PROGRAM
M.Tech in
Automotive Engineering

Department of Mechanical Engineering

CURRICULUM AND SYLLABUS
(From 2018 Admission Onwards)
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Vision of the Institute

To be a global leader in the delivery of engineering education, transforming individuals to become creative, innovative, and socially responsible contributors in their professions.

Mission of the Institute:

* To provide best-in-class infrastructure and resources to achieve excellence in technical education,
* To promote knowledge development in thematic research areas that have a positive impact on society, both nationally and globally,
* To design and maintain the highest quality education through active engagement with all stakeholders – students, faculty, industry, alumni and reputed academic institutions,
* To contribute to the quality enhancement of the local and global education ecosystem,
* To promote a culture of collaboration that allows creativity, innovation, and entrepreneurship to flourish, and
* To practice and promote high standards of professional ethics, transparency, and accountability.

Vision of the Department

To transform our students into outstanding mechanical engineers with strong domain knowledge and skills, society-centric research intent, and exemplary ethical values, making them the most desired professionals by research institutions, industry, and society.
**Mission of the Department**

- To develop in each student, a profound understanding of fundamentals, motivation for continuous learning, and practical problem-solving skills for building a successful career.
- To create and share technical knowledge and collaborate with Industry and Institutions for the betterment of Society.
- To imbibe ethical values, leadership skills and entrepreneurial skills in students.
- To sustain a conducive environment to involve students and faculty in research and development.

**Program Outcomes (POs)**

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

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

**Program Specific Outcomes (PSOs)**

PSO1 - Acquire ethical and intellectual integrity in research and apply the impact of research outcome for sustainable development of society
M. TECH in AUTOMOTIVE ENGINEERING

Department of Mechanical Engineering

CURRICULUM

(From 2018 Admission Onwards)
### First Semester

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<tr>
<th>Course Code</th>
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**Credits**: 19

* Non-credit course

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Credits 14

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Credits 12

Total Credits 65

### List of Courses

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#### Subject Core
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**Elective**

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**Electives II & III**

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**Students undertaking and registering for a Live-in-lab project can be exempted from registering for an elective course in higher semester.**
### Evaluation Pattern

#### 50:50 (Internal: External) (All Theory Courses)

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#### 80:20 (Internal: External) (Lab courses and Lab based Courses having 1 Theory hour)

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#### 70:30 (Internal: External) (Lab based courses having 2 Theory hours/ Theory and Tutorial)

**Theory- 60 Marks; Lab- 40 Marks**

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<td>Periodical 2</td>
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<td>Continuous Assessment (Lab) (CAL)</td>
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#### 65:35 (Internal: External) (Lab based courses having 3 Theory hours/ Theory and Tutorial)

**Theory- 70 Marks; Lab- 30 Marks**
Grades O to P indicate successful completion of the course.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.

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Grades O to P indicate successful completion of the course.

\[
CGPA = \sum \left( \frac{C_i \times Gr_i}{C} \right)
\]

Where

- \(C_i\) = Credit for the \(i^{th}\) course in any semester
- \(Gr_i\) = Grade point for the \(i^{th}\) course
- \(Cr.\) = Credits for the Course
- \(Gr.\) = Grade Obtained
M. TECH in AUTOMOTIVE ENGINEERING

Department of Mechanical Engineering

SYLLABI

(From 2018 Admission Onwards)


Differential Equations:

Course Outcomes

CO-01 Understand the power of mathematical abstraction through introduction and application of concepts like vector spaces, inner product spaces and linear transformations.

CO-02 Gain a working knowledge of computational methods for solution of linear algebra problems like systems of linear equations and eigen value problems.

CO-03 Solve ordinary differential equations (linear and nonlinear) arising in practical problems numerically.

CO-04 Recognize the three basic types of partial differential equations and to apply both analytic and numerical methods to the solution of hyperbolic, parabolic and elliptic partial differential equations.

CO-05 Apply linear algebra and ordinary and partial differential equations to problems in automotive engineering.

