VIT UNIVERSITY
(Estd. u/s 3 of UGC Act 1956)
VELLORE ■ CHENNAI
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M.Tech. Automotive Engineering

Curriculum

University Core

Course Code	Course Title	L	T	P	C
MEE699	Masters Thesis	0	0	0	16
SET501	Science, Engineering and Technology Project – I	0	0	0	2
SET502	Science, Engineering and Technology Project – II	0	0	0	2
	Total Credits				**20**

Programme Core

Course Code	Course Title	L	T	P	C
MAT502	Applied Engineering Mathematics	3	1	0	4
MEE501	Automotive Materials	3	0	0	3
MEE502	Vehicle Engine Technology	3	0	2	4
MEE503	Instrumentation and Automotive Electronics	3	0	2	4
MEE504	Automotive Chassis Systems	3	0	0	3
MEE505	Vehicle Dynamics	3	1	0	4
MEE592	Computational Fluid Flow and Heat Transfer (or)	3	0	2	4
MEE593	Finite Element Methods and Analysis	3	0	2	4
MEE508	Noise, Vibration and Harshness	2	1	2	4
MEE509	Automotive Fuels and Emission	3	0	2	4
MEE510	Automotive Safety and Lighting	3	0	2	4
MEE512	Computer Aided Design Laboratory	0	0	2	1
MEE549	Advanced Vibration Engineering	2	1	0	3
MEE601	Soft Skills	0	0	0	2
	Total Credits				**44**

Programme Elective

Credits to be taken: 9

MEE515	Product Design and Life Cycle Management	3	0	0	3
MEE516	Tribology	3	0	0	3
MEE517	Automotive Refrigeration and Air Conditioning	3	0	0	3
MEE518	Vehicle Body Engineering	3	0	0	3
MEE519	Vehicle Aerodynamics	2	1	0	3
MEE520	Automotive Power Transmission Systems	3	0	0	3
MEE511	Mechatronics and Robotics	3	0	0	3
	Advanced Manufacturing Technology for Auto Components	3	0	0	3
	Vehicular Maintenance and Diagnostics	3	0	0	3
	Modeling, Simulation and Analysis of Engineering Systems	2	1	0	3
MEE529	Autotronics and Vehicle Intelligence	3	0	0	3

Two University Electives, instead of two Programme Electives, can be taken

credit Summary	
Minimum Qualifying credits	73
Total credits Offered (UC+PC+PE)	73
UC	20
PC Offered	44
PE Needed	09

MAT502	APPLIED ENGINEERING MATHEMATICS	LTPC	3	1	0	4
Course Prerequisites	Nil					
Objectives	The objective of this module is to introduce the concepts of solving Partial Differential equations by reducing to normal forms, finding solutions of differential equations by using the principles of calculus of variations along with Eigen Value problems by iteration methods.					
Expected Outcome	Upon completion of this module the student will be able to: Acquire good knowledge of solving differential, Partial differential equations Solve Eigen value problems with relevant applications in their discipline.					
Unit 1	**Boundary Value Problems**	**12hrs**				
Linear second order partial differential equation in two independent variables – Normal forms hyperbolic, parabolic and elliptic equations – Cauchy problem.						
Unit 2	**Boundary Condition Problems Applications**	**12hrs**				
Wave equations – Solution of initial value problem – Significance of characteristic curves. Laplace transform solutions – Displacements in a long string – long string under its weight – a bar with prescribed force on one end – Free vibrations of a string.						
Unit 3	**Calculus of variations**	**12hrs**				
Concepts of functionals and their stationary values – Euler's equation and solution for the problem and for more general cases – Natural boundary conditions – Variational problems with moving boundaries – Conditional variational problems – Isoparametric problems.Direct Methods: Ritz, Kantorovich and Galerkin techniques.						
Unit 4	**Eigen Value Problems**	**12hrs**				
Standard Eigen value problems – properties of Eigen values and Eigen vectors – Generalized Eigen value problems – strum sequence – Jacobi, Givens and House holder transformations.						
Unit 5	**Numerical Methods**	**12hrs**				
Forward and inverse iteration schemes – Graham Schmidt deflation – Simultaneous iteration method – Subspace iteration – Lanczo's algorithm – Estimation of core and time requirements.						

Reference Books

1. Jennings. A., Matrix Computation for Engineers and Scientists., John Wiley and Sons, 1992.
2. Prem.K.Kythe, Pratap Puri, Michael R.Schaferkotter, Introduction to Partial Differential Equations and Boundary Value problems with Mathematics, CRC Press, 2002
3. Kreyszig, Erwin, I.S., Advanced Engineering Mathematics, Wiley, 1999.
4. Ramamurthy. V., Computer Aided Design in Mechanical Engineering., Tata McGraw Hill Publishing Co., 1987.
5. Fundamental Concepts in the Design of Experiments, 5th Ed., by Hicks and Turner
6. Devore, Jay L., Probability and Statistics for Engineering and the Sciences, 5th edition, Brooks-Cole (1999)

Mode of Evaluation	Assignments / Quiz / Term end Examinations.

MEE501	AUTOMOTIVE MATERIALS	LTPC	3	0	0	3
Course Prerequisites	Nil					
Objectives:	• To develop the knowledge of Automotive engineering materials and Selection • To develop the knowledge of materials and their applications in automotive applications • To introduce the concepts of heat treatment and surface modification techniques • To introduce knowledge in advanced metallic and non metallic materials.					
Expected Outcome:	The student will be able to: • Understand the Selection criteria for various components and importance. • Gain knowledge on different class of materials and their applications • Gain knowledge on application of various surface treatments of metals. • Understand failure mechanisms.					
Unit 1	**Review of Mechanical and Chemical behavior of Materials**					**9hrs**
Structure of crystalline solids, imperfections in solids, Plastic deformation - Strengthening mechanisms - Griffith's theory of failure modes –- Damping properties of materials - fracture toughness - Initiation andn propagation of fatigue cracks - Creep mechanisms —environmentally induced degradation and preventive solutions.						
Unit 2	**Automotive Components & Material Selection**					**9hrs**
Organized process of Selection of Materials for different components. Materials for Power train components like cylinder block ,head& liner, piston &piston rings, gudgeon pin, connecting rod, bearings, crankshaft, flywheel, camshaft, valves, valves seats, springs, gear train, chain &belt drives. Materials for Automobile components like body –in –white, crash worthiness, suspension systems, cabin interiors. Functional requirements, manufacturing processes & failure modes for each.						
Unit 3	**Engineering Alloys**					**9hrs**
Cast iron, steels, alloy steels - significance of iron – iron carbide equilibrium diagram in design steels and cast irons, stainless steels –, types, specific applications, heat treatment, effect of alloying elements Aluminum, Magnesium and Ti wrought and cast alloys used in automotive applications –Types, specifications, heat treatment.						
Unit 4	**Surface Modification of Materials**					**4hrs**
Mechanical surface treatment and coating - Case hardening and hard facing - thermal spraying – vapour deposition-iron implantation - Diffusion coating - Electroplating and Electro-less - Conversion coating - Ceramic and organic coatings – laser based surface modification Diamond coating.						
Unit 5	**Non Metallic materials**					**5hrs**
Elastomers and Engineering Plastics, FRP Composite materials, ceramics, laminated &heat treated glass, adhesive bonding, An over view of Manufacturing processing, their characteristics features, types and applications.						
Unit 6	**Modern Materials and Alloys**					**9hrs**
Light weight materials & implications on vehicle design,, Micro alloyed, high strength low alloy steel–- High strength Steels (HSS), Advanced High Strength Steels (AHSS), Ultra high strength Steels (UHSS), developments in Aluminum and Magnesium alloys, Advanced forming & joining processes like - Hydroforming, Warm forming, Laser welding techniques, Induction heating, etc; carbon fiber composites, Natural fibers, refractory metals, SMART Materials - shape memory alloys (SMA), Piezo-electric materials, MEMS, Metallic glass-Quasi crystal and Nano crystalline materials, metal foams.						

Text Books

1. Callister W.D. (2006) "Material Science and Engineering- An introduction", Wiley –Eastern can be indicated as a text book.
2. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 9th Edition 2009, can be included as a text book

Reference Books

1. Hiroshi Yamagata “The Science and Technology of Materials in Automotive Engines”
2. Thomas H. Courtney, (2000) “Mechanical Behavior of Materials”, McGraw Hill.
3. Flinn R. A. and Trojan P. K., (1999)”Engineering Materials and their Applications”, Jaico.
4. KENNETH BUDINSKI – (1988) “Surface Engineering for wear resistance", Prentice Hall.
5. Avner S.H., (2006) “Introduction to physical metallurgy” –Tata McGraw Hill.

6. Ashby & Jones, “Engineering Materials 1 - An introduction to their Properties and Applications”.
7. Ashby and Jones, “Engineering Materials 2 - An Introduction to Microstructures, Processing and Design”.
8. LC Brinson, “Polymer Engineering Science and Viscoelasticity”.
9. Paul Hiemenz, “Polymer Chemistry-The Basic Concepts”.
10. Deborah Chung, “Composite Materials - Science & Applications”.
11. Robert Jones, “Mechanics of Composite Materials”.
12. Mayers & Chawla, “Mechanical Behavior of Materials”.

