Curriculum M.Tech. 2021

Mechanical Engineering
With Specialization in
Mechanical Systems Design
(From The Academic Year 2021)
Approved by Senate- 44

Indian Institute of Information Technology, Design and Manufacturing, Kancheepuram
Chennai-600 127

Curriculum & Syllabus

Semester 1							
S.No	Course Code	Course Name	Category	L	T	P	C
1	ME5000	Advanced Numerical Methods	PCC	3	1	0	4
2	ME5001	Advanced Mechanics of Materials	PCC	3	1	0	4
3	ME5002	Design for Manufacture and Assembly	DSC	3	1	0	4
4		Elective 1	ELC	3	1	0	4
5		Elective 2	ELC	3	1	0	4
6	ME5003	Advanced Numerical Methods Practice	PCC	0	0	3	1.5
7	ME5004	Advanced Mechanics of Materials Practice	PCC	0	0	3	1.5
							23.0

Semester 2							
S.No	Course Code	Course Name	Category	L	T	P	C
1	ME5005	Design with Advanced Engineering Materials	PCC	3	1	0	4
2	ME5006	Analysis and Synthesis of Robot Mechanisms	PCC	3	1	0	4
3		Elective 3	ELC	3	1	0	4
4		Elective 4	ELC	3	1	0	4
5		Elective 5	ELC	3	1	0	4
6	ME5007	Analysis and Synthesis of Robot Mechanisms Practice	PCC	0	0	3	1.5
7	ME5008	Advanced Engineering Simulation Practice	PCC	0	0	3	1.5
							23.0

Semester 3							
S.No	Course Code	Course Name	Category	L	T	P	C
1	PCD	Project I (Summer Project)	PCD	0	0	20	10
2	PCD	Project II	PCD	0	0	32	16
							26.0

Semester 4							
S.No	Course Code	Course Name	Category	L	T	P	C
1	PCD	Project III	PCD	0	0	32	16
							16.0

Semester wise Credit Distribution

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Category	Semester wise Credit						
	S1	S2	Summer	S3	S4	Total	%
Professional Core Course (PCC)	11	11	0	0	0	22	25.0
Design Course (DSC)	4	0	0	0	0	4	4.5
Elective Course (ELC)	8	12	0	0	0	20	22.7
Professional Career Development (PCD)	0	0	10	16	16	42	47.7
Total	23.0	23.0	10.0	16.0	16.0	88.0	100.0

