Program Outcomes: M.Tech. Automotive Engineering

PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document and function as a member of a multidisciplinary team with a sense of ethics, integrity and social responsibility.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO4	Students will be able to apply their knowledge of mathematics, science and automotive technology to the solution of complex problems in automotive engineering.
PO5	Students will be able to design the complex automotive system, components, processes that meet the specified needs, with appropriate consideration for public health and safety along with social, cultural and environmental considerations.
PO6	Students will be able to create, select and apply appropriate techniques,resources and modern engineering and IT tools including prediction and modeling to complex automotive engineering activities with understanding of the limitations.

Program Outcomes: M.Tech Design Engineering

PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document and function as a member of a multidisciplinary team with a sense of ethics, integrity and social responsibility.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO4	Students will be able to apply analytical and computational methods and optimization techniques by using software tools to develop new or modify existing products.
PO5	Students will demonstrate creative abilities to design, develop, analyze mechanical systems by using principles of continuum mechanics, vibrations, reliability, maintainability, rapid prototyping & reverse engineering methods and feasibility of manufacturing processes.
PO6	Students will be able to comprehend different aspects of design such as tribology, modern composite materials, fracture mechanics required in various fields such as Aerospace, Automotive and Manufacturing to control the damage for enhancement of reliability as well as life of products.

Program Outcomes: M.Tech Thermal Engg. And Energy System

PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document and function as a member of a multidisciplinary team with a sense of ethics, integrity and social responsibility.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO4	Graduate will acquire knowledge about current issues/advances in thermal Engg. and Energy systems.
PO5	Able to utilize non-conventional energy resources for the development of ecofriendly thermal systems.
PO6	Students will demonstrate skills to use modern engineering tools, software and equipment to analyze and solve complex engineering problems.

Mapping of Course Outcomes with Program Outcomes for M.Tech (Automotive)

	Course Code	Course Name		PO1	PO2	PO3	PO4	PO5	PO6
Semester I									
Sem I	MAT-19001	Computational Methods in Engineering	CO1 -Understand the mathematical models and methodologies to solve those models			2			
			CO2 -Analyze and develop the mathematical model of an engineering system.			2	2		
			CO3 -Solve differential equations using numerical techniques.			3	3		
	MAT-19002	Automotive Engineering Systems	CO1 -Identify the need of transmission system, it's function, and discuss different types of Passenger car transmission systems.			2	3		3
			CO2 -Calculate vehicle resistance, predict vehicle power requirement curve.			3	3	3	
			CO3 -Calculate transmission gear ratio's & predict vehicle performance.			2	2	2	2
			CO4 -Categorize different vehicles bodies & layout's, it's nomenclature, structural elements and synthesis it to meet vehicle crashworthiness requirements.			3	3		
			CO5 -Describe the different breaking & suspension systems in an automobile & demonstrate the vehicle safety.			3	3		
	MAT(DE) -19002	Department Elective –I Hybrid and Electric vehicles	CO1 -Understand the basic components of the hybrid systems	3					
			CO2 -Understand the variations (different types) of hybrid configurations			2		2	
			CO3 -Develop understanding of batteries, and motors			2		2	
			CO4 -Design and develop the hybrid and electric vehicles			2		2	
			CO5 -Understand the speed control mechanisms for electric motors and generators			2		2	
	MAT-19003	Automotive Fuels & Emission	CO1 -Implement the different fuels and their feasibility as an automotive fuels.	2					2
			CO2 -Predict and compare the performance characteristics of engine with different alternate fuels.		3	3			
			CO3 -Understand the emissions of an engine and their treatment techniques		3		3	3	3
			CO4 -Understand the procedure to select a fuel on basis of power output, performance, emission, engine size & applications.		3		3	3	3
			CO5 -Understand the measurement principle of emission				2		
	MAT-19004	Automotive Noise Vibration Harness	CO1 -Identify sources of noise and vibration in automotive	2		2			
			CO2 -Understand working of noise & vibration measuring instruments				2	2	2
			CO3 -Understand the principle of active noise cancellation			2	2	2	2
			CO4 -Understand noise control techniques			3	3		3
			CO5 -Understand signal analysis techniques				2		2