Mode of Evaluation:	Assignment / Seminar / Term End Examination

MEE502	VEHICLE ENGINE TECHNOLOGY	LTPC	3	0	2	4
Course Prerequisites	**Nil**					
Objective	• To broaden the understanding of engine working and its subsystems • To enhance the knowledge about the fuel supply system of SI engines • To understand the working of different fuel supply systems used in CI engines • To broaden the understanding of the combustion phenomenon in engines • To enhance the fundamental knowledge about the charging systems and different combustion chambers of engines					
Expected Outcomes	• Understand the working of engines and appreciate the engine performance • Able to understand different fuel systems of SI engines • Understand the working of CI engine fuel supply system • Understand the basic difference between combustion in SI engines and CI engines • Understand the fundamental behind charge induction systems, combustion chambers and its importance					
Unit 1	**Engine Basic Theory**					**9 hrs**
Engine construction and their operation – Classification – Operating cycles of S.I. and C.I. engines Engine Subsystems: Ignition system – Conventional and Electronic, Cooling systems – radiator types and Lubricating systems Performance Testing of engines: Volumetric efficiency - Friction Power measurement - Performance curves for SI and CI engines - Heat balance – Performance maps.						
Unit 2	**Fuel Supply Systems – SI engines**					**9 hrs**
Mixture requirements – Theory of carburetion – Simple Carburetor - Modern Carburetor – Carburetor types – Drawbacks of carburetor. Petrol injection systems – Types – Components of Fuel Injection systems – Electronic Engine Control – Injection Strategies – Air flow metering – Operational modes – Working principle of TBI, D-Jetronic, L-Jetronic, K-Jetronic, KE-Jetronic systems and Gasoline Direct Injection(GDI) systems						
Unit 3	**Fuel Supply Systems – CI engines**					**9 hrs**
Functional requirements – Components – Injector Nozzle control – Injection types: Unit, Unit Pump and Common Rail systems – Injection Pumps – Injectors: Pintle, Pintaux and Orifice types – Electro Hydraulic Injectors: Solenoid and Piezo actuated Advance Injection Systems: Common Rail Direct Injection(CRDI) systems – HEUI systems – Cummins HPI-TP systems – Xtreme Pressure Injection(XPI) systems						
Unit 4	**Combustion in Engines**					**9 hrs**
Types of combustion – Combustion in SI engines: Phases of Spark Ignition – Stages of Combustion – Flame development – Flame Structure – Flame Propagation – Abnormal Combustion – Factors affecting knocking Combustion in CI engines: Stages of combustion – Factors affecting ignition delay – Spray Characteristics: Cavitation, Spray penetration, Spray Atomization, Spray Evaporation and Droplet Distribution – Abnormal Combustion						
Unit 5	**Air Induction systems and Combustion Chambers**					**9 hrs**
Charge Motion: Intake Jet Flow – Turbulence – Swirl – Swirl Generation – Squish Charging Systems : Super chargers and Turbo Chargers – Types and working - Boost control - Charge cooling Combustion Chambers: Requirements – Design considerations – Swirl ratio and Surface to Volume ratio – SI engine combustion chambers – CI Engine combustion chambers – Open and IDI types						
Text Books 1. J.B. Heywood. 'Internal Combustion Engine Fundamentals' McGraw Hill Book Co., 1988. 2. V.Ganesan, 'Internal Combustion Engines' McGraw Hill Book Co, 2010						

Reference Books

1. Richard Stone, 'Introduction of Internal Combustion Engines', McMillan, London, 1985.
2. Heinz Heizler, 'Advanced Engine Technology'. Butterworth Heinemann, 1994
3. Robert Bosch, 'Automotive Hand Book', SAE, 2003.
4. The Internal Combustion Engine (1984) C. F. Taylor and E. S. Taylor,
5. Klaus Mollenhauer and Helmut Tschoeke, 'Handbook of Diesel Engines' Springer, 2010.

Mode of Evaluation	Assignments / CAT / Term end Examinations

MEE502L	**VEHICLE ENGINE TECHNOLOGY LABORATORY**	-	-	-	-
Course Prerequisites	**Nil**				

List of Experiments:

1. Study of various types of dynamometers
2. Study of engine emission analyzers and pressure transducers
3. Determination of valve timing of and port timing of an internal combustion engine
4. Determination of frictional power of a multi-cylinder petrol engine using Morse Test.
5. Determination of frictional power of a diesel engine using Willan's line method.
6. Performance, emission & heat balance test on single cylinder constant speed petrol engine.
7. Performance, emission and heat balance test on twin cylinder four stroke constant speed diesel engine.
8. Performance study of variable speed multi-cylinder petrol engine.
9. Performance study on variable compression ratio engine.
10. Evaluate combustion characteristics of a constant speed diesel engine.
11. Evaluate combustion characteristics of a constant speed petrol engine.

Mode of Evaluation	Continuous Assessment (Quizzes, CATs, Model exam, Record Work, Viva-voce, Practicals, etc.) and TEE

MEE503	INSTRUMENTATION AND AUTOMOTIVE ELECTRONICS	LTPC	3	0	2	4

Course Prerequisites	Nil
Objectives:	1. To instill a fundamental understanding of various instrumentation and control detection circuits as they relate to temperature, pressure, flow, and level monitoring of various processes. 2. Introduce various data acquisition systems, and converters relevant to instrumentation and its applications 3. Learn professional measurement techniques used to engineer thermal and mechanical systems 4. Students shall be familiar with data acquisition systems and their components including A/D converters and their characteristics and limitations.
Expected Outcome:	Upon completion of this course the student will be able to: 1. Understand the fundamental elements of instrumentation, measurement and control systems. 2. Handle various instruments for engineering applications Design and set a data acquisition system for mechanical application

Unit 1	**Instrumentation and measurement**	**9hrs**

Instrumentation – selection of measuring instruments. Data Acquisition and processing -General data acquisition system examples, storage, processing. Recording and display devices

Measurement and calibration of speed, force, torque, temperature, pressures and flow rate measurement of power, power factor, light intensity - Level measurements. Measurement thermophysical properties such as of density, viscosity, humidity, specific heat, thermal conductivity and heat flow measurement.

Unit 2	**Dash Board Instrumentation**	**9hrs**

Batteries - Starter motor and drive mechanism - D.C. generators and Alternators - regulation for charging - Electronic controls - lighting design - Horn - Warning systems - Brake actuation warning systems, speed warning systems, oil pressure warning system, engine over heat warning system, air pressure warning system, safety devices - Wind shield wiper and washer.

Unit 3	**Fundamentals of Automotive Electronics**	**9hrs**

Basic sensor arrangement – Types of sensors. Oxygen Sensor – Cranking Sensor – Position Sensors – Engine cooling water temperature Sensor – Engine oil pressure Sensor – Fuel metering – Vehicle speed sensor and detonation sensor – Stepper motors – Relays - Micro processor and Micro Computer applications in automobiles.

Unit 4	**Engine and Chassis management systems**	**18hrs**

Introduction - components for engine management system - Open loop and closed loop control system – Engine cranking and warm up control – Acceleration, deceleration and idle speed control-Integrated engine system – Exhaust emission control engineering - Feedback carburetor system – Throttle body injection and multi point fuel injection system – Injection system controls – Advantage of electronic ignition systems – Types of solid state ignition systems and their principles of operation – Electronic spark timing control.

Electronic management of chassis systems, Vehicle motion control, anti - lock braking system, Tyre pressure monitoring system, Collision avoidance system, Traction control system, Active suspension system Key less entry system and Electronic power steering system.

References

1. Holman, J.P, Experimental methods for Engineers, McGraw Hill Book Co., 2000
2. Beckwith, T.G and Buck, N.L, Mechanical Measurements, Addison Wesley, 1982.
3. Ernest O Doeblin, Measurement Systems, Application and design, McGraw Hill Book Co., 1983.
4. Andrews, W.G, Applied Instrumentation in Process Industries, Butterworth-Heinemann, 1979.
5. Eckman, Automatic Process control, Wiley Eastern Limited, 1993.
6. Bechfold, Understanding Automotive electronics, SAE, 1998.
7. William, B. Ribbens, Understanding Automotive electronics, ButterWorth Heinemann 1998.
8. Robert N. Brandy, Automotive computers and Digital Instrumentation, Prentice Hall Eaglewood Cliffs, New Jersey, 1988.

Robert Bosch, Automotive Handbook, SAE, 2003.

Mode of Evaluation	Assignments / Seminars / Term end Examinations.

MEE503L	INSTRUMENTATION AND AUTOMOTIVE ELECTRONICS LABORATORY	-	-	-	-
Course Prerequisites	**Nil**				

List of Experiments:

1. Measurement of pressure, temperature, torque, power, speed etc.
2. Measurement of thermophysical properties such as density, viscosity and thermal conductivity
3. Measurement of flow rate using various devices
4. Calibration of various measuring instruments
5. Study of Hall-Effect generator
6. Programming of micro controllers and micro processors
7. Interfacing of microprocessors, microcontroller, stepper motors and servo motors

Mode of Evaluation	Record, Lab examination, Viva-voce, Quizzes, Assignment, Mini Project, Term-End Examination

MEE504	AUTOMOTIVE CHASSIS SYSTEMS	LTPC	3	0	0	3
Course Prerequisite	Nil					
Objectives	1. To introduce vehicle chassis structure 2. To broaden the understanding of components of transmission systems 3. To introduce automotive suspension systems 4. To broaden the importance of conventional and advanced braking systems 5. To introduce steering systems					
Expected Outcome	Student will be able to: 1. Understand the importance of vehicle frame 2. Determine steering systems 3. Identify suitable braking systems 4. Construct automotive suspension systems 5. Design a suitable transmission system					

Unit 1	**Introduction**	**9hrs**

Layout with reference to prime mover location and drive. Frames, Constructional details – Materials – Testing of frames – Integrated body construction- **Study of loads, moments and stresses on frame members, computer aided design of frame for passenger and commercial vehicles.**

Unit 2	**Steering System**	**9hrs**

Front Axle types. Construction details. Materials. Front wheel geometry viz. Camber, kingpin inclination, caster, toe-in and toe-out. Conditions for true rolling motion of road wheels during steering. Steering geometry. Ackermann and Davis steering. Constructional details of steering linkages. Different types of steering gear boxes. Steering linkage layout for conventional and independent suspensions. Turning radius, wheel wobble and shimmy. Power and power assisted steering – **Electric steering – Steer by wire.**

Unit 3	**Design of chassis system**	**9hrs**

Analysis of loads, moments and stresses at different sections of chassis components due to vibration - Design of propeller shaft, Design of final drive gearing, Design of full floating, semi-floating and three quarter floating rear shafts and rear axle housings.

Unit 4	**Braking System**	**9hrs**

Types of brakes. Principles of shoe brakes. Constructional details, materials. Braking torque developed by leading and trailing shoes. Disc brake theory, constructional details, advantages. Brake actuating system – mechanical, hydraulic, pneumatic. Factors affecting brake performance viz. operating temperature, area of brake lining, brake clearance. Exhaust brakes. Power and power assisted brakes - **Antilock braking system , Retarded engine brakes, eddy retarders , Regenerative braking system – Brake by wire-** Testing brakes – Road tests, garage tests and tests in the laboratory.