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<table>
<tr><td>Course Name</td><td>Advanced Numerical Methods</td><td>Course Code</td><td colspan="4">ME5000</td></tr>
<tr><td rowspan="2">Offered by Department</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>To be offered for</td><td>M. Tech</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>Mathematics for Engineers</td><td>Approved In</td><td colspan="4">Senate-44</td></tr>
<tr><td>Learning Objectives</td><td colspan="5">This course provides
• an introduction to the concepts of Linear Algebra
• techniques to solve various kinds of equations that students encounter in the fieldof engineering.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">At the completion of the course, the student will be able
• to understand the methods by which physical problems can be solved using computation.
• to use computation in theoretical analysis and experimental data interpretation.</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial)</td><td colspan="5">• Introduction to Linear Algebra: Vector space and subspaces, Tensors, Linear Transformation, system of Linear equation and Matrices, Applications in Engineering (6L +2T)
• Solution of Linear Algebraic equations: Gauss elimination, Gauss-Jordon, LU Decomposition, QR Method, Jacobi and Gauss-Seidel Methods; Eigenvalues and Eigenvectors – Power and inverse power method, physical interpretation of eigenvalues and eigenvectors, Regression based on Least Squares and Principal Component Analysis (8 L+ 3T)
• Solution of Nonlinear Algebraic equations: Bisection method, fixed-point iteration method, Newton-Raphson, Secant method (6 L+ 2T)
• Finite difference formula using Taylor series, Differentiation of Lagrange polynomials, Simpson's rule, Gauss-quadrature rule, Romberg method, multiple integrals (6 L+ 2T)
• Solution for ODE – Euler's method and Stability criterion, second order and fourth order Runge-Kutta methods, system of ODEs and nonlinear ODEs (6 L+ 2T)
• Solution for PDE – Classification of PDEs, Elliptic equations, Parabolic equations (Transient diffusion equation), Hyperbolic equations (wave equation) (5 L+ 2T)
• Numerical Optimization-Line Search method, Steepest Descent method, Conjugate Gradient method, Penalty and Augmented Lagrangian method, Introduction to ANNand GA (5 L+ 1T)</td></tr>
<tr><td>Essential Reading</td><td colspan="5">1. S. P. Venkateshan, Prasanna Swaminathan, Computational Methods in Engineering, Ane Books, 1st edition, 2013, ISBN-13: 978-0-12-416702-5.
2. Steven C. Chapra, Numerical Methods for Engineering, Mc-Graw Hill Education,7the edition, 2015, ISBN-13: 978-0073397924.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="5">1. Gilbert Strang, Introduction to Linear Algebra, Wellsley-Cambridge 2009.
2. Joe D Hoffman, Steven Frankel, Numerical Methods for Engineers and Scientists, Second Edition, CRC Press, 2001, ISBN-13: 978-0824704438.
3. Jain, M.K., Iyengar, S.R., and Jain,R.K., `Numerical Methods for Scientific and Engineering Computation', New Age International Pvt. Ltd., 2019, ISBN-13: 978-9387477254..
4. E Kreszig, Advanced Engineering Mathematics, John Wiley, 10th edition, 2015,
5. ISBN-13: 978-8126554232.</td></tr>
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<table>
<tr><td>Course Name</td><td>Advanced Numerical Methods Practice</td><td>Course Code</td><td colspan="4">ME5003</td></tr>
<tr><td>Offered by Department</td><td>Mechanical Engineering</td><td>Structure(LT PC)</td><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td>To be offered for</td><td>M.Tech</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>Programming using C or C++</td><td>Approved In</td><td colspan="4">Senate-44</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course provides an introduction to the numerical methods to solve various kinds ofequations relevant to engineering field that students encounter using programming tools like C and C++.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the completion of the course, the student will be able to
• understand the importance of obtaining approximate solutions to various practicalproblems
• solve the application-oriented problems using C codes or C++ codes</td></tr>
<tr><td>Course Contents (with approximate breakup ofhours for lecture/ tutorial)</td><td colspan="6">• Exercise on Solution for Linear Algebraic equations: Gauss-Jordon, LU Decomposition, Jacobi and Gauss-Seidel Methods; Eigenvalues and Eigenvectors (9)
• Exercise on Solution of Nonlinear Algebraic equations: Bisection method, fixed-point iteration method, Newton-Raphson, Secant method (6)
• Exercise on Finite difference formulation (6)
• Exercise on Solution for ODE – Euler, second order and fourth order Runge-Kutta methods, system of ODEs and nonlinear ODEs (6)
• Exercise on Solution for PDE – Elliptic equations, Parabolic equations, Hyperbolic equations (6)
• Exercise on Numerical Optimization – Line Search method, Steepest Descentmethod, Conjugate Gradient method, Introduction to ANN and GA (6)
• Practical engineering problems in structural and thermal systems (3)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. S. P. Venkateshan, Prasanna Swaminathan, Computational Methods in Engineering, Ane Books, 1st edition, 2013, ISBN-13: 978-0-12-416702-5.
2. Steven C. Chapra, Numerical Methods for Engineering, Mc-Graw Hill Education,7the edition, 2015, ISBN-13: 978-0073397924.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. Joe D Hoffman, Steven Frankel, Numerical Methods for Engineers and Scientists, Second Edition, CRC Press, 2001, ISBN-13: 978-0824704438.
2. Jain, M.K., Iyengar, S.R., and Jain,R.K., Numerical Methods for Scientific and Engineering Computation, New Age International Pvt. Ltd., 2019, ISBN-13: 978-9387477254.
3. Jorge Nocedal, Stephen J. Wright, Numerical Optimization, Second Edition,Springer, 2006, ISBN-10: 0-387-30303-0, ISBN-13: 978-0387-30303-1.
4. E Kreszig, Advanced Engineering Mathematics, John Wiley, 10th edition, 2015, ISBN-13: 978-8126554232.</td></tr>
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Course Name	Advanced Mechanics of Materials	Course Code	ME5004			
Offered by Department	Mechanical Engineering	Structure(LTPC)	3	1	0	4
To be offered for	M.Tech	Course Type	Core			
Prerequisite	Strength of Materials and Engg Mechanics	Approved In	Senate-44			
Learning Objectives	This course is intended to give necessary • understanding of behavior of solid materials in terms of their motion and deformation under the action of static forces. • analytical and numerical methods to analyze the behavior of various structuralmembers.					
Learning Outcomes	At the completion of the course, the student will be able to • Formulate the behavior of various mechanical structures • Perform stress analysis of various products of different shapes made with all kindsof linear elastic materials.					
Course Contents (with approximate breakup ofhours for lecture/ tutorial/practice)	• Theories of stress and strain – Principal stresses and strains, equations of equilibrium, strain displacement relations, compatibility conditions, and constitutive relations. ***(L 9 + T 2)*** • Energy methods – elastic strain energy, Theorems of Castigliano, virtual work and stationary potential energy, Applications. ***(L 6 + T 2)*** • Euler-Bernoulli beam bending of asymmetrical sections – bending stresses and deflection. ***(L 3 + T 1)*** • Formulation, Analytical and Finite Difference and Finite element solutions – Beams on elastic foundation, Torsion of prismatic members. ***(L 6 + T 3)*** • Formulation and analytical methods of solution of 2D linear elasticity problems – Airy's stress function approach for plane stress and plane strain, displacement function approach for axisymmetrically loaded members, temperature effects. ***(L 12 + T 4)*** • Formulation and analytical methods of solution of Plates and shells –Governing equations, Solutions for simple boundary conditions. ***(L 6 + T 2)***					
Essential Reading	1. L. S. Srinath, Advanced Mechanics of Solids, Tata McGraw-Hill, 1st edition, 2009, ISBN: 9780070139886. 2. A. C. Ugural and S. K. Fenster, Advanced Strength and Applied Elasticity, PrenticeHall, 5th edition, 2013, ISBN-13: 978-0-13-707920-9.					
Supplementary Reading	1. S. P. Timoshenko and J. N. Goodier, Theory of Elasticity, Tata McGraw-Hill, 3rd edition, 2013, ISBN-13: 978-0-07-070122-9. 2. A. P. Boresi and R. J. Schmidt, Advanced Mechanics of Materials, John Wiley &Sons, Inc., 6th edition, 2003, ISBN 978-0-471-43881-6. 3. R. G. Budynas, Advanced strength and Applied Stress Analysis, McGraw-Hill, 2ndedition, 1999, ISBN: 9780070089853.					

