DEPARTMENT OF MECHANICAL ENGINEERING
UNIVERSITY COLLEGE OF ENGINEERING KAKINADA
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
R23 COURSE STRUCTURE & SYLLABUS
M.TECH (MACHINE DESIGN)

Vision and Mission of the Institute

Vision

To be a premier institute of excellence developing highly talented holistic human capital that contributes to the nation through leadership in technology and innovation through engineering education.

Mission

1. To impart Personnel Skills and Ethical Values for Sustainable Development of the Nation.
2. To create Research & Industry oriented centers of excellence in all engineering disciplines.
3. To be a renowned IPR generator and repository for innovative technologies.
4. To develop Research and Industry oriented technical talent.
5. To benchmark globally the academic & research output.

Vision and Mission of the Department

VISION

To nurture the excellence in modeling and designing of modern mechanical engineering systems by imparting timeless core values to the learners and to mould the Department into a centre of academic excellence catering to industrial needs through advanced research.

MISSION

1. **To offer high-quality graduate and postgraduate programs in Mechanical Engineering in order to make the learners globally competitive technologists who are professionally capable and socially responsible.**
2. **The department enables the learners to inculcate and imbibe theoretical and practical knowledge for exploration and deep insight into advanced technological innovations and inventions.**

Dr.N.Mohan Rao Dr.V.V.Subba Rao Dr.K.MeeraSaheb

Dr.K.Mallikarjuna Rao Dr.M.Venkatesham Dr.K.Ramji

Dr.V.Suresh Babu Dr.PSV Ganesh Kumar Dr.J.Suresh Kumar

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M.Tech Program Course Structure & Syllabus

Dr.N.Mohan Rao Dr.V.V.Subba Rao Dr.K.MeeraSaheb

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M.Tech

Program Educational Objectives (PEOs) – Program Educational Objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

Departments needs to include PEOs (Three to Five)

PEO 1 : Excel in professional career and/or scientific research by acquiring knowledge in advanced mathematical, computational, and engineering principles.

PEO 2: Analyze real-life problems and design eco-friendly mechanical systems as appropriate promising solutions that are technically sound, economically feasible, and socially acceptable.

PE0 3: Exhibit professionalism, ethical attitude, communication skills, and teamwork in their Profession and adapt to current trends by engaging in lifelong learning.

Mapping of PEOs with Mission statements

	PEO1	PEO2	PEO3	PEO4
M1				
M2				
M3				
M4				

Program Outcomes (POs)

POs are statements that describe what students are expected to know and be able to do upon completion of the program. These relate to the skills, knowledge, attitude and analytical ability and behavior that students acquire through the program.
(As defined by NBA)

PO 1: An ability to independently carryout research / investigation & development work to solve practical problems.

PO 2: Ability to work and present a substantial technical report / document.

PO 3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be a level higher than the requirements in the appropriate bachelor program.

Departments needs to include POs (Two to Three)

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PO 4: Acquire in-depth knowledge in machine design from conceptual design to synthesis, part design and analysis making use of/employing systematic design process, modeling methods and computational tools to achieve minimum cost, ease of manufacture and assembly.

PO 5: Ability to design, implement and evaluate new approaches to the mechanical system problems, processes, and components to meet desired needs with a multi-disciplinary approach considering public health and safety, cultural, societal, and environmental issues.

PO 6: Engage in life-long learning with an ability to work effectively in teams as well as individually.

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I-SEMESTER

S.No	Course Code	Courses	Cate gory	L	T	P	C
1	MT-MD-1101	**Program Core-1** Integrated course Mechanical Vibrations and Acoustics and Vibration and Acoustics LAB	PC	3 0	0 0	0 3	4.5
2	MT-MD-1102	**Program Core-2** Advanced Mechanics of Solids	PC	3	0	0	3
3	MT-MD- 1103	**Program Elective-1** ➢ Advanced Finite Element Methods ➢ Product Design ➢ Geometric Modeling ➢ Numerical methods for Mechanical Engineering	PE	3	0	0	3
4	MT-MD- 1104	**Program Elective-2** ➢ Design for Manufacturing & Assembly ➢ Multi Body Dynamics ➢ Vision Systems and Image Processing ➢ Introduction to Artificial Intelligence and Machine Learning	PE	3	0	0	3
6	MT-MD-1105	**Research Methodology and IPR**	CC	2	0	0	2
5	MT-MD-1106	**Laboratory -2** Computational Lab	LB	0	0	3	1.5
7	MT-MD-1107	**Audit Course-1 *** English for Research paper writing	AC	2	0	0	0
Total Credits							17

Student has to choose any one audit course listed below.