UNIT 5	**Suspension System**	**9hrs**

Types of suspension. Factors influencing ride comfort, Suspension springs – leaf spring, shackle and mounting brackets, coil and torsion bar springs. Spring materials, Independent suspension – front and rear. Rubber, pneumatic, hydroelasitc suspension – **Active suspension system** . Shock absorbers – **Magneto Rheological fluids** . Types of wheels. Construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres - **computer aided design of leaf springs, coil springs and torsion bar springs.**

References:

1. William F. Milliken, Douglas L. Milliken, Maurice Olley, Chassis Design, SAE, 2002.
2. Newton, Steeds and Garret, 'Motor Vehicle', Illifee Books Ltd., London, 1989.
3. Crouse W.H- "Automotive Chassis and Body"- McGraw-Hill, New York- 1971.
4. Giles.J.G- "Steering, Suspension and tyres"- Iiiffe Book Co., London- 1988.
5. The Automotive Chassis : Engineering principles - Prof. Dipl.-Ing. Jörnsen Reimpell Dipl.-Ing. Helmut Stoll , Prof. Dr.-Ing. Jürgen W. Betzler.

Mode of Evaluation	Assignment/ Seminar/Written Examination.

MEE505	VEHICLE DYNAMICS	LTPC	3	1	0	4
Course Prerequisites	Nil					
Objectives:	1. Understand vibrating systems and its analysis, modeling and simulation and modal analysis 2. Understand various Suspension systems, selection of springs and dampers 3. Understand the stability of vehicles on curved track and slope, gyroscopic effects and cross wind handling 4. Know about tyres, ride characteristics and effect of camber, camber thrust 5. Learn about vehicle handling under different steering conditions and directional stability of vehicles					
Expected Outcome:	Upon completion of this course the student will be able to: 1. Understand and analyze the various dynamic aspects of the vehicle					
Unit 1	**Introduction**	**12hrs**				
Classification of vibration, definitions, mechanical, vibrating systems, mechanical vibration and human comfort. Modelling and simulation studies. Model of an automobile, one degree of freedom, two degree of freedom systems, free, forced and damped vibrations - Random vibration - Magnification and Transmissibility. Vibration absorber. Multidegree of Freedom Systems-Closed and far coupled system, Orthogonality of modal shapes, Modal analysis.						
Unit 2	**Suspension**	**12hrs**				
Requirements. Spring mass frequency. Wheel hop, wheel wobble, wheel shimmy, Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft directions. Hydraulic dampers and choice of damper characteristics. Independent, compensated, rubber and air suspension systems. Roll axis and vehicle under the action of side forces.						
Unit 3	**Stability of Vehicles**	**12hrs**				
Load distribution. Stability on a curved track and on a slope. Gyroscopic effects, weight transfer during acceleration and braking, over turning and sliding. Rigid vehicle – stability and equations of motion. Cross wind handling.						
Unit 4	**Tyres**	**12hrs**				
Types. Relative merits and demerits. Ride characteristics. Behaviour while cornering, slip angle, cornering force, power consumed by a tyre. Effect of camber, camber thrust.						
Unit 5	**Vehicle Handling**	**12hrs**				
Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering. Effect of camber, transient effects in cornering. Directional stability of vehicles.						
Reference Books 1. Thomas D.Gillespie, Fundamentals of vehicle dynamics,SAE,1992 2. J.G. Giles, 'Steering, Suspension and Tyres, Illiffe Books Ltd., 1968. 3. J. Y. Wong, 'Theory of Ground Vehicles', John Wiley and Sons Inc., New York, 2001.						
Mode of Evaluation	Assignments / Seminars / Term end Examinations					

MEE592	COMPUTATIONAL FLUID FLOW AND HEAT TRANSFER	LTPC	3	0	2	4
Course Prerequisites	MAT502					
Objectives :	1. This course brings together the knowledge gained in fluid mechanics, thermodynamics, heat transfer and numerical methods in order to develop computational techniques for the engineering analysis of heat and fluid flow processes. 2. This course also intends to provide the students with sufficient background to understand the mathematical representation of the governing equations of fluid flow, discretization techniques, grid generation, transformation equations and to numerically solve the flow field problems. 3. The student will be introduced to the modeling and computational techniques that are incorporated in current computational fluid dynamics (CFD) software. 4. The student will also have the opportunity to use a standard CFD software package to analyze some complex flow situations.					
Expected Outcome:	Student will be able to 1. Under stand the governing of fluid flow, heat transfer and numerical solution. 2. Numerically solve the fluid flow field using some popular CFD techniques. Model fluid flow problems and heat transfer.					
Unit 1	**Fundamentals of Fluid flow modeling**	**9hrs**				
Introduction & Advantages of CFD, important requirement of CFD solver, Review of the equations governing fluid flow and heat transfer finite difference equations, consistency, explicit and implicit methods, error and stability analysis, Discritization Methods, round off, first order wave equation, stability of hyperbolic and elliptic equations, conservative property, upwind scheme, transportive property, artificial viscosity, examples.						
Unit 2	**Applied numerical methods**	**9hrs**				
Numerical integration, Gauss – Chbyshev & Gauss – Laguerre quadratures, roots of a function, solution of a simultaneous linear algebraic equation, interactive schemes of matrix inversion – direct methods for matrix inversion, Conjugate gradient algorithm, examples						
Unit 3	**Finite Difference Applications in Heat Transfer**	**9hrs**				
Introduction, Steady heat conduction in rectangular geometry, examples, control volume formulation, cylindrical and spherical geometry's, transient conduction problem - Finite difference in convection heat transfer, examples. Grid generation						
Unit 4	**Solution of Navier-Stokes equations for Incompressible Flows**	**9hrs**				
Discretisation by control volume - basic rules, discretisation technique on a one dimensional control volume – discretisation of one dimensional convection – diffusion equation, Central difference approximation, exact solution and the exponential scheme, power law scheme. Introduction, Staggered grid, Solution to the unsteady N-S equations, stream function and vorticity formulation. SIMPLE/SIMPLER algorithm, MAC algorithm: method and formulation, higher order upwind differencing, examples, solution of energy equation, Two dimensional incompressible viscous flow, incorporation of upwind scheme, discretisation error, application to curvilinear geometry, surface pressure and drag, examples.						
Unit 5	**Fluid flow problems in I.C. Engines**	**9hrs**				
Flow through manifolds (single and multi cylinder engines), valves and ports – Elements of air motion in engines viz. Swirl, squish, tumble and turbulence. Basics of turbulent flow – Turbulence modeling and characterization of turbulent mixing. Outline of fluid dynamic models – application of available commercial codes to engine processes with and without chemical reactions.						

Reference Books

1. K. Muralidhar, T. Sundarajan, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 1997.
2. Veersteeg .H.K. & Malaseekara, "Introduction to CFD, The Finite Volume Method, Longman Scientific & Technical, 1995.

3. John, D. Anderson.J R., Computational Fluid Dynamics, McGraw Hill, 1995.
4. C.T.Shaw, Computational Fluid Dynamics, Prentice Hall, 1992.
5. S.V.Patankar, Numerical Heat Transfer and Fluid Flow, McGraw Hill, 1993.
6. M.N. Ozisik, Finite Difference Methods in Heat transfer, CRC press, !994.

Mode of Evaluation	Assignments / Seminars / Term end Examination

MEE592L	**Computational Fluid Flow and Heat Transfer Laboratory**	-	-	-	-
Course Prerequisites	MAT502				

List of Experiments:

1. Modeling and analysis of periodic and heat transfer over a bank of tubes
2. Modeling and analysis of external compressible flow over an aero foil blade
3. Analysis of unsteady compressible flow through a nozzle
4. Analysis of flow pattern inside Turbomachines applications
5. Analysis of air quality inside a passenger car
6. Analysis of varies nose body configuration.

Mode of Evaluation	Record, Lab exercises, Viva-voce, Quizzes, Assignment, Mini Project, Term-End Examination

MEE593	FINITE ELEMENT METHODS AND ANALYSIS	LTPC	3	0	2	4
Course Prerequisites	MAT502					
Objectives:	1. Understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis. 2. To understand the behaviour of various finite elements. 3. To derive finite element equations for simplex and complex elements. 4. To solve problems in solid mechanics and heat transfer using FEM. 5. To analyze more complex problems (in solid mechanics or thermal analysis) using the commercial FEM code.					
Expected Outcome:	Student will be able to 1. Understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis. 2. Be able to create FEM computer programs, for simple problems 3. Be able to analysis more complex problems (in solid mechanics or thermal analysis) using the commercial FEM code.					
Unit 1	**Introduction**					**9hrs**
Basic concepts of FEM – Historical Back ground – Relevance and scope for FEM – Need for Approximation – Weighted Residual, Ritz and Galerkin method – Variational formulation.						
Unit 2	**General procedure of FEM**					**9hrs**
Discretization, Interpolation, shape function, formulation of element characteristic matrices, assembly and solution.						
Unit 3	**Formulation of element characteristic matrices and vectors for elasticity problems**					**9hrs**
One dimensional elasticity – Two-dimensional elasticity – Three-dimensional elasticity – Axisymmetric elasticity. Formulation of element characteristic matrices and vectors for Field problems Thermal problems – one dimensional, Two dimensional and three dimensional heat transfer – Axisymmetric heat transfer – Torsion problems.						
Unit 4	**Higher order and Isoparametric formulations**					**9hrs**
Natural coordinate system and Numerical Integration – Higher-order, one-dimensional, two-dimensional and three-dimensional elements – Structural beam, plate and shell elements – Isoparametric elements – Isoparametric formulation.						
Unit 5	**Computer Implementation**					**9hrs**
An overview of FE analysis program – preprocessing – solution – post processing.						
Reference Books 1. O.C. Zienkewitz and Taylor, The Finite Element Method, Vol. I & II, McGraw Hill, 1991. 2. J.N. Reddy, An Introduction to Finite Element Method, McGraw Hill, 1993. 3. S.S.Rao, The finite element method in Engg., Pergamon Press, 1993. 4. M.J.Fagan, Finite Element Analysis Theory and Practice, Longman Scientific and Technology, 1992. 5. R.D.Cook, Concepts and Applications of Finite Element Analysis, John Wiley & sons Inc., 1995.						
Mode of Evaluation	Assignments / Seminars / Term end Examination					

MEE593L	FINITE ELEMENT METHODS AND ANALYSIS LABORATORY	-	-	-	-
Course Prerequisites	MAT502				

List of Experiments:

1. Introduction to CAD, Geometric Modeling, Engineering Analysis, Design review and Evaluation.
2. 3D Part Modeling, Assembly and Drafting of Automobile chassis and its components.
3. Normal Mode Dynamic Analysis using FEA Technique.
4. Finite Element Analysis of structural problem.
5. Finite Element Analysis of Heat transfer problems
6. Finite Element Analysis of fluid flow problems
7. Finite Element Analysis of Heat transfer problems.
8. Normal Mode Dynamic Analysis using FEA Technique.