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Course Name	Advanced Mechanics of Materials Practice	Course Code	ME5004			
Offered by Department	Mechanical Engineering	Structure(LTP C)	0	0	3	1.5
To be offered for	M.Tech.	Course Type	Core			
Prerequisite	Strength of Materials and Engg Mechanics	Approved In	Senate-44			
Learning Objectives	This course is intended to give necessary • Numerical formulation to predict stresses, and in-turn life of structures • Simulation of complex shaped components to predict stresses.					
Learning Outcomes	At the completion of the course, the student will be able to • Formulate the behavior of various structural elements and • Predict the life of various products of different shapes made with a wide variety ofmaterials.					
Course Contents (with approximate breakup ofhours for lecture/ tutorial/practice)	• Finite difference solutions for torsion of prismatic bars, beams with varying forces and cross section along the span, beams on elastic foundation. ***(P 9)*** • Finite element solutions for axially and transversely loaded members, thin plates or discs with in-plane and lateral forces, long noncircular pipes and dams, solidflywheel, long (infinite) cylinders and brackets ***(P 21)*** • Basic dynamic problems ***(P 6)***					
Essential Reading	1. A. C. Ugural and S. K. Fenster, Advanced Strength and Applied Elasticity, Prentice Hall, 5th edition, 2013, ISBN-13: 978-0-13-707920-9. 2. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements inEngineering, Pearson, 4th edition, 2011, ISBN: 978-0132162746.					
Supplementary Reading	1. L. S. Srinath, Advanced Mechanics of Solids, Tata McGraw-Hill, 1st edition, 2009, ISBN: 9780070139886. 2. A. P. Boresi and R. J. Schmidt, Advanced Mechanics of Materials, John Wiley &Sons, Inc., 6th edition, 2003, ISBN 978-0-471-43881-6. 3. R. G. Budynas, Advanced strength and Applied Stress Analysis, McGraw-Hill, 2ndedition, 1999, ISBN: 9780070089853.					