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II SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MT-MD-1201	**Program Core-3** Integrated course Advanced Mechanisms & Robotics Mechanisms and Robotics Lab	PC	3	0	3	4.5
2	MT-MD-1202	**Program Core-4** Advanced Machine Design	PC	3	0	0	3
3	MT-MD-1203	**Program Elective-3** ➢ Theory of Plasticity ➢ Signal Analysis and Condition Monitoring ➢ Computational Fluid Dynamics ➢ Mechanics of Composite Materials ➢ Smart materials	PE	3	0	0	3
4	MT-MD-1204	**Program Elective-4** ➢ Experimental stress analysis ➢ Fracture Mechanics ➢ Mechatronics ➢ Tribology ➢ Experimental Modal Analysis	PE	3	0	0	3
5	MT-MD-1205	**Laboratory-3** Composite fabrication and Characterization laboratory	LB	0	0	3	1.5
6	MT-MD-1206	**Mini Project with Seminar**	MP	2	0	0	2
7	MT-MD-1207	**Audit Course-2 *** **Design thinking**	AC	2	0	0	0
Total Credits							17

Two months Mandatory Industrial Training/Internship during summer / semester break

Student has to choose any one audit course listed below.

Audit Course 1 & 2:

1. English for Research Paper Writing 2. Disaster Management 3. Sanskrit for Technical Knowledge 4. Value Education 5. Design thinking	

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III-SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MT-MD-2101	**Program Elective-5** ➢ Advanced Optimization Techniques ➢ Vehicle Dynamics ➢ Pressure Vessel Design ➢ Reliability Engineering ➢ Advanced Robotics ➢ MOOCs (NPTEL)-12 Week Course recommended by the department	PE	3	0	0	3
2	MT-MD-2102	**Open Elective** 1. MOOCs (NPTEL/SWAYAM)-Any 12 Week Course on Engineering/ Management/ Mathematics offered by other than parent department 2. Course offered by other departments in the college	OE	3	0	0	3
3	MT-MD-2103	**Internship** *(Performed during summer / I year break)*		-	-	-	2
4	MT-MD-2104	**Dissertation-Part I/ Industrial Project part-I#**	PJ	0	0	20	10
Total Credits							18

**Students going for Industrial Project/Thesis will complete these courses through MOOCs*

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IV SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MT-MD-2201	**Dissertation-Part II/ Industrial Project part II**	PJ	0	0	32	16
Total Credits							16

Open Electives:

1. Industrial Robotics
2. Optimization Techniques
3. Finite Element Analysis

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M.Tech I SEMESTER

COURSE CODE	COURSE NAME	CATEGORY	L-T-P	CREDITS
MT-MD-1101	**MECHANICAL VIBRATIONS AND ACOUSTICS & VIBRATIONS AND ACOUSTICS LAB**	Program Core 1(Integrated Course)	3-0-0 0-0-3	4.5

Pre-requisite:

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.	Understand
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	Evaluate 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.	Understand
CO5	Describe the noise measurement by using transducers and able to assess occupational and environmental noise problems.	Remember

#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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UNIT	CONTENTS	Contact Hours
UNIT – 1	**INTRODUCTION** Relevance of 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.	9
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	10
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 non-linear and random vibrations.	10
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, Source ranking, Weighting network, Dosage.	10
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, sound absorption and insulation,Noise Sources, Noise control strategy.	9
	Total	48

*Note:

TEXT BOOKS:

1. S.S.Rao, “Mechanical Vibrations ", 5th Edition, Prentice Hall, 2011.

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2. M.L.Munjal, “Noise and Vibration Control”, World Scientific, 2013.