Mode of Evaluation	Record, Lab exercises, Viva-voce, Quizzes, Assignment, Mini Project, Term-End Examination

MEE508	NOISE, VIBRATION AND HARSHNESS (NVH)	LTPC	2	1	2	4
Course Prerequisites	MEE505					
Objectives:	1. To introduce source of noise and vibration 2. To broaden the understanding of sound measurement and human sensitivity 3. To underline the importance of simulation, anechoic chamber and acoustic holography 4. To broaden the importance of statistical and frequency analysis 5. To introduce active control techniques					
Expected Outcome:	Upon completion of this course the student will be able to: 1. Identify sources of noise and vibration 2. Measure sound intensity and human sensitivity 3. Carryout statistical energy analysis and simulators 4. Determine active control techniques 5. Carryout statistical and frequency analysis					
Unit 1	**NVH in the Automotive Industry**				**9hrs**	
Sources of noise and vibration. Design features. Common problems. Marque values. Noise quality. Pass-by noise requirements. Target vehicles and objective targets. Development stages in a new vehicle programme and the altering role of NVH engineers.						
Unit 1I	**Sound and Vibration Theory**				**9hrs**	
Sound measurement. Human sensitivity and weighting factors. Combining sound sources. Acoustical resonances. Properties of acoustic materials. Transient and steady state response of one degree of freedom system applied to vehicle systems. Transmissibility. Modes of vibration.						
Unit 1II	**Test Facilities and Instrumentation**				**9hrs**	
Laboratory simulation: rolling roads (dynamometers), road simulators, semi-anechoic rooms, wind tunnels, etc. Transducers, signal conditioning and recording systems. Binaural head recordings., Sound Intensity technique, Acoustic Holography, Statistical Energy Analysis						
Unit 1V	**Signal Processing**				**9hrs**	
Sampling, aliasing and resolution. Statistical analysis. Frequency analysis. Campbell's plots, cascade diagrams, coherence and correlation functions.						
Unit V	**NVH control Strategies & comfort**				**9hrs**	
Source ranking. Noise path analysis. Modal analysis. Design of Experiments, Optimisation of dynamic characteristics. Vibration absorbers and Helmholtz resonators. Active control techniques.						
Reference Books 1. Norton M P, Fundamental of Noise and Vibration, Cambridge University Press,1989 2. Munjal M.L., Acoustic Ducts and Mufflers, John Wiley, 1987 3. Baxa, Noise Control of Internal Combustion Engine, John Wiley, 1984. 4. Ewins D. J., Model Testing : Theory and Practice, John Wiley,1995. 5. Boris and Kornev, Dynamic Vibration Absorbers, John Wiley, 1993. **6.** McConnell K, "Vibration Testing Theory and Practice", John Wiley, 1995.						
Mode of Evaluation	Assignments / Seminars / Term end Examination.					

MEE508L	NOISE, VIBRATION AND HARSHNESS LABORATORY	-	-	-	-
Course Prerequisites	MEE505				

List of Experiments:

1. Demonstration and calibration of various noise and vibration measuring instruments.
2. Acoustic Material Characterization
3. Modal Analysis
4. Sound absorption coefficient-normal incidence
5. Sound transmission loss measurement
6. Sound power level measurement of noise source
7. Vehicle pass by noise measurement

Mode of Evaluation	Record, Lab exercises, Viva-voce, Quizzes, Assignment, Mini Project, Term-End Examination

MEE509	AUTOMOTIVE FUELS AND EMISSION	LTPC	3	0	2	4
Course Prerequisites	MEE502					
Objectives:	1. To broaden the knowledge of alternate fuels. 2. To understand the manufacturing and performance characteristics of alternate fuels. 3. To broaden the understanding of performance of single and multi cylinder diesel and petrol engines. 4. To introduce emission tests procedure					
Expected Outcome:	Upon completion of this course the student will be able to: 1. Understand the importance of alternate fuels. 2. Determine the performance of alternate fuels. 3. Analyze performance of single and multicylinder diesel and petrol engine. 4. Introduce emission test procedure					
Unit 1	**Introduction**					**9hrs**
Estimate of petroleum reserve, need for alternate fuel, availability and comparative properties of alternate fuels.						
Unit 2	**CNG, LPG, Alcohol, Vegetable oil and Bio-gas**					**9hrs**
CNG & LPG - Availability, properties, modifications required in SI and CI engines, performance and emission characteristics, storage, handling and dispensing, safety aspects. Alcohol - Manufacture of alcohol, properties, blending of Methanol and Ethanol, engine design modifications required and effects of design parameters, performance and emission characteristics, durability. Types of vegetable oils for engine application, esterification, biogas, properties, engine performance and emission characteristics.						
Unit 3	**Hydrogen and Fuel cells**					**9hrs**
Production methods, properties, performance and emission characteristics, storage and handling, safety aspects, Working principle, classification, description of fuel cell systems, fuel cell components, properties of fuel cell, general performance characteristics, emission characteristics, merits and demerits, vehicle design and layout aspects.						
Unit 4	**Emissions from SI & CI Engines and its Control**					**9hrs**
Emission formation in S.I. engines – Hydrocarbons – Carbon monoxide – Nitric Oxide, Lead particulates – Polyneculear aromatic hydro carbon emission – Effects of design and operating variables on emission formation in spark ignition engines – Controlling of pollutant formation in engines – Thermal reactors – After-treatment Devices DOC , DPF , NSC , SCR - Charcoal Canister Control for evaporative emission – Positive crank case ventilation system for UBHC emission reduction. EGR Systems Valve types , EGR Circuit types , EGR Cooler types, EGR- Types Internal , Low pressure , High pressure - ECU Functionalities and its architecture - how it controls engine. Chemical delay – Significance – Intermediate compound formation – Pollutant formation on incomplete combustion – effect of operating variables on pollutant formation – Controlling of emissions – Driving behavior – Fumigation – Exhaust gas recirculation – Air injection – Cetane number effect.						
Unit 5	**Emission Measurement and Test procedure**					**9hrs**
Measurement of CO, CO_2, by NDIR. Hydrocarbon by FID – Chemiluminescent detector for NO_x measurement, Smoke meters – Dilution tunnel technique for particulate measurement. Procedures on Engine and Chassis Constant Volume Sampling procedures –Emission Test– Sampling probes and valves – Quantifying emissions – Dynamometers.						

Reference Books

1. Ganesan.V, Internal Combustion Engines, Tata McGraw Hill, 1994.
2. Crouse.W.M, Anglin.A.L., Automotive Emission Control, McGraw Hill 1995.
3. Springer.G.S, Patterson.D.J, Engine Emissions, pollutant formation, Plenum Press, 1986
4. Patterson, D.J, Henin.N.A, Emissions from Combustion engines and their Control, Anna Arbor Science, 1985. Linden.D, Handbook of Batteries and Fuel Cells, McGraw Hill, 1995.
5. Maxwell et al, Alternative Fuel : Emission, Economic and Performance, SAE, 1995
6. Watson, E.B., Alternative fuels for the combustion engine, ASME, 1990
7. Bechtold, R., Alternative fuels guidebook, 1998.
8. Joseph, N., Hydrogen fuel for structure transportation, SAE, 1996.

9. Holt and Danniel, Fuel cell powered vehicles: Automotive technology for the future, SAE, 2001.	
Mode of Evaluation	Assignments, seminars, Term End Examination

MEE509L	**AUTOMOTIVE FUELS AND EMISSION LABORATORY**	-	-	-	-
Course Prerequisites	MAT502				

List of Experiments:

1. Performance & emission test on Heavy duty diesel engine (Transient Dynamometer)
2. Performance test on Gasoline engine
3. Performance & emission test on Tractor / Genset diesel engine (Eddy Dynamometer)
4. Swirl & Flow tests of ports on steady state flow-bench
5. Performance & combustion characterization test on Diesel engine
6. Study of emission test for SI engine 2/3/4 wheels on chassis dynamometer
7. Analysis of carbonyl compound from exhaust emission using HPLC.
8. Chemical characterization of Gasoline Fuel.
9. Chemical characterization of Diesel Fuel.

Mode of Evaluation	Record, Lab exercises, Viva-voce, Quizzes, Assignment, Mini Project, Term-End Examination

MEE510	AUTOMOTIVE SAFETY AND LIGHTING	LTPC	3	0	2	4
Course Prerequisites	Nil					
Objectives:	1. To broaden the understanding of role of safety systems in automobiles 2. To introduce vehicle structural crashworthiness and crash testing 3. To broaden the importance of ergonomics in automotive safety and human response to impact 4. To introduce pedestrian safety 5. To underline the importance of vehicle safety systems.					
Expected Outcome:	Upon completion of this course the student will be able to: 1. Identify different safety systems and its role in automobiles 2. Determine vehicle structural crashworthiness 3. Analyze and simulate vehicle in barrier impacts 4. Determine injury thresholds and apply trauma for analysis of crash injuries 5. Analyze pedestrian safety by use of pedestrian simulator 6. Design vehicle safety systems					
Unit 1	**Introduction to safety and Vehicle structural crashworthiness & Crash testing**	**9hrs**				
Automotive Safety-Active and passive safety, Driver assistance systems in automobiles, Definitions and terminology. Balance of stiffness and toughness characteristics and energy absorption characteristics of vehicle structures, Design of crash crumple zones, Modeling and simulation studies, Optimization of vehicle structures for crash worthiness, Types of impacts, and Impact with rebound, movable barrier tests, Analysis and simulation of vehicle in barrier impacts, Roll over crash tests, Behavior of specific body structures in crash testing, Photographic analysis of impact tests, Regulatory requirements for crash testing. Side and Frontal Pole Impact, Pedestrian Impact.						
Unit 2	**Ergonomics and Human response to Impact**	**9hrs**				
Importance of Ergonomics in Automotive safety, Locations of controls, Anthropomerty, Human impact tolerance, Determination of Injury thresholds, Severity Index, Study of comparative tolerance, Application of Trauma for analysis of crash injuries. Injury criteria's and relation with crash and modeling and simulation studies in dummy.						
Unit 3	**Vehicle safety systems**	**9hrs**				
Survival space requirements, Restraints systems used automobiles, Types of safety belts, Head restraints, Air bags used in automobiles, Use of energy absorbing systems in automobiles, Impact protection from steering controls, Design of seats for safety, types of seats used in automobiles.Importance of Bumpers in automobiles, Damageability criteria in bumper designs. Introduction to the types of safety glass and their requirements and rearward field of vision in automobiles, Types of rear view mirrors and their assessment. Warning devices, Hinges and latches etc. Active safety.						
Unit 4	**Fundamentals of light, vision and colour**	**9hrs**				
Electromagnetic radiation and light, Propagation of light, Spectral sensitivity of light,Measures of radiation and light, Standard elements for optical control. Illuminant calculations, Derivation of luminous flux from luminous intensity, flux transfer and inter reflection, luminance calculations, discomfort glare, eyes as an optical system, visual processing, lighting for results, modes of appearance, Pointers for lighting devices. Nature of the colour, Tri-chromatic Colorimetry, Surface colour, colour spaces and colour solids,, colour rendering.						
Unit 5	**Light Measurements, Testing equipment, calibration and photometric practice**	**9hrs**				
Basics of standards and detectors, spectral measurements and Colorimetry, illuminant meters and luminance meters, colorimeters. Fundamentals of equipment used for light measurement in Automotive field; Gonio-Photometer, Reflecto-meter, Colorimeter, Integrating sphere, types, application, coordinates system, Types of sensors and working principle, construction, characteristics etc. used in different equipment. National and international Regulations, test requirements and testing procedure.						