TEXT BOOKS/REFERENCES:


18AT601 AUTOMOTIVE CHASSIS AND TRANSMISSION SYSTEMS 3-0-0-3


COURSE OUTCOMES

CO1 Identify the loads, moments and stresses acting on different vehicle parts and analyse the equilibrium condition of the vehicle and its parts

CO2 Select the appropriate clutch type and design the clutch assembly for a typical vehicle

CO3 Select and design the transmission system and its components based on load and speed requirements of the vehicle

CO4 Design suspension systems for vehicles

CO5 Select the appropriate steering system and carry out its optimal design to minimise steering error

TEXT BOOKS/REFERENCES:


18AT602 INTERNAL COMBUSTION ENGINES 3-0-0-3

Charge Motion within the Cylinder – Swirl, squish - Mixture formation, Ignition, Load Control. Combustion process, Power output calculations, Atmospheric conditions and corrections.

Combustion in Spark-Ignition Engines and Compression-Ignition Engines, Lubrication, Crevice flow, blowby, Prechamber flow, Cooling, Nature of engine heat transfer and its basic considerations, Parametric relationship of engine output with heat transfer, Convective and radiative heat transfer in engines; Heat transfer correlations in engines, Boundary layer model for in cylinder heat convection; Thermal loading and transient heat transfer through walls.

Advanced combustion technology- HCCI, PCCI, RCCI Engines, Lean burn engines-Cycles- Miller cycle, Atkinson cycle

Simulation using appropriate tools (GT Power / Autonomie)

COURSE OUTCOMES

CO1 Design engines with alternate fuels with an understanding of thermo-chemistry.
CO2 Model gas flow behavior and predict performance of engines.
CO3 Optimally design heat flow in engines.
CO4 Comprehend newer combustion technology and its requirement.

TEXT BOOKS/REFERENCES:


18AT603 AUTOMOTIVE MATERIALS AND MANUFACTURING 3-0-0-3

Introduction to common engineering materials; metallic and non-metallic automotive materials. Materials and processes with relevance to automotive applications. Advanced materials, light weight material, nano material, synthesis and in-situ materials for automotive applications, corrosion, Standards for automotive materials.

High strength low alloy steels (HSLA), Advanced high strength steels, dual phase steels, martensitic steels etc., Advanced plastics and composites, Novel material for automotive applications, ultra-light weight material, Graphene, Battery materials and technology, case studies related to automotive applications. Case studies on crank shaft, connecting rod, piston, gear and gear box, propeller shaft.

Futuristic technology and material for automotive applications, Designing hybrid materials- material for auto piloting, manufacturing considerations for various lightweight automotive structures, 3D printing-materials, processes and applications. Case studies on Li-ion battery, polymer composites and sensor materials.

COURSE OUTCOMES

CO1 Select suitable materials for automotive applications
CO2 Analyse the behaviour of advanced materials and processes
CO3 Identify appropriate manufacturing processes for automotive applications
CO4 Select suitable process chains for sheet metal processing and its manufacturing considerations

TEXT BOOKS/ REFERENCES:


18AT611 AUTOMOTIVE ELECTRONICS 3-0-0-3

Introduction to Electronic systems in Automotives – Sensors and Actuators for body electronics, power train and chassis systems. Body electronics domain- Automotive alarms, Lighting, Central locking and electric windows, Climatic Control, Driver information, Parking, etc.

Power train and chassis control domain – Engine management, Transmission control, ABS, ESP, Traction Control, Active Suspension, passive safety, Adaptive Cruise Control, etc. Hardware implementation example of simple automotive systems using Sensors, Controller, Actuators etc.