	MAT-19005	Vehicle Dynamics	CO1 -Understand the dynamics of the automotive systems and its performance parameters.	2		2			
			CO2 -Identify the driving/ braking resistances and their influences on vehicle dynamics.				2	2	2
			CO3 -To analyze dynamics systems such as suspension systems, body vibrations, steering mechanisms.			2	2	2	2
			CO4 -Understand ride characteristic of vehicle.			2	2		2
			CO5 -To identify, formulate, and solve engineering problems			2	2		2
	MAT-19006	Automotive Lab-I	CO1 -Demonstrate the significance of experimentation and explore the possibility of carrying out engineering investigations	3					
			CO2 -Acquire hands on experience on the various test-rigs, experimental set up		3	3			
			CO3 -Measure the various technical parameters by instrument and by mathematical relationship			3	3		
			CO4 -Validate actual performance of the system experimentally					3	3
			CO5 -Analyse experimental test data for further improvement of the system					3	3
			CO6 -Identify the effect of various parameters on the system and co-relate them						3
			CO7 -Understand selection of fuel on basis of power output, emission norms, engine size and applications					3	
Semester II									
	MAT-19009	IC Engine Modeling	CO1 -Learn about advanced concepts being pursued for modeling of IC Engine.			2	2	2	
			CO2 -Determine engine performance characteristics for IC Engine by Applying thermo-chemical principles of energy and chemical balances through appropriate modeling.			1	1		
			CO3 -Identify engineering problems, formulate model and solve the problems using knowledge of mathematics science and	2	2	2			
			CO4 -Create and analyse zero dimensional thermodynamic model of IC Engine combustion	3	3	3			
			CO5 -Use and analyse of one dimensional commercial software.	3	3	3	3		
	MAT-19010	Automotive Engine Design	CO1 -Able to find the required engine power for given vehicle.			1	1	1	
			CO2 -Able to select type of engine and it's layout for given			1	1		
			CO3 -Able to find basic dimensions of main engine parts like piston, connecting rod, crank shaft and valve gear.	1	1	1			
			CO4 -Able to design inlet and exhaust system for optimum engine performance.	2	2	2			
			CO5 -Able to gain basic knowledge of designing engine foundation and cooling system.	3	3	3	3		

Sem II	MAT(DE)-19008	Computational Fluid Dynamics (DLE – II)	CO1 -Understand the discretization procedure of the governing equations	1			2	2	
			CO2 -Prepare the problem definition of a given fluid flow heat transfer problem	1			2	2	
			CO3 -Decide the governing equations, boundary conditions, initial conditions etc for the given problem	2			2	2	
			CO4 -To carry out the simulations and obtain the results in terms of dependent variables	2			2	2	
			CO5 -Analyze the CFD results through post processing to obtain engineering parameters	1			1	2	
	MAT(DE)	Energy Management and Vehicle Integration(DLEIII)	CO1 -Identify the need of Light weighting along with active safety which will lead to better performance, higher reliability, robust design, longer range and improved vehicle dynamics.	2	2		2	2	2
			CO2 -Battery sizing, range estimation, Motor & drive train sizing, Acceleration & performance, Safe driving distance estimation, optimal braking and power regeneration, Advantage estimation in terms of emission and performance in terms of km per unit of power.	2	2		2	2	2
			CO3 -Design and selection of different types of motors based on application, power-train design.	2	2		2	2	2
			CO4 -Categorisation of different class of vehicle, architecture, packaging, homologation & vehicle level simulation with	2	2		2	2	2
			CO5 -Vendorisation along with supply chain, sourcing, technological innovation, vehicle costing along with all sub-	2	2		2	2	2
			CO6	2	2		2	2	2
	MAT-19008	Automotive Mechatronics	CO1 -Understand the basic components of automotive mechatronics and control systems.	1	1				
			CO2 -Understand the basics of sensors, actuators and its interaction with automotive parameters	1	1				
			CO3 -Understand the basics of electronic engine management system for SI and CI Engine Management System						2
			CO4 -Identify the use of multiplex networking for automotive applications	1	2				
			CO5 -Identify the applications of automotive mechatronics in different sub-domains of automobiles						2
	MAT(DE)-19009	E – Noise vibration Harshness (DLE-II)	CO1 -Understand electrical motor noise behavior.		3	3			
			CO2 -Understand electric power sources in the driveline and its NVH impact		3	3			
			CO3 -Understand Driveline NVH characteristics		3	3			
			CO4 -Understand Electric vehicle Sound Quality		3	3			

