrices, Effect to fulmination scheme son [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 sand witched composite structures. Applications-Industrial, aerospace, automobile, sports, medical and house hold etc.	
	Total	

TEXTBOOKS

1. Isaa cM. Daniel, OriIshai, Mechanics of Composite Materials,2006 by Oxford University Press; 2nd edition.
2. AutarK. Kaw, Mechanics of Composite Materials, 2006 by Taylor & Francis Group, LLC, 2nd edition.
3. Robert M. Jones, Mechanics of composite materials.1998, McGraw-Hill, NewYork.2nd edition.

REFERENCETEXTBOOKS

1. MichaelW.Hyer,1998byMcGraw-Hill,NewYork.International Edition
2. Mechanics of Laminated Composite Platesand Shells, Theory and Analysis, Second Edition McGraw-Hill, New York. 2nd edition
3. BhagwanD. Agarwal, L awrenceJ. Broutman, Analysis and Performance of Fiber Composites, 2012 by John Wiley, 3rd Edition

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	Understand the measurement of the cutting forces	Apply
CO2	Apply the different temperature measuring instruments	Apply
CO3	Understand the Metallurgical Studies of the different types of materials	Apply
CO4	Experimental design and planning with Orthogonal arrays and linear graphs	Analyze
CO5	Experiment design & data analysis:	Understand

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

(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, Mohr's 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,dynamicrecordingathighfrequencies,dynamicrecordingat Very high frequencies, telemetry systems.	
UNIT–3	**Photo elasticity:** Photo elasticity – Polari scope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials – Is chromatic fringes – Isoclinic's **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. **Moiré 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 planes lope measurements, sharpening and Multi placation of Moire- Fringes, experimental procedure and techniques.	
UNIT–5	**Brief regent Coatings** Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe-Order determinations in coatings, stresses parathion methods.	
	Total	

TEXTBOOKS:

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

REFERENCES:

1. Atreatiseon Mathematical theory of Elasticity by LOVE.A.H
2. Photo Elasticity by Frocht
3. Experimental stress analysis,Videocourse by K.Ramesh/NPTEL

II-Semester	FRACTURE MECHANICS	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	Able to implement mathematics, science and engineering principles to solve engineering problems in mechanical systems.	understand
CO2	Able to find the source of engineering problems in mechanical system through research that includes identification, formulation, analysis, data interpretation based On engineering principles	Apply
CO3	Abletoformulatethesolutionofengineeringprobleminmechanicalsystemby Considering economy, safety, environment and energy conservation	understand
CO4	Able to design mechanical system and the necessary components through analytical approach based on science and technology by considering technical standard and reliability	Apply
CO5	Able to find the creep deformation parameters, Creep-fatigue.	Apply

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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/brittlefracturetransitiontemperaturefornotchedandunnotched 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 son 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, means tress 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–extra potation and the use of Larson-Miller parameters. Creep- fatigue inters actions. Examples.	
	Total	

TEXTBOOKS:

1. T.L.Anderson, Fracture Mechanics Fundamentals and Applications,2ndEd.CRCpress, (1995)
2. B.Lawn,Fracture of Brittle Solids, Cambridge Solid State Science Series 2nded1993.

REFERENCES:

1. J.F. Knott, Fundamentals of Fracture Mechanics, Butter worths (1973)
2. J.F. Knott, PWithey, 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, Mc Graw Hill Education;1stedition(1July 2017)

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	Understand the design considerations of the mechatronics	Understand
CO2	Apply the Motion Control algorithms	Apply
CO3	Understand the Sensor interfacing & Architecture of intelligent machines	Understand
CO4	Understand basics of image processing, binary and grayscale images	Understand
CO5	Understand the Micro sensors, micro actuators and its performance	Understand

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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,fluidpressure,liquid Flow, liquid level, temperature and light sensors.	
UNIT–2	Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analogsignalconditioning,amplifiers,filtering.IntroductiontoMEMS& 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	Digitalelectronicsandsystems,digitallogiccontrol,microprocessorsand Microcontrollers, 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	

TEXTBOOKS:

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

REFERENCES:

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

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

Course Objectives:

1. To introduce fundamental concepts of quantum mechanics and it's the metical 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 tore late quantum the or 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 the technological Implications.	Understand
CO2	Analyze quantum phenomena like super position and entanglement.	Apply
CO3	Apply mathematical tools to model and solve quantum systems.	Understand
CO4	Demonstrate understanding of quantum algorithms and quantum circuits.	Understand
CO5	Evaluate potential applications and challenges in quantum Communication and sensing.	Understand