COURSE OUTCOMES

CO1 Choose suitable sensors and actuators for automotive applications
CO2 Understand the control systems for drive by x systems
CO3 Make use of controllers and sensors for implementation of simple automotive electronic hardware
CO4 Understand the working of starting, charging system and vehicle networks

TEXT BOOKS/REFERENCES:
1. Bosch, “Automotive Electrics and Automotive Electronics. System and components ,Networking and
   Hybrid drive”, Fifth edition, Springer view 2014
3. Hillier’s, “Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics”, Fifth

18AT621 INTERNAL COMBUSTION ENGINES LAB 0-0-1-1
Disassembly and assembly of IC Engines)- Valve timing and port timing diagram- Heat balance
   test -Performance and emission study on SI/CI Engine using 13 mode and 8 mode test cycle, with
   alternative fuels, 5 mode test cycle for constant speed engines- Performance, combustion and Emission
   study on the effect of different fuel injection pressure and timing on the engine-Performance, combustion
   and emission characteristics study on the effect of preheated air and fuel. -Experiments on single and multi-
   cylinder SI/CI Engines to find friction power-Combustion analysis of IC engines using P-O data.

COURSE OUTCOMES

CO1 Understand the working principle of IC Engine Operation
   Conduct performance and emission analysis of IC engines fuelled with Gasoline, Diesel and
   alternate fuels
CO3 Analyze the effect of engine perormance on various design parameters
CO4 Conduct combustion study using pressure datas

18AT622 AUTOMOTIVE ELECTRONICS LAB 0-0-1-1
Voltage and Current Divider Circuit – RLC circuit(MATLAB simulation) –Passive filter circuits –Diode
   circuits–rectifiers, clippers, clampers-Zener diode-OPAmp Circuits – Inverting and Non – Inverting
   amplifiers – Adder – PID controller (MATLAB simulation)
MK40DX256 - IO Configuration, Timer, PWM- DC motor speed control, ADC, DAC, Periodic Timer
   Interrupt, sensor interfacing to MK40DX256 via CAN, OBD exercises using BOSCH KTS 540 kit.

COURSE OUTCOMES

CO1 Simulate electric circuits using MA
RESEARCH METHODOLOGY 2-0-0-2

Unit I:

Unit II:
Problem Formulation, Understanding Modeling & Simulation, Conducting Literature Review, Referencing, Information Sources, Information Retrieval, Role of libraries in Information Retrieval, Tools for identifying literatures, Indexing and abstracting services, Citation indexes

Unit III:
Experimental Research: Cause effect relationship, Development of Hypothesis, Measurement Systems Analysis, Error Propagation, Validity of experiments, Statistical Design of Experiments, Field Experiments, Data/Variable Types & Classification, Data collection, Numerical and Graphical Data Analysis: Sampling, Observation, Surveys, Inferential Statistics, and Interpretation of Results

Unit IV:
Preparation of Dissertation and Research Papers, Tables and illustrations, Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript. References, Citation and listing system of documents

Unit V:

COURSE OUTCOMES

CO1: Understand and apply some basic concepts of research and its methodologies

CO2: Able to select and define appropriate research problem and parameters

CO3: Demonstrate skills to write a research paper

CO4: Comprehend the ethical practices involved in conducting research and dissemination of results in different forms

TEXT BOOKS/ REFERENCES:

**18AT612 VEHICLE DYNAMICS 3- 0- 0- 3**


Aerodynamic forces on ground vehicles - Wheel load - traction due to Aerodynamic forces - safety, performance characteristics –Problems-Three dimensional effects - Design features to reduce drag. This module will introduce the student to computational analysis and kinematic and force analysis of systems with appropriate software.

Appropriate ADAMS models to be developed for Multibody Dynamics study.

**COURSE OUTCOMES**

CO1  Analyse and formulate the fundamental of vehicle dynamics
CO2  Evaluate the performance characteristics of vehicle dynamics topics under various driving circumferences
CO3  Demonstrate the vehicle motion and analyze the vehicle response for various driving conditions
CO4  Perform computational analysis of various driving conditions using software

**TEXT BOOKS/REFERENCES:**

18AT613 ALTERNATE FUELS, EMISSIONS AND CONTROL 3-0-0-3


COURSE OUTCOMES

CO1 Recognize and identify selected modern emission systems to reduce emissions
CO2 Comprehend newer combustion technology and its requirement
CO3 Analyse engine malfunctions relating to the vehicle emission control system
CO4 Select alternate fuels for controlling engine emissions