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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M.TECH (MACHINE DESIGN)

COURSE CODE	COURSE NAME	CATEGORY	L-T-P	CREDITS
– MT-MD-1106	**VIBRATIONS AND ACOUSTICS LAB**			

Pre-requisite:

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

		Knowledge Level (K)#
CO1	Estimate the damping coefficient of a viscous damper and its effect on the free vibration of a single degree of freedom system.	Understand
CO2	Perform forced vibration analysis of discrete and continuous systems using measurement instruments VFT	Apply
CO3	Demonstrate experimental modal analysis on different of beams and plates with variable boundary condition.	Apply
CO4	Identify the shaft misalignment and rotary unbalance using Machine fault simulator	Remember
CO4	Measure acoustic parameters and outdoor noise	Understand

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

COURSE OBJECTIVES:

1. Determine natural frequency, mode shapes and unbalance (static/dynamic) of mechanical systems.
2.study the signature of common machinery faults such as unbalance & alignment

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LIST OF EXPERIMENTS:

1. Determination of damped natural frequency of vibration 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. Whirling speed of a shaft
5. Diagnosis of Shaft Misalignment and its Effects using MFS
6. Static Balancing Studies of Rotary Systems using MFS
7. Experimental modal analysis of Beams (ME Scope).
8. Experimental modal analysis of plates (ME Scope).
9. Source directivity measurement
10. Sound power and intensity measurement
11. Sound absorption measurement by impedance tube
12. Sound transmission loss measurement by impedance tube
13. Outdoor Noise Measurements and Hemispherical Divergence

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M.TECH (MACHINE DESIGN)

COURSE CODE –	COURSE NAME	CATEGORY	L-T-P	CREDITS
MT-MD-1102	**ADVANCED MECHANICS OF SOLIDS**	**PC**	**3-0-0**	**3**

Pre-requisite:

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

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

#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.	9
UNIT – 2	**Failure criteria:** Modes of failure, Failure criteria, Excessive deflections, Yield initiation, fracture, Progressive fracture, (High Cycle fatigue for	10

	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.	10
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.	10
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.	9
	Total	48

*Note:

TEXT BOOKS:

1.Advanced Mechanics of materials by Boresi& Sidebottom-Wiely International.
2. Theory of elasticity by Timoschenko 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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COURSECODE – MT-MD-1201	COURSE NAME ADVANCED FINITE ELEMENT METHODS	CATEGORY PE	L-T-P 3-0-0	CREDITS 3

Pre-requisite:

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

		Knowledge Level (K)#
CO1	Apply Variational methods and weighted residual methods to solve governing equations of different engineering problems.	Apply
CO2	Derive elements matrices for one-dimensional elements and solve related engineering problems	Apply
CO3	Derive elements matrices for two-dimensional elements and solve related engineering problems	Apply
CO4	Apply the concepts of Isoparametric formulation for different finite elements. Solve free vibration problems and heat transfer problems	Apply
CO5	Explain the procedures to solve the problems involving material non-linearity and geometrical non-linearity.	Understand

#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,	9

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	Essential and natural boundary conditions.	
UNIT – 2	**One-dimensional elements:** Bar, trusses, beams and frames, displacements, stresses and temperature effects.	10
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.	10
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.	10
UNIT – 5	**Introduction to Non-linear finite element Analysis**(Syllabus from Ref. 3) **NonlinearMaterial 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	9
	Total	48

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. Zienckiwicz O.C. Finite Element Method, McGraw-Hill,Third Edition, 1977.
3. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996.

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COURSE CODE	COURSE NAME	CATEGORY	L-T-P	CREDITS
– MT-MD-1103	**PRODUCT DESIGN (PROGRAMME ELECTIVE - I)**	**PE**	**3-0-0**	**3**

Pre-requisite:

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

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

#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	Product Design Process: Design Process Steps, Morphology of Design. Problem Solving and Decision Making: Problem-Solving Process, Creative Problem Solving, Invention, Brainstorming, Morphological Analysis, Behavioral Aspects of Decision Making, Decision Theory, Decision Matrix, Decision Trees. Modeling and Simulation: Triz, Role of Models in Engineering Design,	9

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	MathematicalModeling, Similitude and Scale Models, Computer Simulation, Geometric Modeling 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, 10The impact of manufacturing processes on product decisions, Prototype planning,, Productivity potentials, Management of product quality, Customer service levels.	10
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.	10
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.	10
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	9
	Total	48