New Technology in Automotive lighting

Technology progress in automotive lighting, Gas Discharges lamps, LED, adoptive front lighting system, Daylight running lamps.

Reference Books

1. Watts, A. J., et al "Low speed Automobile Accidents" Lawyers and Judges 1996
2. Jullian Happian-Smith 'An Introduction to Modern Vehicle Design' SAE, 2002
3. Johnson, W., and Mamalis, A.G., "Crashworthiness of Vehicles, MEP, London, 1995
4. Edward .A, Lamps and Lighting, Hodder & Stoughton, London, 1993.
5. Keitz H. A. E, Light calculations and Measurements, Macmillan, 1971.
6. Olson L. P, Forensic aspects of driver perception and response, Lawyers and Judges 1996.
7. Pantazis. M, Visual instrumentation: Optical design & engineering Principles, McGraw - Hill 1999.
8. Matthew Huang, "Vehicle Crash Mechanics".
9. David C. Viano, "Role of the Seat in Rear Crash Safety".
10. Jeffrey A. Pike, "Neck Injury".
11. Ching-Yao Chan, "Fundamentals of Crash Sensing in Automotive Air Bag Systems".
12. Rollover Prevention, Crash Avoidance, Crashworthiness, Ergonomics and Human Factors", SAE Special Publication, November 2003.

Mode of Evaluation:	Assignments, seminars, Term End examinations

MEE510L	**AUTOMOTIVE SAFETY AND LIGHTING LABORATORY**	-	-	-	-
Course Prerequisites	Nil				

List of Experiments:

1. Study of "H" point measurement on 3-D manikin.
2. Study on air bags
3. Anthropometric measurement using 3d scanner
4. Study of dummy calibration
5. Rear view mirror testing
6. Study of signaling devices and performance evaluation
7. Study of legal requirements, testing and evaluation of lighting devices.
8. G lock testing of seat belt
9. Impact testing of bumpers
10. Study of seat belt anchorage

Mode of Evaluation	Record, Lab exercises, Viva-voce, Quizzes, Assignment, Mini Project, Term-End Examination

MEE 512	COMPUTER AIDED DESIGN LABORATORY	LTPC	0	0	2	1
Course Prerequisites	Nil					
Objectives:	1. To train the student in the latest CAD software so that he will able make conceptual model for new product design and development and 3D model of real and complex shaped components for down stream applications.					
Expected Outcome:	Upon completion of this course the student will be able to: 1. Make a conceptual design for a new product design and development 2. Create 3D model of real time components using latest CAD software 3. Prepare a detailed drawing from 3D model of any components for manufacturing process 4. Prepare a 3D model of any product for the down stream application like FEM and Rapid prototyping.					
	Contents: • Introduction to Computer Aided Design. • Exercise based on the basic features of modeling packages. • Exercises on surface modeling for automotive applications. • Exercises on solid modeling for automotive applications. • Modeling and Assembly of Automobile chassis and its components. • Generation of 2D drawings as per BIS standards from modeling packages. • CAD data transfer for use in analysis packages. • Introduction to dynamical analysis of mechanisms of using MSC/ADAMS.					
Mode of Evaluation:.	Record, Lab exercises, Viva-voce, Quizzes, Assignment, Mini Project, Term-End Examination					

MEE549	ADVANCED VIBRATION ENGINEERING	LTPC	2	1	0	3
Course Prerequisites	**MAT502**					
Objectives	• To introduce classical Vibration theories, relating to discrete and continuous systems with applications. • To teach various numerical techniques including FE for analysis of complex structures and modal testing for natural frequencies and mode shapes. • To introduce special cases of non-linearity and random phenomena in vibrating systems including their stability.					
Expected Outcome	Upon completion of this course, the student shall be able to: • Understand the concepts of Mechanical vibrations starting from single, two, Multi degree freedom systems and advanced topics like continuous, Non-linear and Random Vibration concepts.					
Unit 1	**Single and Two degrees of freedom system**	**9hrs**				
Introduction to free, forced, transient and damped vibrations, terminology and applications. Discrete systems – single degree and two degree systems, response to free forced motions (steady state and transient) applications to vibration isolation and absorption.						
Unit 2	**Several degrees of freedom**	**9hrs**				
Multi degree systems – techniques of analysis such as Dunkerley, Rayleigh, Holzer, Matrix iteration, Transfer matrices and modal analysis.						
Unit 3	**Continuous and Torsional Vibration**	**9hrs**				
Continuous systems Free and forced vibrations of bars for longitudinal, shear, torsional and transverse vibrations, Beams with attached masses rotor dynamics and FEM applications.						
Unit 4	**Non-linear Vibrations**	**9hrs**				
Non-linear vibrations, jump phenomenon and stability. Applications including self excited and parameter excited vibrations.						
Unit 5	**Random Vibrations**	**9hrs**				
Random vibrations – stationary and non-stationary, ergodic systems, response of single degree systems to random excitation.						
Text Books 1. W. T. Thomson, " Theory of Vibration" Kluwer Academic Pub; 4th edition , 1999. 2. TSE, Morse and Hinkel, "Mechanical Vibrations", Chapman and Hall, 1991.						
Reference Books Den Hartong, " Mechanical Vibrations", McGraw Hill, 1986. 2. V.P.Singh, Dhanput Rai & Co., "Mechanical vibrations". 1988. 3. S.Timoshenko, D.H.Young , "Vibrations Problems in Engineering", D.Van Hostrand Company, Inc, Afiliated east-west press Pvt. Ltd.,1991.						
Mode of Evaluation	Assignments, seminars, Term End Examinations					

MEE601	SOFT SKILLS	LTPC	0	0	0	2
Course Prerequisites	Nil					
Objectives	**1.** This course aims to polish the skills of the students like a Diamond **2.** Teach Etiquettes and Ethics to improve his overall branding **3.** Reinforce passion, team work and communication skills **4.** Prepare him to be ready to face the corporate world and be successful.					
Expected Outcome	**1.** Understanding the essence of Soft Skills **2.** Understand "What is meant by Passion?" **3.** The Concept of Personal Brand. **4.** Understand self, self confidence, self esteem, and self assessment. **5.** Identify professional & personal goals and plan for its achievements. **6.** Build on your strengths and estimate ones weaknesses through SWOT analysis. **7.** Learn the fundamentals of leadership *& skills needed to become a real and effective leader, Motivate and energize one's team. Achieve confidence. Improve productivity. **8.** Demonstrate independent learning ability **9.** Become self-disciplined, self- responsibility in the pursuit of studies and professional motivated, demonstrating personal successful.					
Unit 1	**Introduction**				**6hrs**	
Introduction to soft Skills, Personality Development and Human Values, Self Awareness & Esteem, Perception and Attitudes, Self Assessment & WSOT Analysis, Career Plan & Personal Goal setting, Building Personal Brand, Johari Window and Leadership.						
Unit 2	**Communication and Skill Building**				**6hrs**	
Communication Skills, Verbal Communication, Written communication, Body Language Event Management, How to write Report & SAE Papers, Paper Review, Book Review, Presentation, Intelligence Building, Emotional Quotient, Intelligence Quotient & Memory Improvement, Cracking Written tests, Interviews & Group Discussions.						
Unit 3	**Ethics and Etiquettes**				**6hrs**	
Professional Ethics & Etiquettes, Business Ethics, Corporate Ethics, Engineering Ethics, Office Etiquettes, Email Etiquettes, Telephone Etiquettes, Lunch/Dinner Etiquettes Social and Public Etiquettes.						
Unit 4	**Soft Skills at Workplace:**				**6hrs**	
How and Industry Works, Various Departments of Industry, Industry Review, Team building & Motivation, Auto Passion, Confidence Building, Product Development Cycle, Customer Satisfaction & Quality Function Deployment (QFD), Benchmarking, Design for Failure Mode Effects Analysis (DFMEA), Design Review, Vehicle Review.						
Unit 5	**Business/Work Success:**				**6hrs**	
Time Management, Inter personal Skills, Negotiation Skills, Delegating Skills, Executive Summary & Business Report, Handling of Difficult People, Business Analysis, Business Strategy, Meeting Skills, Stress Management & Meditation, Knowledge Management, Project Management, Performance Management System, Total Quality Management,.						
Text Books 1. Narian Ram, Twelve Management Sill for Success, Viva Books, 2006. 2. Dr Bond Allan, Your Masters Thesis, Viva Books, 2006. 3. Verity Judith, Succeeding at Interviews, Viva Books. 4. High Jana L, High Tech Etiquettes, Viva Books. 5. Haynes Marion E., Effective Meeting Skills, Viva Books.						
Reference Books ARAI & SAEINDIA W.S. Proceedings, 3 day Certificate Course on Quality Function Deployment ARAI & SAEINDIA W.S. Proceedings, 3 day Certificate Course on Design Failure Mode & Effect Analysis.						
Mode of Evaluation	Assignments, seminars, term end examinations					

MEE515	PRODUCT DESIGN AND LIFE CYCLE MANAGEMENT	LTPC	3	0	0	3

Course Prerequisites	Nil
Objectives	To make the student to be familiar with • The new product management process • Product lifecycle management stages • The DFx concepts from the conception to recovery or disposal • Applying analytic methods for all stages of product planning, development, launch, and control
Expected Outcome	Upon completion the course, student will be familiar with • The new product management process and Product lifecycle management stages • The DFx concepts from the conception to recovery or disposal • Applying analytic methods for all stages of product planning, development, launch, and control • Development and implementation of a product development and management strategy within a simulated environment, including product platform, branding, pricing, distribution, and promotion decisions. • Performing the decision analysis on new product development • Assessing and improving product development and management performance in the context of a case study

Unit 1	**Introduction**	**9hrs**

Product development – Trends affecting product development – Best practices for product development- Business and New Product Development – Need- NPD & its relevance for business survival- Business & NPD relationship- Investment in NPD and its return realization process - NPD for developing economies like India.