Curriculum & Syllabus

Course Name	Design for Manufacture and Assembly	Course Code	ME5002			
Offered by Department	Mechanical Engineering	Structure(LTPC)	3	1	0	4
To be offered for	M.Tech.	Course Type	Core			
Prerequisite	Basic Materials & Manufacturing Engineering Courses	Approved In	Senate-44			
Learning Objectives	• To provide understanding of interrelationships between design and manufacturing • To explore implications of early selection of materials, shapes and manufacturingprocesses in a product development • To impart knowledge on assembly considerations and assembly cost evaluations					
Learning Outcomes	After the completion of the course, students will be able: • To understand the importance of considering assembly and manufacturing choicesin the early stages of product design • To quantitatively estimate the assembly and manufacturing cost of a product. • To select an appropriate assembly sequence, material and processing method toreduce the manufacturing complexity and cost of a product					
Course Contents (with approximate breakup ofhours for lecture/ tutorial/practice)	• Engineering Design: Linear types, Descriptive and prescriptive models, problem statement – objectives, constraints and specifications, Concept generation and evaluation, Embodiment and detailed design, Applications. ***(L 6 + T 2)*** • Selection of Materials: Connection between engineering design and selection of materials, Material performance requirements, Initial screening, Comparing and ranking alternatives, optimal material selection based on shape, size and manufacturing process, Case studies. ***(L 8 + T 3)*** • Process Selection: Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Design for Additive Manufacturing, Case-Studies. ***(L 15 + T 5)*** • Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies. ***(L 5 + T 1)*** • Design for manual assembly, Design for PCB Manufacturing and assembly, Electrical Connections and Wire harness assembly, Design for Automated and Robotic Assembly, Case studies. ***(L 8 + T 3)***					
Essential Reading	1. M. F. Ashby, Materials Selection in Mechanical Design, 5th edition, Elsevier, 2011.ISBN: 9780081005996. 2. M. M. Farag, Materials and Process Selection for Engineering Design, 3rd edition,CRC Press, 2014, ISBN-13: 978-0367438340. 3. P. Dewhurst, W. Knight, G. Boothroyd, Product Design for Manufacture and Assembly, 3rd edition, CRC Press, 2010, ISBN: 9781420089271. 4. L. C. Schmidt, G. Dieter, Engineering Design, 4th edition, McGraw Hill EducationIndia Private Limited, 2013. ISBN: 978-1259064852					
Supplementary Reading	1. M. F. Ashby, K. Johnson, Materials and Design: The Art and Science of Material Selection in Product Design, 3rd edition, Butterworth-Heinemann Ltd, 2014. ISBN:978- 0080982052. 2. M. F. Ashby, Materials and the Environment: Eco-informed Material Choice, 2 ndedition, Butterworth-Heinemann, 2012. 3. G. Boothroyd, Assembly Automation and Product Design, 2nd edition, CRC Press2005. 4. J. G. Bralla, Design for Manufacturability Handbook, 2nd edition, McGraw-HillProfessional, 1998. ISBN: 978-0070071391.					