TEXT BOOKS/REFERENCES:


18AT614 NVH AND REFINEMENT 3-0-0-3

Introduction to Automotive NVH – Fundamentals of vibrations – Vibrations of Single degree of freedom, Multi degree of freedom and Continuous Systems - Vehicle vibration measurement and analysis –


COURSE OUTCOMES

CO1 Vibration – SDOF, MDOF, Continuous systems, vibration measurement and analysis
CO2 Acoustics – fundamentals, measurement and analysis
CO3 Vehicle Noise and vibration, Signal Processing and analysis including Random signals, modal analysis
CO4 Principles of NVH refinement in Vehicles and their systems – power train, chassis, body, suspension, etc., acoustic materials and their applications
CO5 Introduction to advanced Techniques – NVH simulation, Statistical Energy Analysis, Acoustic Holography, beam forming, etc.,

TEXT BOOKS/REFERENCES:


18AT615 MODELLING, SIMULATION AND ANALYSIS OF 2-0-0-2 VEHICLE SYSTEMS DESIGN

Fundamental Concepts in Mathematical Modelling


**Modeling of First–order and Second–order Systems**

**Systems Engineering and Application**

**COURSE OUTCOMES**

CO1 Interpret the system engineering and application.
CO2 Develop the first order and second system modelling.
CO3 Solve the system modelling using Laplace transform.
CO4 Build Functional Building block to solve and understand the feedback system.

**TEXT BOOKS/REFERENCES:**


**18AT616**

**HYBRID ELECTRIC VEHICLES**

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Electric Drive-trains and Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Sizing the drive system: Matching the electric machine and the internal combustion engine, Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

**COURSE OUTCOMES**

CO1 Networking various hybrid drive-train topologies  
CO2 Solving mathematical models to describe vehicle performance  
CO3 Categorizing Electric Propulsion unit and the Energy storage system  
CO4 Understand the case studies of designing the Hybrid Electric Vehicle (HEV) and Battery Electric Vehicle (BEV)

**TEXT BOOKS/REFERENCES:**


**18AT623 NVH LAB 0-0-1-1**


**COURSE OUTCOMES**

CO1 Conduct the Modal testing and analyze the signals using FFT  
CO2 Identify the noise source and measure the vehicle noises like passby noise, stationary noise  
CO3 Analyze the sound quality
Homologation trials - Acceleration test, Brake test, Single lane change test, Double lane change test.
Steering effort test.- Steering torque measurement- Brake force measurement test- Gear shift effort test.
Pitch, Yaw and roll measurement- Steering robot demonstration.
Simulated Vehicle performance on road profile-creating and customizing the vehicle model to the
requirement-Exercises using simulation tools

COURSE OUTCOMES

CO1 Analyse and formulate the fundamental of vehicle dynamics
CO2 Evaluate the performance characteristics of vehicle dynamics topics under various driving
circumferences
CO3 Demonstrate the vehicle motion and analyze the vehicle response for various driving conditions
CO4 Perform computational analysis of various driving conditions using software

ELECTIVES

18AT701 COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER 2-0-2-3

Mathematical description of fluid flow and heat transfer-Conservation equations for mass, momentum,
energy and chemical species-Classification of partial differential equations

Discretization techniques using finite difference and finite volume formulations, Direct & Iterative
Techniques or solving Discretized Equations - TDMA,

Formulations for Convection-Diffusion problems, Upwinding, Explicit, Semi-implicit and Fully-Implicit
formulations for unsteady problems, Stability analysis, Irregular geometries and body-fitted coordinate
system.Introduction to Turbulence Modeling, Applications to practical problems.