Unit 2	**Product Development Life cycle – I**	**9hrs**

Early design – Requirement Definition and Conceptual design - Product development process and organizations – Collaborative product development – concurrent engineering – risk management - Stages of Product development. Trade-off Analysis – Optimization using cost and utility metrics – Trade-off analysis models and parameters- design to cost – Design to Life cycle cost – Design for warranties.

Unit 3	**Product Development Life cycle – II**	**9hrs**

Detailed design – Analysis and modeling – Best practices for detailed design – Design analyses – Prototypes in detailed design – Test and Evaluation – Design review, prototyping – simulation and testing – Manufacturing – Strategies – planning and methodologies. Quality assurance of NPD.

Unit 4	**Product Development Life cycle – III**	**9hrs**

Supply chain – Logistics, packaging, supply chain and the environment – ISO 14000/210 – Design for people – Ergonomics, Repairability, maintainability, safety and product liability – Task analysis and failure mode analysis.

Unit 5	**Producibility and Reliability**	**9hrs**

Producibility – strategies in design for manufacturing – requirements for optimizing design and manufacturing decisions – Simplification – commonality and preferred methods – Modularity and scalability – part reduction – functional analysis and value engineering – Reliability – Strategies and practices – Testability – Design for test and inspection.

Reference Books

1. John W. Priest and Jose M. Sanchez, " Product development and design for manufacturing- A collaborative approach to produciability and reliability", Marcel Dekker Publications, 2001.
2. Stephen C. Armstrong, "Engineering and product development management – the holistic approach", Cambridge university press, 2001.
3. Thomas A. Sabomone, "What every engineer should know about concurrent engineering", Marcel Dekker Publications, 1995.
4. Karl T. Ulrich, Steven D. Eppinger "Product Design and Development" Tata McGraw-Hill, 2003.

Mode of Evaluation	Assignments, seminars, Term End Examinations

MEE516	TRIBOLOGY	L T P C	3	0	0	3
Course Prerequisites	Nil					
Objectives	1. To teach the students about the friction and wear phenomena, different types of bearings and lubrication, tribo-testing and standards as well as to sensitize the student on the inevitability of tribological considerations in the design of automotive components, which are invariably subjected to extreme conditions.					
Expected Outcome	Upon completion of this course the student will be able to: 1. Conduct various testing in engines to identify the efficiency.					
Unit 1	**Introduction**					**5hrs**
Introduction of Tribology – Tribological components -Tribo testing, matching and Selection tribometry and standards						
Unit 2	**Friction and Wear**					**5hrs**
Nature of metal surfaces – Surface properties – Surface parameters and measurements. Friction – Sliding friction – Rolling friction characteristics of common metals and non-metals – Friction under extreme environments. Engine friction – Losses and engine design parameters. Economic role of wear – type of wear – wear mechanism – Factors affecting wear – Selection of materials for different wear situations – Measurement of wear- Tribometers and Tribometry. Engine wear – mechanisms, wear resistance material and coatings and failure mode analysis.						
Unit 3	**Hydro Dynamic Bearings and lubrication**					**9hrs**
Theory of hydrodynamic lubrication – Generalized Reynolds Equation – slider bearings- Fixed and pivoted shoe bearings – Hydrodynamic journals bearings – short and finite bearing – Thrust bearings – Sintered bearing – Non-Circular bearings and multi side surface bearings.						
Unit 4	**Lubricants and Monitoring :**					**9hrs**
Lubricants – Type of lubricants – Properties and testing – service classification of lubricants- Additives– Lubrication of tribological components – Lubrication systems – Lubricant monitoring, SOAP, Ferrography and other rapid testing methods for lubricants contamination.						
Unit 5	**Hydrostatic (externally – pressurized) Bearings & lubrication**					**9hrs**
Hydrostatic bearing – basic concepts Bearing pad coefficients. Restrictors – Capillary, orifice and flow control valve – bearing characteristic number and performance coefficients – flat, Conical and spherical pad thrust bearing – Multirecess journal and thrust bearings – Air and gas lubricated bearings.						
Unit - 6	**Elasto Hydro Dynamics and Grease lubrication (Rheology)**					**8hrs**
Lubrication of Ball and roller bearings, cams and gears, selection and life estimation, fatigue and diagnostics. Non-Newtonian fluids, characteristics, Thixotopic, materials and Bingham solids, grease lubrication and stability. Trilogy in Extreme environments Tribology of components in extreme environments like vacuum, Pressure and Temperature						
Reference Books 1. Bowden, F.P. & Tabor, D., "Friction and Lubrication of solids", Oxford University press., 1986. 2. Ernest Rabinowiez, : "Friction and wear of materials" Interscience Publishers, 1995. 3. Neale, M.J., Tribology – :Hand Book", Butterworth, 1995. 4. Fuller D.D., : "Theory and practice of Lubrication for engineers", John Wiley sons, 1984. 5. Gross, W.A.,: "Gas film lubrication", Wiley, 1980.						
Mode of Evaluation	Assignments / Seminars / Term end Examinations					

MEE517	AUTOMOTIVE REFRIGERATION AND AIR CONDITIONING	LTPC	3	0	0	3

Course Prerequisites	Nil
Objectives	1. To broaden the understanding of air conditioning systems and its components 2. To introduce air conditioner heating systems and protection of engine 3. To broaden the understanding of refrigerants and its handling 4. To introduce air routing and temperature control 5. To underline the importance of maintenance and service of air conditioning systems.
Expected Outcome	Upon completion of this course the student will be able to: 1. Locate the components of air conditioning systems in a car 2. Design the air conditioner and heater systems 3. Identify air routing systems, Handling of refrigerants and temperature control 4. Carryout trouble shooting of air conditioning systems

Unit 1	**Air conditioning Fundamentals**	**9hrs**

Basic air conditioning system – Location of air conditioning components in a car – Schematic layout of a refrigeration system - Transport refrigeration - Compressor Components – Condenser and high pressure Service ports. Thermostatic expansion valve – Expansion valve calibration – Controlling Evaporator Temperature – Evaporator pressure regulator – Evaporator temperature regulator.

Unit 2	**Air conditioner – Heating Systems**	**9hrs**

Automotive heaters – Manually controlled, aitr air controlled air conditioner – Heater Systems – Ford automatic controlled air conditioner and heater systems – Automatic temperature control – Air conditioning protection – Engine protection.

Unit 3	**Refrigerant**	**9hrs**

Containers – Handling refrigerants – Tapping into the refrigerant container – Refrigeration system diagnosis – Diagnostic procedure – Ambient conditions affective system pressures.

Unit 4	**Air Routing and Temperature Control**	**9hrs**

Objectives – Evaporator care air glow – Through – the Dash Recirculating Unit – Automatic temperature control – Duct system – Controlling flow – Vacuum reserve – Testing the air control and handling systems.

Unit 5	**Air Conditioning Service**	**9hrs**

Air conditioner maintenance and Service – Servicing heater systems removing and replacing components – Trouble shooting of air conditioning systems – Compressor Service.

Reference Books

1. William.H.Crouse, Donald.L.Anglin, Automotive Air Conditioning, McGraw Hill, 1990.
2. Tom Birch, Automotive Heating and Air conditioning, Prentice Hall, 2003.
3. Mitchel Information Services, Inc., Mitchell Automatic Heating and Air Conditioning Systems, Prentice – Hall, Inc., 1989.
4. Paul Weisler, Automotive Air Conditioning, Reston Publishing Co., Inc., 1990.

Mode of Evaluation	Assignments / Seminars / Term end Examinations

MEE518	VEHICLE BODY ENGINEERING	LTPC	3	0	0	3
Course Prerequisites	Nil					
Objectives	1. To broaden the understanding of details of car body and safety design aspects 2. To introduce bus body details and types of metal sections used 3. To broaden the understanding of vehicle aerodynamics and wind tunnel technology 4. To introduce commercial vehicle body details and driver's seat design 5. To underline the importance of bus body loads and stress analysis.					
Expected Outcome	Upon completion of this course the student will be able to: 1. Carryout construction of different car bodies and designing of car for safety 2. Determine metal sections used for bus body construction 3. Optimize of vehicle bodies for minimum drag 4. Carryout testing of vehicle bodies in wind tunnel 5. Determine vehicle body loads and stress analysis 6. Design driver's seat and carryout construction of commercial vehicle bodies.					
Unit 1	**Car Body Details**					**9hrs**
Types car bodies – Visibility: regulations, driver's visibility, methods of improving visibility – Safety: Safety Design, constructional details of roof, under floor, bonnet, boot, wings etc.						
Unit 2	**Bus Body Details**					**9hrs**
Types of bus bodies. Floor height, engine location – Entrance and exit location, Constructional details, frame construction, Double skin construction, Types of metal sections used, regulations, Conventional and integral type construction.						
Unit 3	**Vehicle Aerodynamics**					**9hrs**
Objects – Vehicle drag and types. Various types of forces and moments. Effects of forces and moments various body optimization techniques for minimum drag. Principle of wind tunnel technology. Flow visualization techniques. Tests with scale models.						
Unit 4	**Commercial Vehicle Details**					**9hrs**
Types of bodies – Flat platform, drop side, fixed side, tipper body, tanker body. Construction of commercial vehicle bodies. Dimensions of driver's seat in relation to controls. Drivers cab design.						
Unit 5	**Body Loads and Stress Analysis**					**9hrs**
Scalized structure – Structural surface – Shear panel method – Symmetric and Asymmetrical vertical loads in a car – Longitudinal loads – Different loading situations – Load distribution on vehicle structure – Stress analysis of bus body structure under bending and torsion – Stress analysis in integral bus body. Analysis of shock and impulse.						
Reference Books 1. Powloski, J., 'Vehicle Body Engineering', Business Books Ltd., 1989. 2. John Fenton, 'Vehicle Body Layout and Analysis', Mechanical Engineering Publication Ltd., London, 1982. 3. Vehicle aerodynamics, SAE, 1996.						
Mode of Evaluation	Assignments, seminars, Term End Examinations					