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<tr><td>Course Name</td><td>Design with Advanced Engineering Materials</td><td>Course Code</td><td colspan="4">ME5005</td></tr>
<tr><td>Offered by Department</td><td>Mechanical Engineering</td><td>Structure(LTPC)</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>To be offered for</td><td>M.Tech</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>Basic Materials Engineering Course</td><td>Approved In</td><td colspan="4">Senate-44</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">This course is proposed to offer
• the connection between engineering design and materials
• an understanding of rate dependent and independent mechanical behavior of various advanced materials
• the constitutive (phenomenological) models and simplified design methods for various advanced materials that are required for design engineers.
• the process of designing advanced/new materials for various products /components</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">After the completion of the course, students will be able:
• to correlate the methodologies of engineering design and selection of materials andselect right kind of material and process
• to use necessary mathematical (constitutive) models and simplified engineering design methodologies in engineering product / component design</td></tr>
<tr><td>Course Contents (with approximate breakup of hours for lecture/ tutorial/practice)</td><td colspan="6">• Engineering design process and role of materials: Connection between engineering design and selection of materials, Time independent and dependent mechanical behavior of materials, Classification of advanced engineering materials based on their properties and applications, Computer aided material and process selection, Applications. (L 15 + T 5)
• Design with rate dependent materials: Deformation mechanisms, Phenomenological models considering viscous effects, Design with polymers, Fatigue and fracture of polymers, Case studies. (L 9 + T 3)
• Design with anisotropic materials: Types of anisotropic materials, Constitutiveequations for anisotropic materials and composites, Design with composite materials, Fatigue and fracture of composites, Case studies. (L 12 + T 4)
• Design with high temperature materials: Classification and characteristics of superalloys, Creep and fatigue resistance of super alloys, Design considerations for advanced ceramics, fracture reliability, Case studies. (L 6 + T 2)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. M. F. Ashby, Materials Selection in Mechanical Design, Butterworth Heinemann, 2016, ISBN: 978-0081005996.
2. R. J Crawford, Plastics Engineering, 3rd edition, Butterworth-Heinmann, 2006, ISBN: 978-81-312-0174-9.
3. J. C. Gerdeen and R. A. L. Rorrer, Engineering Design with Polymers and Composites, CRC Press, 2nd edition, 2012, ISBN-13: 978-1-4398-6053-3.</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. G. E. Dieter, Engineering Design: Materials and Processing Approach, McGraw-Hill,1999 ISBN-13: 978-0070168961
2. M. M. Farag, Materials and Process Selection for Engineering Design, 3rd edition, CRC Press, 2014, ISBN-13: 978-0367438340
3. R. C. Reed, The Superalloys: Fundamentals and Applications, 1st edition, Cambridge University Press, 2006, ISBN: 9780511541285.
4. D. W. Richerson and W. E. Lee, Modern Ceramic Engineering: Properties, Processing and Use in Design, 4th edition, CRC Press, 2018, ISBN:9780429488245.</td></tr>
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<tr><td>Course Name</td><td>Analysis and Synthesis of Robot Mechanisms</td><td>Course Code</td><td colspan="4">ME5006</td></tr>
<tr><td>Offered by Department</td><td>Mechanical Engineering</td><td>Structure(LTPC)</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>To be offered for</td><td>M.Tech.</td><td>Course Type</td><td colspan="4">Core</td></tr>
<tr><td>Prerequisite</td><td>Kinematics and Dynamics</td><td>Approved In</td><td colspan="4">Senate-44</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To impart advanced knowledge in analysis and synthesis of robot mechanisms</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course student will able to:
• Ability to design and analyze planar and spatial mechanisms
• Ability to synthesize various mechanisms
• Ability to design and analyze mechanisms for robotic applications</td></tr>
<tr><td>Course Contents</td><td colspan="6">• Review of Kinematics of Planar Mechanisms: Kinematic pairs, chains and mechanisms, kinematic inversions; Velocity and acceleration of planar mechanisms-graphical and analytical methods; Loop closure equation; Four-bar mechanisms, Grashof criterion. (6 L + 1 T)
• Graphical Synthesis of Planar Mechanisms: Type and number synthesis; Motion, path and function generation, Chebyshev's accuracy points; Two-three- four position synthesis with and without prescribed timing; Synthesis of dwell and Geneva mechanisms. (8 L + 2 T)
• Analytical Synthesis of Planar Mechanisms: Complex algebra representation; Standard form equation; Two and three position analytical synthesis for motion, path and function generation; Introduction to commercially available software for mechanism synthesis. (8 L + 2 T)