COURSE OUTCOMES

CO1 Model computation domain required for CFD simulation based on the physical flow simulation
CO2 Generate computational grid to capture necessary flow and geometrical features
CO3 Formulate fluid flow problem mathematically and apply appropriate boundary conditions
CO4 Analyze the results from computation to evaluate parameters of interest

TEXT BOOKS/REFERENCES:

1. Versteeg, H.K., and Malalasekara, W, “An Introduction to Computational Fluid Dynamics”, The
Finite Volume Method, 2007

18AT702 FINITE ELEMENT METHODS AND COMPUTATIONAL TOOLS 2-0-2-3


COURSE OUTCOMES

CO1 Static analysis of structures using commercially available FE software package - Abaqus
CO2 Analysis of coupled problems like thermo-mechanical systems
CO3 Dynamic analysis of mechanical and industrial processes like machining and rolling
CO4 Develop user-defined codes for specific applications
CO5 Utilize non-default controls available in Abaqus for special applications

TEXT BOOKS/REFERENCES:


18AT703 TESTING AND VALIDATION 3-0-0-3

Need for testing and validation –vehicle development process - Types of testing –Objectives of testing- Measurement of Real world usage patterns and their analysis – design of test specifications-Engine testing –
Definitions and calculations – Instrumentation – Services - Types of engine tests – Transient and chassis dynamometer tests - Emissions and their measurement – Emission legislation – TAPS document

Vehicle tests – Tests on components and systems – Instrumentation and Transducers – EMI/EMC testing and regulations - Safety and crash testing and Regulations - Materials and material testing - Servo-hydraulics and fatigue testing - CMVR – Indian and Automotive Industry standards – International standards and WP 29

Virtual product development and computer aided engineering – virtual testing - Road to lab to desktop - Design of experiments – Basic concepts - application of statistics – Analysis of variance - factorial testing – Fractional factorial testing - Taguchi methods.

**COURSE OUTCOMES**

- **CO1** Need, objectives and types of testing
- **CO2** Testing of vehicles, prime movers, drivelines, components, and materials
- **CO3** Specialized testing like emissions, EMI/EMC, fatigue, crash, accelerated testing, etc
- **CO4** Measurement systems, Instrumentation, data acquisition and analysis systems
- **CO5** Introduction to design of Experiments (DOE), Taguchi’s methods

**TEXT BOOKS/REFERENCES:**


**18AT704 SPECIAL TOPICS IN ADVANCED ENGINEERING APPLICATION 3-0-0-3**

- Light weighting for electric vehicles
- Green engine technology.
- Battery management systems.
- Hybrid Technology
- Tribology of Automotive Components
- Additive Manufacturing for Automotive Applications.
- Electrocoating for automotive applications.
- Connected cars-Requirements & Technical feasibility.
- Advancement in onboard diagnostics.
- Autotronics and Vehicle Intelligence.
- Visco-Elastic Materials and Vibration Control
- Flow-Induced Noise and Vibration Sources in Automotive systems.
- Surface Coatings for Automotive Applications.

Note: Evaluation for this course is based on Review documents, Reports, and Presentation

COURSE OUTCOMES

CO1 Understand the recent trends in electric vehicles and respective systems
CO2 Understand the recent advancements in auto infotronics, OBD, Vehicle Intelligence.
CO3 Understand the concept of lightweight materials in automotive applications

18AT705 OFF-HIGHWAY MOBILITY 3- 0- 0- 3

Study of morphology, operational characteristics, and design considerations of off-road vehicles used in the agriculture, infrastructure and construction. Traction and Tractor Performance. Tractor, harvester, windrowers: engine performance and design, vehicle testing, turbo chargers and intercoolers, drive trains, chassis mechanics, hydraulic systems including PTO. Tractor Test procedure – Nebraska Test. Emission norms and legislative requirement for off highway vehicles


COURSE OUTCOMES

CO1 Illustrate the Off-Road vehicle morphology and understand the human safety in handling
CO2 Infer the Terramechanics
CO3 Evaluate the Off-Road vehicle performance
CO4 Design the Dredgers, Crane, Tractor

TEXT BOOKS/REFERENCES:

5. Gianpiero Mastinu, Manfred Ploechl “Road and Off-Road Vehicle System Dynamics Handbook” CRC Press, 2014

18AT706 VEHICLE BODY ENGINEERING 3-0-0-3

CAR BODY DETAILS: Types: compact, hatch-back, saloon, convertibles, limousine, estate car, racing and sports car. Car body construction; design criteria, prototype making, Body In white, creating the inner panels, underfloor panels, detailing of class A surfaces (Flanges, seatings, hemming) from manufacturing point of view.