	MAT(DE)-19014	Automotive Intelligence (DLE – III)	CO1 -Understand the relation between system and signals,	2					2
			CO2 -Apply the knowledge of intelligence to automotive domain		2	3	2	2	3
			CO3 -Explore various tools in the field of intelligence awareness		3	3	3	3	3
			CO4 -Know enough on the neural network as applied for automotive application		3	3	3	3	3
			CO5 -Learn different ways to extract and retrieve information from automobile		3	3	3	3	3
	ML-19012	Automotive Lab-II	CO1 -Demonstrate the significance of experimentation and explore the possibility of carrying out engineering investigations	3					
			CO2 -Acquire hands on experience on the various test-rigs, Experimental set up	3	3				
			CO3 -Measure the various technical parameters by instrument and by mathematical relationship		3				
			CO4 -Validate actual performance of the system experimentally		3	3	3		
			CO5 -Analyse experimental test data for further improvement of the system					3	
			CO6 -Identify the effect of various parameters on the system and co-relate them				3		3
			CO7 -Demonstrate the algorithm, its coding and its use for automotive application				2		3
	LL-19002	Mini Project	CO1 -Carry out the given engineering problem independently.	3			3	3	3
			CO2 -Present the engineering analysis effectively.	2			3	3	2
			CO3 -Learn to write technical reports.	3			3	3	3
Semester III									
Sem III	MAT-20001	Dissertation Phase I	CO1 -Critically read, interpret & evaluate current literature in the discipline.	3	3	3			
			CO2 -Integrate and synthesize ideas within the field.	3	3				
			CO3 -demonstrate comprehensive knowledge of the literature in the field				3	3	
			CO4 -Critically evaluate empirical evidence.			3	3		
			CO5 -Demonstrate a comprehensive understanding of techniques critical to the field					3	3
			CO6 -Able to communicate clearly and effectively to specialist and non-specialist audiences					3	3
Semester IV									
	MAT-20003	Dissertation Phase II	CO1 -Critically apply the research techniques such as experimental, computational or analytical to resolve the engineering problem in automotive engineering.	3	3	3			
			CO2 -Carry out the validation of technique of his choice using existing literature.	3	3	3			
			CO3 -Analyze his own results to derive an engineering parameters as a function of governing parameters			3	3	3	
			CO4 -Present his engineering results in a generalized fashion.					3	3

Mapping of Course Outcomes with Program Outcomes Design Engineering

Sem I

PCC-MDE-23002 : Advanced Vibration and Acoustics						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1:The students will be able to model a given vibratory system as SDOF or MDOF system, with or without damping. He would also identify the type of given base or force excitation as periodic or aperiodic. He would be able to write, mathematically, the excitations of the types such as impulse, step, ramp, half sinusoidal, or such simple arbitrary excitations	1				3	
CO2: The student will be able to predict response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitations mentioned above using convolution integral; They will be able to obtain Shock Response Spectrum of SDOF systems for such excitations and understand use of the SRS	2				3	
CO3: The students will be able to write differential equations of motion for MDOF systems, and through the technique of decoupling and orthogonal properties of natural modes, should be able to obtain the eigen-values and mode shapes of natural vibrations and response to harmonic and arbitrary excitations.	1				2	
CO4: The students will be able to obtain the eigen-values and mode shapes of natural vibrations and response to harmonic excitations using orthogonal properties of natural modes	1				3	

PSBC-MDE-23001: Computer Aided Design						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1: understand the principles of CAD systems and implement these principles to CAM and CAE systems.	1	1		2		
CO2: apply 2D, 3D transformations and projection transformations to solve mechanical engineering problems	2	2		3		
CO3: get knowledge of various approaches of geometric modeling	1	2		2		
CO4: understand mathematical representation of 2D and 3D entities	1	2		2		
CO5: develop an ability to create automated solid model using CAD Customization and understand CAD/CAM data exchange formats	2	1		3		