*Note:

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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R23 COURSE STRUCTURE & SYLLABUS
M.TECH (MACHINE DESIGN)

COURSE CODE	COURSE NAME	CATEGORY	L-T-P	CREDITS
– MT-MD-1103	**GEOMETRIC MODELING (PROGRAMME ELECTIVE - I)**	**PE**	**3-0-0**	**3**

Pre-requisite:

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

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

#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)

UNIT	CONTENTS	**Contact Hours**
UNIT – 1	**Introduction:** Definition, Explicit and implicit equations, parametric equations.	9
UNIT – 2	**Cubic Splines-1:** Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four point form,	10

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	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.	10
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.	10
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.	9
	Total	48

*Note:

TEXT BOOKS:

1. CAD/CAM by Ibrahim Zeid, Tata McGraw Hill.
2. 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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M.TECH (MACHINE DESIGN)

COURSE CODE – MT-MD- 1103	COURSE NAME NUMERICAL METHODS FOR MECHANICAL ENGINEERING	CATEGORY PE-I	L-T-P 3-0-0	CREDITS 3

Pre-requisite:

Course Objectives:

The objective is to teach students how to apply computational methodologies to solve engineering problems when closed-form and analytical solutions do not exist.

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 and hyperbolic partial differential equations by finite difference method.

Able to perform transformations between time and frequency domains in terms of Fourier transforms, FFT and Laplace transforms.

To implement algorithms and computer-programs for solving complicated problems using numerical methods.

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

		Knowledge Level (K)#
CO1	Solve systems of linear equations and non-linear equations using numerical methods.	Apply
CO2	Develop a function (having error) for fitting data by linear, multiple linear and polynomial regression.	Understand
CO3	Implement the numerical solution techniques for boundary value and characteristic value problems	Understand
CO4	Apply Fourier and Laplace transforms and perform transformations between time and frequency domains.	Apply
CO5	Solve partial differential equations (one dimensional and two dimensional) (Elliptic, parabolic, hyperbolic) by finite difference method	Apply

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#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	**Introduction to 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.	9
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.	10
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).	10
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.	10

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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	9
	Total	48

*Note:

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale "Numerical Methods for Engineers" Tata Mc-Graw Hill
2.Curtis F.Gerald, Partick.O.Wheatly,"Applied numerical analysis"Addison-Wesley,1989
3.Douglas J.Faires,RichedBurden"Numerical methods", Brooks/Cole publishing 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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M.TECH (MACHINE DESIGN)

COURSE CODE –	COURSE NAME	CATEGORY	L-T-P	CREDITS
MT-MD- 1104	**DESIGN FOR MANUFACTURING & ASSEMBLY**	**PE-2**	**3-0-0**	**3**

Pre-requisite:

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

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

#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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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. 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.	9
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.	10
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 guidelines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.	10
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.	10
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.	9
	Total	48

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TEXT BOOKS:

1. Product Design for Manufacture and Assembly, Geoffrey Boothroyd , Peter Dewhurst, Winston A. Knight, CRC Press, Third Edition,2010.

2. Design for Manufacturability Handbook, James G. Bralla, The McGraw-Hill Companies, Inc. 2nd edition, 1999.

REFERENCE:

1. ASM Hand book, ASM International, 1997.
2. A Text Book of PRODUCTION TECHNOLOGY (Manufacturing Processes), P. C. Sharma, S. Chand Publishing, 2007

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COURSE CODE –	COURSE NAME	CATEGORY	L-T-P	CREDITS
MT-MD- 1104	**MULTI-BODY DYNAMICS**	**PE-2**	**3-0-0**	**3**

Pre-requisite:

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

		Knowledge Level (K)#
CO1	Define the position of a point mass and rigid body and determine their velocity and acceleration. Derive equations of motion for a rigid body.	Remember
CO2	Derive equations of motion for planar multi body systems using point coordinates, body coordinates, and joint coordinates formulations	Understand
CO3	Find the solutions to planar multi-body systems for various formulations using numerical methods	Apply
CO4	Apply procedures of forward dynamic analysis to McPherson strut suspension, Double A-arm suspension, planar robot manipulator	Apply
CO5	Derive the kinematic constraints of spatial joints such as revolute, prismatic, spherical, and cylindrical joints.	Understand