MEE519	VEHICLE AERODYNAMICS	LTPC	2	1	0	3
Pre-requisites	Nil					
Objectives	1. To broaden the understanding of vehicle aerodynamics 2. To analyze the stability, safety and comfort of the vehicles 3. To understand wind tunnels and testing techniques 4. To apply CFD for aerodynamic design of vehicle					
Expected Outcome	Upon completion of this course the student will be able to: 1. Understand vehicle aerodynamics 2. Analyze stability, safety and comfort of vehicles 3. Understand wind tunnels and testing techniques 4. Apply CFD for aerodynamic design of vehicle					
Unit 1	**Fundamentals of Aerodynamics**					**9hrs**
Scope – Concept of bluff body, Generic shapes, Relevance of these shapes to ground vehicles, Pressure drag & Viscous drag. – Flow phenomena related to vehicles – External and Internal flow problems – Performance of cars and light vans – Resistance to vehicle motion – Flow field around car – Aerodynamic development of cars – Optimization of car bodies for low drag.						
Unit 2	**Stability, Safety and Comfort**					**9hrs**
The origin of forces and moments – effects – vehicle dynamics under side wind – Force and Moment coefficients – Safety limit Design stage measures, Modifications of other details & their effect, Important factors affecting Aerodynamics - Rear slant, Engine cooling air drag, Crosswinds, Underside flows, Wheel Rotation – dirt accumulation on vehicle - wind noise – Air flow around individual components – High performance vehicles – Very log drag cars – Design alternatives – High efficiency radiator arrangement – Development and simulation methods.						
Unit 3	**Wind Tunnels and Test Techniques**					**9hrs**
Principles of wind technology – Limitations of simulation – Simulation based optimization of geometries, Drag reduction Technologies – Surface shaping Scale models – Existing automobile wind tunnels Wind Tunnel Experiments – Measurement of Pressure Coefficient , Measurement of Drag Force .Wind Tunnel limitations & Corrections – Boundary Layer Control , Pressure Gradient , Wind Tunnel Blockages. – Climatic tunnels – Measuring equipment and transducers. Pressure measurement – velocity measurements – Flow visualization techniques – Road testing methods – Wind noise measurements.						
Unit 4	**Application of CFD**					**9hrs**
Methods to solve Navier–Stokes equation – Forces acting in a fluid element – Compressibility effects in a flow field – Inviscid flow – Governing equations – Irrotation flow field and consequences – Potential flows – Boundary layer methods Important requirements of CFD solver – Geometric / Dynamic similarity, Robust Flow solver / Numerical scheme, Convergence level, Transition prediction, Turbulence models. – Numerical modelling of fluid flow around vehicle body.						
Unit 5	**Aerodynamic Design**					**9hrs**
Development and simulation methods –cars, buses, trucks. Surface Motion, Surface permeability, Mass addition, Energizing the external flow						

Reference Books

1. W.H. Hucho, 'Aerodynamics of Road Vehicles', Butterworth and Co., 2004.
2. Schlichting, H. 'Boundary Layer Theory', McGraw Hill, New York, 1999.
3. Pope, A., Low speed Wind Tunnel Testing, John Wiley and Sons, New York, 1999.
4. Vehicle aerodynamics, SAE, !996.
5. E.L.Houghton & P.L.Carpenter, "Aerodynamics for Engineering students", Butterworth Heinman (2003)
6. David C Wilcox, "Turbulence Modeling", La Canada, DCW Ind, 1993.
7. Milliken and Milliken, "Race Car Vehicle Dynamics".
8. M. Abe and W. Manning, "Vehicle Handling Dynamics, Theory and Application".

Mode of Evaluation :	Assignments / Seminars / Term end Examination

MEE520	AUTOMOTIVE POWER TRANSMISSION SYSTEMS	LTPC	3	0	0	3

Course Prerequisite	Nil
Objectives	To impart a comprehensive knowledge on power train components To broaden the knowledge of design of power train components and system
Expected Outcome	Upon completion of this course the student will be able to : Demonstrate the principle of power transmission components Design power train system and components for a new vehicle

Unit 1	**Clutch**	**9hrs**

Clutches- need ,types-design of single plate clutch , multi plate clutch ,centrifugal clutch, cone clutch , electromagnetic clutch , over running clutch - fluid coupling – clutch linkage – mechanical and hydraulic- clutch energy dissipated, torque capacity of clutch-trouble shooting – service procedure.

Unit 2	**Gear Box**	**9hrs**

Gearbox – need , speed selection – sliding mesh , constant mesh , synchromesh – over drives – gear shift mechanisms - total resistance to motion- traction and tractive effort - acceleration - calculation of gear ratio for vehicles - design of three speed gear box and four speed gear boxes- performance characteristics in different speeds - speed synchronizing devices, gear materials, lubrication – transfer case.

Unit 3	**Torque Converter and Automatic Transmission**	**9hrs**

Principal of torque conversion, single, multi stage and polyphase torque converters, performance characteristics, constructional and operational details of typical hydraulic transmission drives .
Automatic transmission: relative merits and demerits when compared to conventional transmission – epicyclic and hydromatic transmission – continuously variable transmission -

Unit 4	**Driveline**	**9hrs**

Effect of driving thrust and torque reactions - Hotchkiss drive, torque tube drive and radius rods - propeller shaft, universal joints, slip joint - front wheel drive - different types of final drive, double reduction and twin speed final drives – differential - construction details , non-slip differential, differential locks- rear axle assembly - types - multi axle vehicles – power train for hybrid vehicles.

Unit 5	**Power train design**	**9hrs**

Design of complete power train for a given engine power and vehicle load - clutch, gear box, propeller shaft, differential, rear axle and wheel.

Text Books

1. Crouse W.H-"Automotive chassis and body"-McGraw-Hill, New York- 1971.
2. Giri. N.K. "Automobile Mechanics" Khanna Publishers – New Delhi – 2002.

References

1. Heldt P.M - Torque converters- Chilton Book Co.-1992
2. Newton Steeds & Garret- "Motor Vehicle"- Illiffe Books Ltd., London – 2000
3. Automotive chassis system – Thomas W . Birch .

Mode of Evaluation	Assignment/ Seminar/Written Examination.

MEE511	MECHATRONICS AND ROBOTICS	LTPC	3	0	0	3
Pre-requisites	MEE503					
Objectives	1. To broaden the understanding of Mechatronics systems 2. To underline the importance of control systems. 3. To introduce Stress, Strain and Force measurement methods. 4. To broaden the importance of Robotics and automation					
Expected Outcome	Student will be able to 1. Analyze various Mechatronics systems like sensors, actuators. 2. Determine the stress, strain, force and other parameters using suitable devices. 3. Design the components of Mechatronics systems 4. Write the programme for robots, automation.					

Unit 1	**Introduction to Mechanical, Electrical, Fluid and Thermal Systems**	**7hrs**

Introduction to Mechanical, Electrical, Fluid and Thermal Systems. Rotational and Transnational systems, electro-mechanical, hydraulic-mechanical systems. Basic principles, characteristics and selection issues for typical Sensors / Actuators used in mechatronics system. Integration Electronics, Controls, Information technology with Mechanical system.

Unit 2	**Control Systems**	**7hrs**

Control Systems: Open loop, Close loop, Transfer function, Feedback and Feed-forward System. Response, Modeling of dynamic system, Dynamic response of First, Second Order systems to Step, Ramp and Impulse inputs. Bode plot and stability of systems. Control actions, P, I, D.

Unit 3	**Components of Mechatronics systems**	**7hrs**

Stress, Strain and Force measurement using strain gauges. Study of devices as Accelorometers, tachometers, velocity measurement, potentiometers. Modeling of sensors, Modeling of Actuators, Steeper motors, D C / A C servos, Solenoids, Hydraulic and Pneumatic actuators, Piezo-electric sensors and actuators, Shape memory alloys.Signal conditioning, Operational amplifier, Protection, Filtering, Digital signal, Data acquisition using DAQ Board, Digital signal processing, A2D, D2A convectors.

Unit 4	**Digital Logic Circuits**	**7hrs**

Number system, Combinational and Sequential circuits. Boolean algebra, binary / floating point arithmetic, Micro-processor building blocks, Terminology, Intel 8085, a microprocessor and a Micro-controller, Flow charts, Assembly language, Instruction set, sample programs, Structure of PLC, I/O Processing, Programming.

Case studies: Data acquisition, Data acquisition and Control, MatLab Data acquisition application for controls.

Unit 5	**Robotics and Automation**	**7hrs**

Robot anatomy, Structure of Robots, Point to Point and Continuous path Robots, Robot Gripper, Sensors, Control systems, Sensors & Vision system in control, Actuators, modeling and control of a single joint, Kinematics, Transformation matrices, Link and Joint description, D-H parameters, Direct kinematics, Inverse kinematics, Velocities and static forces in manipulator.

Unit 6	**Robot programming**	**10hrs**

Robot programming: Methods of Robot programming, Lead through programming, Motion interpolation, Branching capability, WAIT, SIGNAL and DELAY commands, subroutines. Programming Languages: Introduction to various types such as RAIL, VAL-II and SGL, Artificial Intelligence, AI Problems, AI Techniques, Need and Application of AI, New trends and Recent updates.

Text Books

1. Richard D. Klafter, Thomas A. Chemielewski, Michael Negin, Robotic Engineering : An Integrated Approach, Prentice Hall India, 2002.

2. Introduction to Mechatronics and Measurement Systems, David Alciators & Michael B. Histand, Tata McGraw Hills, India, 2001.

Reference Books

1. D.K. Miu, Mechatronics- Electro mechanics and Control mechanics, Springer Verlag.
2. W. Bolton, Mechatronics: Electronic Control Systems,Longman, Publ 98.
3. W. Stadler, Analytical Robotics and Mechatronics, McGraw Hill, 1994.
4. D. M. Auslander and C.J. Kempf, Mechatronics: Mechanical System Interfacing, Prentice Hall, 1995.
5. D.Shetty and R.Kolk, Mechatronic Systems Design,Wadsworth Publ., 1997.
6. HMT Ltd., Mechatronics, Tata McGraw Hill, 1998.
7. K.J.Astrom and B.Wittenmark, Computer Controlled Systems: Theory and Design, Prentice Hall of India Pvt. Ltd., New Delhi, 1994.
8. A.V. Oppenheim and R.W. Schafer, Discrete-Time Signal Processing, Prentice Hall, Englewood Cliffs, New Jersey, 1989.
9. A.V. Oppenheim and A.S. Willsky with I.T. Young, Signals and Systems, Prentice Hall, Englewood Cliffs, New Jersey, 1983.
10. Nadim Maluf, An Introduction to Micro electromechanical Systems, Engineering, Artech House, Boston, London, 2000
11. Dan Necsulescu, Mechatronics, Pearson Education Asia, India, 2002.
12. John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 2004
13. L. Sciavicco and B. Siciliano, Modelling and control of robot manipulators, The McGraw-Hill Co. Inc., 1996.
14. R.J. Schilling, Fundamentals of Robotics: Analysis and Control, Prentice Hall.1987.
15. K.S. Fu, R.C. Gonzales, C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw Hill, 1987.
16. Shimon Y. Nof, Handbook of Industrial Robotics,, John Wiley Co, 2001.