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 uncertain principle; Quantum postulates and measurement theory; Eigen values, Eigen functions.	
UNIT–2	**Quantum Information Theory:** Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum super position and quantum entanglement; Dir ac 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 entanglementswapping;Roleofquantumrepeaters;Single-photonsources And detectors; Implementation challenges (loss, de coherence, noise)	
UNIT–5	**Quantum Technologies and Applications:** Quantum sensors: magneto merry, gravimetric; Quantum metrology: standard time, atomic clocks; Quantum imagingandlithography;Quantummaterials:topologicalinsulators,graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Super conducting quits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era.	
	Total	

<u>**Text Books**</u>:

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

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.	Apply
CO2	2. Develop programmes to solve system of linear equations.	Apply
CO3	3. Understand various curve fitting methods.	Apply
CO4	4. Write various codes to solve differential and partial differential equations.	Apply
CO5	5. Understand and implement Fourier transformations.	Apply

#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: 1Numerical 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 solve1DB a 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.

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	Testing of circuits using basic pneumatic trainer kits	Apply
CO2	Study of sequential and hydraulic motor circuit using hydraulic systems	Apply
CO3	Testing the Material Characterization	Apply
CO4	Apply the X-ray methods	Apply
CO5	Testing of circuits using basic pneumatic	Apply

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

(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 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 least two given positions
4. A RRRP mechanism whose input and output motion is coordinated at least three given positions.
5. A RRRR mechanism whose input and output motion is coordinated at least two given positions.
6. A RRRR mechanism whose couple curve will pass through 4given points.
7. A RRRR mechanism whose couple curve will pass through 3given points.

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

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:
Up on 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 copy right laws, subject matters of copy rights, 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: Analyze	**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.

TEXT BOOKS:

1. C.R. Kothari, 2nd Edition," Research Methodology: Methods and Techniques".
2. RanjitKumar,2ndEdition,"Research Methodology: AStep-by-StepGuide 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&FrancisLtd,2007.
4. Mayall,"IndustrialDesign",McGrawHill,1992.
5. Niebel,"Product Design",Mc GrawHill,1974.
6. Asimov,"Introduction to Design",Prentice Hall,1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in NewTechnological Age", 2016.
8. T.Ramappa,"IntellectualPropertyRightsUnderWTO",S.Chand,2008

WEB REFERENCES:

- Please include hyper links related to NPTEL/VL abs etc.,

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	To learn the application of knowledge in real world problems.	Understand
CO2	To get exposure to team-work and leadership quality.	Understand
CO3	To deal with industry-professionals and ethical issues in the work environment	Apply
CO4	To strengthen the association of students with construction industry.	Understand
CO5	To create awareness amongst the students the recent trends of civil engineering in industries.	Create

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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	Students should be able to demonstrate the application of the knowledge acquired in the fours semesters to solve the problems of the various forms of organizations /institutions.	Understand
CO2	Understand the practical difficulties in applying the various forms of solutions to find the feasible solution.	Understand
CO3	To make the students to face the expert panel and present the knowledge, skills and problems in the most effient way.	Apply
CO4	Solve the real life problems and assess the implications of various forms of solutions.	Understand
CO5	Students should be able to make effective presentation of different topics learnt before the expert problem.	Create

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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 at opinion advanced areas of machine design.	Understand
CO2	Review literature to identify gaps and define objectives and scope of the work.	Understand
CO3	Employ the ideas from literature and develop research methodology.	Apply
CO4	Develop a model experimental setup and/or computational techniques necessary to meet the objectives.	Understand

#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 problem through building prototypes or simulations or writing codes or establishing processes/synthesis/correlations etc. The department constituted panel will decide the suitability and worth shyness 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 for100, marks with the following weight ages.**

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

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	Weight age
I	Selection of Topic	
II	Literature Survey	
III	Defining the Objectives and Solution Methodology	
IV	Performance of the Task	

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

Pre-requisite:

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

		Knowledge Level (K)#
CO1	Student should carry out the investigation by identifying sources of evidence, accessing those using accepted and rigorous academic methods, and analyzing and interpreting the material gathered by simulation/experimentation.	Understand
CO2	A dissertation phase - II is student's own work & will need to keep up the effort, and the interest, over several months and through several stages.	Understand
CO3	Student need to think carefully about the time necessary to carry-out and complete your project work and the relative writing up.	Apply
CO4	The project should present an orderly and critical exposition of the existing knowledge of the subject and will embody results of original investigations demonstrating the capacity of the candidate to do independent research work.	Understand
CO5	While writing the thesis/dissertation, the candidate will layout clearly the work done by him independently and the sources from which he has obtained other information contained in his/her Dissertation.	Create

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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