#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	Review of kinematics and dynamics of point mass and rigid body - types of constraints - constraints for revolute joints, translational joints, composite joints	9
UNIT – 2	Formulation of planar multi-body systems, kinematics and dynamics in point coordinates, body coordinates, and joint coordinates	10
UNIT – 3	Numerical methods for solution - analysis of planar multi-body systems, kinematic analysis in various formulations.	10
UNIT – 4	Inverse dynamic analysis, forward dynamic analysis, constraint stabilization - case studies, McPherson strut suspension, Double A-arm suspension, planar robot manipulator	10
UNIT – 5	Spatial multi-body systems-formulation- joints: - revolute, prismatic, cylindrical, spherical, universal-case studies.	9
	Total	48

*Note:

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

REFERENCES:

1. Computational dynamics, Shabana A. A., John Wiley & Sons
2. Dynamics and balancing of multi-body systems, Chaudhary H., and S K Saha. Springer.

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M.TECH (MACHINE DESIGN)

COURSE CODE	COURSE NAME	CATEGORY	L-T-P	CREDITS
– MT-MD-1104	**VISION SYSTEMS AND IMAGE PROCESSING**	**PE-2**	**3-0-0**	**3**

Pre-requisite:

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

		Knowledge Level (K)#
CO1	Describe different vision sensors and image acquisition procedures.	Remember
CO2	Describe the techniques involved in image representation.	Remember
CO3	Analyze images in the frequency domain using various transforms.	Analyze
CO4	Explain the techniques for image enhancement and image restoration.	Understand
CO5	Elucidate the mathematical modeling of image restoration and compression	Understand

#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	**Machine vision:** Vision sensors - Comparison with other types of sensors - Image acquisition and recognition - Recognition of 3D objects - Lighting techniques - Machine vision applications.	9
UNIT –	**Image representation:** Application of image processing - Image	10

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2	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	10
UNIT – 4	**Image enhancement**: Filtering, Restoration, Histogram equalisation, Segmentation, Region growing.	10
UNIT – 5	**Image compression:** Edge detection - Thresholding - Spatial smoothing - Boundary and Region representation - Shape features - Scene matching and detection - Image classification. .	9
	Total	48

*Note:

TEXTBOOKS:

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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M.TECH (MACHINE DESIGN)

COURSE CODE –	COURSE NAME	CATEGORY	L-T-P	CREDITS
MT-MD-1203	**Introduction to Artificial Intelligence and Machine Learning**	**PE-2**	**3-0-0**	**3**

Pre-requisite:

Course Objectives: The students will learn

1. To comprehend the classical and symbolic approach to Artificial Intelligence
2. To understand the principles of the main paradigms for learning from data and their Applications.
3. The explore Machine Learning techniques for building new adaptive systems
4.To learn and analyze predictive models for intelligent data analysis.

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

		Knowledge Level (K)#
CO1	Interpret the meaning, purpose, and applications of AI	Apply
CO2	Differentiate supervised and unsupervised learning models and techniques	Understand
CO3	Apply knowledge about application of machine learning techniques to real world problems.	Apply
CO4	Assess different machine learning algorithms based on performance evaluation measures.	Evaluate
CO5	Analyze the importance of AI and ML in industry.	Analyze