MDE-20006 : Finite Element Methods						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1: The student will be able to classify a given problem on the basis of its dimensionality as 1-D, 2-D, or 3-D, time-dependence as Static or Dynamic, Linear or Non-linear.	2	2		3		
CO2: The students will be able to develop system level matrix equations from a given mathematical model of a problem following the Galerkin weighted residual method or principle of stationary potential.	3	3		3		
CO3: While demonstrating the process mentioned in 2 above, he will be able to identify the primary and secondary variables of the problem and choose correct nodal degrees of freedom and develop suitable shape functions for an element, implement Gauss-Legendre scheme of numerical integration to evaluate integrals at element level, and assemble the element level equations to get the system level matrix equations. He will also be able to substitute the essential boundary conditions correctly and obtain the solution to system level matrix equations to get the values of the field variable at the global nodes.	2	2		3		
CO4: The student will be able to state three sources of errors in implementing FEM and suggest remedies to minimize the same for a given problem, viz. Modelling errors, Approximation errors, and numerical errors	1	2		3		
CO5: The student will be able to obtain consistent and lumped mass matrices for axial vibration of bars and transverse vibration of beams and obtain fundamental frequency of natural vibration using the methods mentioned in the curricula	2	2		3		
CO6: The students will be able use MATLAB for implementation of FEM to obtain elongations at nodes of a bar subjected to traction and concentrated loads and prescribed boundary conditions	3	3		3		
CO7: The students will be able to use commercial software like ANSYS or ABAQUS for implementation of FEM to obtain stress concentration due to a small hole in a rectangular plate subjected to traction on edges and concentrated loads at points on the edges and prescribed boundary conditions.	3	3		3		

Course code: PSMC- MDE-23001: Mathematical Methods in Engineering						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1: Identify & solve engineering problems by applying the knowledge of differential equations				3		3
2. apply statistical techniques for analysis.				2		2
3. develop and analyze mathematical models of engineering system				2		3

PCC-MDE-23001: Stress Analysis						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1: Students will understand the tensorial approach of continuum mechanics and will be able to comprehend modern research material.	2	2	2			1
CO2: Student will learn basic field equations such as equilibrium equations, compatibility and constitutive relationship.	1	2	1			1
CO3: Students will be able to apply basic field equations to torsion, bending and two dimensional problems, energy methods and plastic hinges.	2	2	1			2
CO4: Students will be proficient in framing correct boundary conditions while using FEM software packages.	2	2	2			3

PEC-MDE- 23001: Advance Machine Design						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1: Students will realize that creativity, manufacturability, assembly, maintainability, emotions, reliability are also important aspects of design other than finding dimensions and stresses in the highly competitive, dynamic and customer centred market.	2	2				2
CO2: Students will demonstrate the ability to identify needs of the customer and convert them in to technical specifications of a product.	1	2				1
CO3: Students will be able to generate different ideas after identifying the need and determining the specifications and constraints of a product for a particular purpose.	3	3				1
CO4: Students will understand the principals used while designing for manufacture, assembly, emotions and maintenance.	2	2				3
CO5: Students will know various methods of rapid prototyping and reverse engineering to test and modify the designs.	1	3				2
CO6: Students will be able to design the components considering strength based reliability.	3	3				3

PEC-MDE 23003: Molecular Mechanics and Multi Scale Modelling						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1: Deal with molecular dynamics simulations at the nano-scale level and perform bottom-up approach in an efficient way.			2			
CO2: Perform FEM simulations at macro-scale by using nano-scale mechanical properties			2	3		
CO3: Use the knowledge of fracture at nano-scale as well as macro-scale.			2	2		
CO4: Deal with interdisciplinary field problems, e.g nano-scale MD simulations and macro-scale FEM simulations			3	3		
CO5: Use the knowledge to explore naturally available hierarchical materials, which outperform artificial materials in terms of mechanical properties			2	2		
CO6: Apply contents of the lecture to natural as well as artificial materials.			1	1		

LC-MDE-23001: Lab course						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1: Use various experimental techniques relevant to the subject.			1		2	
CO2: Acquire hands on experience on the various test-rigs, experimental set up.			2		3	
CO3: Function as a team member			2		2	
CO4: Develop communication skills.			3		2	
CO5: Write technical reports.			3		2	
CO6: Use different software's.			2		3	
CO7: Develop attitude of lifelong learning.			3		3	