• Kinematics and Dynamics of Serial Mechanisms: Robot kinematics-forward/inverse; Denavit- Hartenberg matrix transformation; Differential motion and Jacobian; Dynamics and position control; Path planning; Applications. (12 L+ 3 T)
• Spatial Linkages and Parallel Mechanisms: Rigid body and spatial transformations; Displacement, velocity and acceleration analyses of spatial linkages; Introduction to kinematic analysis of parallelmechanisms. (8 L + 2 T)
• Compliant Robot Mechanisms: Flexibility and deflection; large deflection analysis; Applications. (3 L+ 1 T)</td></tr>
<tr><td>Essential Reading</td><td colspan="6">1. J. J. Uicker, G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, OxfordUniversity Press, 4th edition, 2014, ISBN: 9780199454167
2. R. L. Norton, Design of Machinery-An Introduction to the Synthesis and Analysis ofMechanisms and Machines, McGraw Hill, 6th edition, 2020, ISBN: 9780077421717
3. Craig J.J., "Introduction to Robotics: Mechanics and Control, Prentice Hall, 4 th Edn, 2018, ISBN: 9780133489798</td></tr>
<tr><td>Supplementary Reading</td><td colspan="6">1. A. G. Erdman and G. N. Sandor, Mechanism Design: Analysis and Synthesis: Vol. 1, Pearson,4th edition, 2004, ISBN: 9780130408723.
2. A. G. Erdman and G. N. Sandor, Mechanism Design: Analysis and Synthesis: Vol. 2, Pearson,2005, 4th edition, ISBN: 9780130114372.
3. K. Russell, Q. Shen and R. S. Sodhi, Mechanism Design: Visual and Programmable Approaches,CRC Press, 1st edition, 2014, ISBN: 9781466570177.
4. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics: Control, Sensing, Vision, Intelligence,McGraw-Hill Education, 1st edition, 2008, ISBN:9780070265103</td></tr>
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Course Name	Analysis and Synthesis of Robot Mechanisms Practice	Course Code	ME5007			
Offered by Department	Mechanical Engineering	Structure(LTPC)	0	0	3	1.5
To be offered for	M.Tech.	Course Type	Core			
Prerequisite	Kinematics and Dynamics	Approved In	Senate-44			
Learning Objectives	• To impart advanced knowledge in analysis and synthesis of robot mechanisms					
Learning Outcomes	At the end of the course student will able to: • Ability to design and analyze planar and spatial mechanisms • Ability to synthesize various mechanisms • Ability to design and analyze mechanisms for robotic applications					
Course Contents	• Design, kinematic analysis and synthesis of linkages and mechanisms for various applications using free and paid software such as MechAnalyzer, Linkage 3.0, GIM Mechanism, AR-CAD, CATIA, ADAMS, Autodesk Inventor, Matlab RoboticsTool Box. • Construction of various robot mechanisms using robot kits. • Programming and validation of kinematics and dynamics of robot manipulators.					
Essential Reading	1. J. J. Uicker, G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, OxfordUniversity Press, 4th edition, 2014, ISBN: 9780199454167 2. R. L. Norton, Design of Machinery-An Introduction to the Synthesis and Analysis ofMechanisms and Machines, McGraw Hill, 6th edition, 2020, ISBN: 9780077421717 3. Craig J.J., "Introduction to Robotics: Mechanics and Control, Prentice Hall, 4 th Edn, 2018, ISBN:9780133489798					
Supplementary Reading	7. A. G. Erdman and G. N. Sandor, Mechanism Design: Analysis and Synthesis: Vol. 1, Pearson,4th edition, 2004, ISBN: 9780130408723. 8. A. G. Erdman and G. N. Sandor, Mechanism Design: Analysis and Synthesis: Vol. 2, Pearson,2005, 4th edition, ISBN: 9780130114372. 9. K. Russell, Q. Shen and R. S. Sodhi, Mechanism Design: Visual and Programmable Approaches,CRC Press, 1st edition, 2014, ISBN: 9781466570177. 10. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics: Control, Sensing, Vision, Intelligence,McGraw-Hill Education, 1st edition, 2008, ISBN: 9780070265103 11. L. W. Tsai, Robot Analysis: The Mechanics of Serial and Parallel Manipulators, Wiley, 1stedition, 2005, ISBN: 9780471325932 12. L. L. Howell, Compliant Mechanisms, John Wiley & Sons, 1st edition, 2002, ISBN:9780471384786.					

Curriculum & Syllabus

Course Name	Advanced Engineering Simulation Practice	Course Code	ME5008			
Offered by Department	Mechanical Engineering	Structure(LTP C)	0	0	3	1.5
To be offered for	M.Tech.	Course Type	Core			
Prerequisite	Kinematics and Dynamics	Approved In	Senate-44			
Learning Objectives	To provide hands-on experience in simulation and analysis of mechanical systemsusing sophisticated tools.					
Learning Outcomes	Students will acquire knowledge necessary for product design using computer aidedengineering tools.					
Course Contents	• Application of Finite element method using CAE software. ***(P 3)*** • Static and transient structural analysis procedure and application to complexphysical components ***(P 9)*** • Steady state and transient thermal analysis of mechanical structuralsystems ***(P 9)*** • Analysis procedure and application of contact elements, nonlinear materialmodels and rigid body dynamics. ***(P 9)*** • Coupled field finite element analysis of mechanical structural systems. ***(P 6)***					
Essential Reading	1. User manuals of software packages.					
Supplementary Reading	1. S. Moaveni, Finite Element Analysis: Theory and Application withANSYS,Pearson 2013, ISBN-13: 978-0133840803					