Mode of Evaluation	Assignment, Mini Project, Term-End Examination.

	ADVANCED MANUFACTURING TECHNOLOGY FOR AUTO COMPONENTS	LTPC	3	0	0	3
Course Prerequisites	Nil					
Objectives	1. To understand the basic concepts of powder metallurgy . 2. To acquire knowledge about the fundamental principles of metal forming processes. 3. To study in detail about the modern casting and machining processes followed in automotive components . 4. To have an in depth study about various processes of gear manufacture .					
Expected Outcome	Upon completion of this course the Student will be able to 1. Select correct manufacturing process for a particular Engineering application. 2. Have in-depth knowledge of various manufacturing processes.					
Unit 1	**Power Metallurgy and Processing of Plastics**	**9hrs**				
Powder metallurgy process, Process variables, manufacture of friction lining materials for clutch and brakes. Plastics - raw material - automobile components - molding- injection, compression and blow - PV foam molding- machining of plastics.						
Unit 2	**Forming Process**	**9hrs**				
Forging- process flow chart, forging of valves of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, steering column. Extrusions: Basic process steps, extrusion of transmission shaft, housing spindle, steering worm blanks, Piston pin and valve tappets. Hydroforming: Process, hydro forming of exhaust manifold and comparison with conventional methods- Hydro forming of tail lamp housing- forming of wheel disc and rims. Stretch forming - Process, stretch forming of auto body panels - Super plastic alloys for auto body panels.						
Unit 3	**Casting and Machining**	**9hrs**				
Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburettor other small auto parts. Machining of connecting rods - crank shafts - cam shafts - pistons - piston pins - piston rings - valves - front and rear axle housings - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.						
Unit 4	**Gear Manufacturing**	**9hrs**				
Gear milling, Hobbing and shaping, planing- Bevel gear production - Gear finishing and inspection.						
Unit 5	**Recent Trends In Manufacturing of Auto Components**	**9hrs**				
Powder injection moulding - Production of aluminium MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming - Squeeze casting of pistons - aluminimum composite brake rotors.Sinter diffusion bonded idler sprocket- Gas injection molding of window channel - cast con process for auto parts.						
Reference Books 1.Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990. 2. Rusinoff, " Forging and Forming of metals ", D.B. Taraporevala Son & Co. Pvt Ltd.,umbai,1995. 3. Sabroff.A.M. & Others, " Forging Materials & Processes ", Reinhold Book Corporation, New York,1988. 4. Upton, " Pressure Die Casting ", pergamon Press, 1985. 5. High Velocity " Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990.						
Mode of Evaluation:	Assignments, seminars, Term End Examinations					

	VEHICULAR MAINTENANCE AND DIAGNOSTICS	LTPC	3	0	0	3
Pre-requisites	Nil					
Objectives	1. To acquire knowledge about basic maintenance principle of vehicle 2. To understand failure and reliability of vehicular components 3. To diagnose body and engine using various techniques.					
Expected Outcome	Upon completion of this course the student will be able to 1. Know preventive and predictive techniques for vehicular maintenance 2. Apply various techniques to diagnose body and engine problems					

1. Basics and principles of maintenance management – preventive and predictive techniques – proactive measures and RCM.
2. Failure statistics and Reliability concepts, Weibull distribution – application and limitations to vehicular applications.
3. Maintenance planning and replacement strategies – organisation of maintenance resources, administrative structure and work planning and scheduling.
4. Quantitative techniques like queuing theory, spares inventory control and network analysis.
5. Condition based maintenance and condition monitoring, Body and Engine Diagnostics and monitoring like visual, NDT, Vibration, thermal and oil contamination – computer aided analysis using fuzzy logic and Artificial Neural Networks (ANN) – development of expert systems for vehicular diagnosis – cost benefit analysis and economic for large fleet and transportation.
6. Basics and principles of maintenance management – preventive and predictive techniques – proactive measures and RCM.
7. Failure statistics and Reliability concepts, Weibull distribution – application and limitations to vehicular applications
8. Maintenance planning and replacement strategies – organisation of maintenance resources, administrative structure and work planning and scheduling
9. Quantitative techniques like queuing theory, spares inventory control and network analysis.
10. Condition based maintenance and condition monitoring, Body and Engine Diagnostics and monitoring like visual, NDT, Vibration, thermal and oil contamination – computer aided analysis using fuzzy logic and Artificial Neural Networks (ANN) – development of expert systems for vehicular diagnosis – cost benefit analysis and economic for large fleet and transportation.

Reference Books

- A. Kelly & M.J. Harris – Management of Industrial Maintenance, Newnes – Butterworths Management library 1978
- Steve Goldman – Vibration Spectrum analysis, Industrial press inc. 1999
- R.A. Collacott – Mechanical fault diagnosis and condition monitoring, Chapman and Hall, 1977
- Bosch – Automotive Handbook 2000
- R.A. Collacott – Vibration monitoring and diagnosis, John Wiley & Sons, 1979
- Frank Gradon – Maintenance engineering, Applied science publishers Ltd., 1973.

Mode of Evaluation:	Assignments / Seminars / Term end Examinations

	MODELLING, SIMULATION AND ANALYSIS OF ENGINEERING SYSTEMS	LTPC	2	1	0	3
Pre-requisites	Nil					
Objectives	1. To broaden the understanding of mathematical modeling of engg. systems **2.** To underline the importance of simulation and analysis					
Expected Outcome	Student will be able to 1. Carryout the mathematical modeling and analysis of Engg. Systems.					
Unit 1	**Fundamental Concepts in Mathematical Modelling**	**9hrs**				
Abstraction – linearity and superposition – balance and conservation laws and the system – boundary approach						
Unit 2	**Lumped – Element Modeling**	**9hrs**				
Mechanical systems-Translational, rotational. Hydraulic systems. Thermal systems. RLC Electrical Systems.						
Unit 3	**Modeling of First–order and Second–order Systems**	**9hrs**				
Governing equations for free and forced responses – transient response specifications – experimental determination – laplace transform.						
Unit 4	**Time Domain, Frequency Domain and State Space**	**9hrs**				
Frequency response of Linear, Time invariant systems – frequency response of first–order and second–order systems – state space formulations of systems problems relating frequency response to pole location – transient response-poles and frequency response						
Unit 5	**Feedback systems**	**9hrs**				
Systems with feedback – block diagrams – properties of feedback systems – relative stability-phase and gain margins.						
References 1. Philip D Cha, James J Rosenberg and Clive L Dym, Fundamentals of Modeling and Analyzing Engineering Systems, Cambridge University, 2000. 2. Woods, Robert L., and Lawrence Kent L, Modeling and Simulation of Dynamic Systems, Prentice Hall, 1997. 3. Amalendu Mukherjee, Ranjit Karmakar, Modeling and Simulation of engineering Systems through Bondgraphs, Narosa, 2000. Close Frederick, Modeling and Analysis of Dynamic Systems, Wiley.						
Mode of Evaluation	Assignments / Seminars / Term end Examinations					

MEE529	AUTOTRONICS AND VEHICLE INTELLIGENCE	LTPC	3	0	0	3
Course Prerequisites	Nil					
Objectives	1. To understand the automotive electronics 2. To introduce the different vehicle systems 3. To broaden the importance of vehicle intelligence system					
Expected Outcome	Student will be able to 1. Analyze various electronics systems like sensors, fuel injection system, ECU 2. Design of intelligence vehicle systems					
Unit 1	**Automotive fundamentals**					**9hrs**
The engine-components-Drive train -Starting &charging systems operation- Ignition system- Suspension systems-brakes -ABS - Steering system.						
Unit 2	**Automotive sensors**					**9hrs**
Temperature sensor-gas sensor-knock sensor-pressure sensor - flow sensor-torque sensor-crash sensor-Speed sensor and acceleration sensor-micro sensor-smart sensor-operation, types, characteristics, advantages and their applications.						
Unit 3	**Fuel injection and Ignition system**					**9hrs**
Introduction -fuel system components-electronic fuel system-fuel injection-types-throttle body versus port injection-electronic control fuel injection-operation-different types-fuel injectors-idle speed control-continuos injection system-high pressure diesel fuel injection -MPFI system -Electronic ignition system-operation-types-Electronic spark timing control.						
Unit 4	**Electric vehicles and hybrid vehicles**					**9hrs**
Introduction-Electric Vehicle development- system layout- basic system components-Electric battery-solar cells-rapid charging system-motor drive system-fuelcell Electric vehicle-hybrid vehicle-series Hybrid Vehicle - parallel Hybrid Vehicle-CNG Electric hybrid vehicle.						
Unit 5	**Vehicle Intelligence**					**9hrs**
Introduction -basic structure-vision based autonomous road vehicles-architecture for dynamic vision system - features-applications- A visual control system using image processing and fuzzy theory-An application of mobile robot vision to a vehicle information system.-object detection, collision warning and Avoidance system-low tire pressure warning system.						

Reference Books

1.Willium B. Ribbens,*Understanding Automotive Electronics* -Sixth edition Elsevier Science 2003
2. Ronald K.Jurgen, *Sensors and Transducers* - SAE 2003
3. Jack Erjavec, Robert Scharff, *Automotive Technology* - Delmar publications Inc 1992
4. Ronald K.Jurgen, *Electric and Hybrid-electric vehicles* - SAE 2002
5.Ichiro Masaki, *Vision-based Vehicle Guidance* - Springer Verlag, Newyork 1992
6.Jay Webster, *Class Room Manual For Automotive Service And System* - Delmer Publications Inc 1995
7. Ron Hodkinson, John Fenton, *Light Weight Electric/Hybrid Vehicle Design* -
Read Educational and Professional Publications Ltd. 2001

Mode of Evaluation	Assignments, seminars, written examinations