#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	**Introduction:** Definition of Artificial Intelligence, Evolution, Need, and applications in real world. Intelligent Agents, Agents and environments; Good Behavior-The concept of rationality, the nature of environments, the structure of agents. **Neural Networks and Genetic Algorithms:** Neural network representation, problems,perceptron, multilayer networks and back propagation algorithms, Genetic algorithms, hypothesis space search	9
UNIT – 2	**Knowledge–Representation and Reasoning:** Logical Agents: Knowledge based agents, the Wumpus world, logic. Patterns in Propositional Logic, Inference in First-Order Logic-Propositional vs first order inference, unification and lifting.	10
UNIT – 3	**Bayesian and Computational Learning:** Bayes theorem, concept learning, maximum likelihood, minimum description length principle, Gibbs Algorithm, Naïve Bayes Classifier, Instance BasedLearning- K-Nearest neighbor learning **Introduction to Machine Learning (ML):** Definition, Evolution, Need, applications of ML in industry and real world, classification; differences between supervised and unsupervised learning paradigms.	10
UNIT – 4	**Basic Methods in Supervised Learning:** Distance-based methods, Nearest-Neighbors, Decision, Trees, Support Vector Machines, Nonlinearity and Kernel Methods. **Unsupervised Learning: Clustering:** K-means, Dimensionality Reduction: PCA and kernel PCA, Generative Models (Gaussian Mixture Models and Hidden Markov Models)	10
UNIT – 5	**Machine Learning Algorithm Analytics:** Evaluating Machine Learning algorithms, Model, Selection, Ensemble Methods (Boosting, Bagging, Random Forests). **Modeling Sequence/Time-Series Data and Deep Learning:** Deep generative models, Deep Boltzmann Machines, Deep auto-encoders, Applications of Deep Networks.	9
	Total	48

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. 2. 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.
3. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, 1/e, Springer, 2001.
4. Bishop, C.M., Pattern Recognition and Machine Learning, Springer, 2006.
5. M NarasimhaMurty, Introduction to Pattern Recognition and Machine Learning, World Scientific Publishing Company, 2015

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COURSE CODE –	COURSE NAME	CATEGORY	L-T-P	CREDITS
MT-MD-1105	**RESEARCH METHODOLOGY AND IPR**	**CC**	**2-0-0**	**2**

Pre-requisite:

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

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

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UNIT	CONTENTS	**Contact Hours**
UNIT – 1	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	9
UNIT – 2	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	10
UNIT – 3	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.	10
UNIT – 4	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	10
UNIT – 5	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	9
	Total	48

*Note:

REFERENCES:

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. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.

5. Mayall, "Industrial Design", McGraw Hill, 1992.

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M.TECH (MACHINE DESIGN)

COURSE CODE –	COURSE NAME	CATEGORY	L-T-P	CREDITS
MT-MD-1107	COMPUTATIONAL MATHEMATICS LAB	LB	0-0-3	1.5

Pre-requisite

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

		Knowledge Level (K)#
CO1	Write programmes to solve system of linear equations.	Apply
CO2	Write various codes to solve differential and partial differential equations.	Apply
CO3	Write python program to apply Neural Networks for regression and classification	Apply
CO4	Write MATLAB / Python programs to solve engineering problems using FEM	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: 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

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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: 2AI/ML

1. Build Neural Network for regression using Python
2. Build Neural Network for classification using Python

Part: 3 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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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
R23 COURSE STRUCTURE & SYLLABUS
M.TECH (MACHINE DESIGN)

COURSE CODE – MT-MD-1108	COURSE NAME ENGLISH FOR RESEARCH PAPER WRITING	CATEGORY AC	L-T-P 2-0-0	CREDITS 0

Pre-requisite:

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

		Knowledge Level (K)#
CO1	Understand basic structure and effectiveness of written English.	Understand
CO2	Precisely and carefully present his findings in an organized manner.	Understand
CO3	Identify the scope of his work plan to design the methods and present his results. He should also manually go through the write up to avoid the errors that creep in by the spell checker.	Understand
CO4	Demonstrate the necessary skills of writing from title to literature review making use of appropriate phrases in use.	Apply
CO5	Demonstrate the necessary skills of writing methods, results, discussion and conclusion	Apply

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

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

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

Dr.N.Mohan Rao Dr.V.V.Subba Rao Dr.K.MeeraSaheb

Dr.K.Mallikarjuna Rao Dr.M.Venkatesham Dr.K.Ramji

Dr.V.Suresh Babu Dr.PSV Ganesh Kumar Dr.J.Suresh Kumar

UNIT	CONTENTS	**Contact Hours**
UNIT – 1	Planning and Preparation, Word Order, Breaking up long sentences. Structuring Paragraphs and Sentences, being concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	9
UNIT – 2	Clarifying Who Did What, highlighting your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	10
UNIT – 3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	10
UNIT – 4	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, useful phrases, how to ensure paper is as good as it could possibly be the first-time submission.	10
UNIT – 5	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions.	9
	Total	48

Assignment: Report writing on a scientific topic and presentation

REFERNCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM Highman's book.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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