Sem II

MDE-19007 : Analysis and Synthesis of Mechanism						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1:develop analytical equations describing the relative position, velocity and acceleration of all moving links.			2		2	
CO2: select, configure, and synthesize mechanical components into complete systems			2		2	
CO3: Use kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks.			1		2	
CO4: Formulate and solve four position synthesis problems for planar and spherical four-bar linkages by graphical and analytical methods.			2		2	
CO5: Analyze and animate the movement of planar and spherical four-bar linkages.			1		1	
CO6: Students will be able to apply modern computer-based techniques in the selection, analysis, and synthesis of components and their integration into complete mechanical systems.			3		2	
CO7: Finally Students will demonstrate ability to think creatively, participate in design challenges, and present logical solutions.			2		3	

MDE-19008 : Fracture Mechanics						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
1. Students will be able to use any one of the four parameters for finding out damage tolerance: stress intensity factor, energy release rate, J integral, Crack tip opening displacement.		2	1			2
2. Students will be able to manage singularity at crack tip using complex variable.		2	2			2
3. Students will understand important role played by plastic zone at the crack tip.		3	2			2
4. Students will learn modern fatigue and will able to calculate the fatigue life of a component with or without crack in it.		2	1			1
5. Students will learn modern sophisticated experimental techniques to determine fracture toughness and stress intensity factor.		1	2			2

PCC-MDE-23005 : Optimization Techniques in Design						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
1. Formulate an optimization problem.			3	2		
2. Apply algorithms for unconstrained optimization.			2	3		
3. Apply algorithms for constrained optimization.			2	2		
4. Find the optimum solution using nontraditional optimization techniques.			3	3		

MDE(DE)-19008 : Advance Engineering Materials						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
1. Comprehend the microstructures and phase diagrams of ferrous and non ferrous materials.						2
2. Apply the learning of various phase diagrams to analyze the phases.						3
3. Apply mechanical testing of composites, semi and super conducting materials for various applications.						2
4. Select the materials like polymers, superalloys, high temperature materials for industrial and domestic applications.						3

MDE(DE)-19007 :Robotics						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
1. Understand basic concepts related with robotics					2	
2. Know various subsystems of robotics & get the basics design & selection parameters of it.					3	
3. Apply the principles of kinematics and dynamics to understand motion and control of robots.					3	
4. Apply tools and methods to understand modelling programming and simulations of robotic systems					2	
5. Make out the effect of the associated knowledge & to observe recent updates in the field of robotics.					2	

PEC-MDE-23009 : Automatic Control Systems						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
1. Describe the basic features and configurations of control systems.					2	
2. Find the transfer function for linear, time-invariant translational mechanical systems and produce analogues electrical and mechanical circuits.					3	
3. Describe quantitatively the transient response of first and second order systems.					2	
4. Apply frequency response techniques for stability analysis.					3	

MDE(DE)-19009 : Mechanics of composite Materials						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
1. Demonstrate role of constituent materials in defining the average properties and response of composite materials on macroscopic level.			2	1		2
2. Apply knowledge for determination of failure envelopes and stress-strain behavior of laminates.			1	2		1
3. Demonstrate advantages by design of structures with composite materials than with conventional materials.using computer programs to solve problems at structural level.			2	1		3
4. Develop a clear understanding to utilize subject knowledge			2	2		1

LC-MDE-23002 : Lab course						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
1. Use various experimental techniques relevant to the subject.		2		3		
2. Function as a team member		2		3		
3. Develop communication skills.		3		2		
4. Write technical reports.		3		3		
5. Use different software's.		3		3		
6. Develop attitude of lifelong learning.		3		2		
7. Acquire hands on experience on the various test-rigs, Experimental set up.		3		3		

Sem III

VSEC-MDE-23001: Dissertation Phase I

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1: Students will learn to survey the relevant literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.	3	2	1	1		
CO2: Students will be able to use different experimental techniques.	2	1	2	3		
CO3: Students will be able to use different software/ computational/analytical tools.	3	2	3	3		
CO4: Students will be able to design and develop an experimental set up/ equipment/test rig	3	2	3	3		
CO5: Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them	2	1	1	3		
CO6: Students will be able to either work in a research environment or in an industrial environment	2	3	3	3		

Sem IV

MDE-20003 : Dissertation Phase II						
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
1. Students will develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field will.	3	2	3	2		
2. Students will learn to write technical reports and research papers to publish at national and international level.	2	3	3	2		
3. Students will develop strong communication skills to defend their work in front of technically qualified audience.	3	2	2	3		