BUS BODY DETAILS: Types: mini bus, single decker, double-decker, two level and articulated bus. Bus body layout; floor height, engine location, entrance and exit location, seating dimensions. Constructional details: frame construction, double skin construction, types of metal sections used, Conventional and integral type construction, Bus Body Code and Regulations

COMMERCIAL VEHICLE DETAILS: Types of body; flat platform, drop side, fixed side, tipper body, tanker body, Light commercial vehicle body types. Dimensions of driver’s seat relation to controls. Driver’s cab design.


Mechanism analysis using software – max. of 3 hours of class,

COURSE OUTCOMES

CO1 Categorize the types of Vehicle Bodies
CO2 Understand the Construction Methodologies of the Vehicle Bodies and Regulations of vehicle body construction
CO3 Select the Body Materials and Trims
CO4 Analyze the body mechanisms using software

TEXT BOOKS/REFERENCES:
18AT707  AUTOMOTIVE SAFETY AND LIGHTING  3- 0- 0- 3

Statistics of accidents - Accident investigation and analysis-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, Optimization of vehicle structures for crashworthiness, Types of impacts, and Impact with rebound, movable barrier tests, Roll over crash tests, Side and Frontal Pole Impact-Behavior of specific body structures in crash testing, Regulatory requirements for crash testing-National and international Regulations, test requirements and testing procedure


Use of energy absorbing systems - Impact protection from steering controls, Design of seats - Damageability criteria in bumper designs - safety glass and their requirements, reawrd field of vision in automobiles - Warning devices- under run protection devices-Collision warning and avoidance systems-Sensors, Comfort and convenient systems, Automotive Lighting and Light Signalling Devices.

COURSE OUTCOMES

CO1 Describe the vehicle crash testing methods and occupants safety systems.
CO2 Identify pedestrian safety requirements and apply ergonomic concepts to vehicle interior design.
CO3 Identify injury severity index and requirements of crash dummies.
CO4 Outline the requirements of automotive lighting, warning devices, bumper and vehicle seats

TEXT BOOKS/REFERENCES:

Introduction to Automotive Controllers – S12XE: 18-Bit Automotive Microcontroller, Port Integration, Memory mapping control, memory protection, External bus interface, interrupts, clock and reset, ADC, Scalable Controller Area Network, periodic interrupt timer, PWM, serial peripheral interfaces, Timer module

Body Controller Application Example, Programming using code warrior IDE. Introduction to longitudinal and lateral vehicle control, Modeling and simulation study of ABS, Adaptive cruise control, Electronic stability control, Active suspension control


COURSE OUTCOMES

CO1 Understand working of various peripherals of automotive controller S12XE

CO2 Make use of Code Warrior IDE for programming S12XE for various automotive applications

CO3 Understand basics of modeling, simulation and Hardware in Loop testing of various automotive subsystems

CO4 Introduced to OSEK/VDX Environment, AUTOSAR layered software architecture

TEXT BOOKS/REFERENCES:


Concept & Ideation: Styling concept creation, realistic rendering with car paints/textures. Translating the cloud of points of clay model into surfaces with reverse engineering. Class A surface creation – refining the styling surfaces to make them Class A surfaces with manufacturability.


Concept - context and role of managing uncertainty – Role of individual in innovation process.
Innovation and operation management – Managing intellectual property – Managing technology and knowledge. Strategic alliances and network, R&D projects, Technology transfer in innovation.

**COURSE OUTCOMES**

- CO1 Understand the new product process.
- CO2 Learn different styling process and surface creation of the products
- CO3 Learn new product brand and marketing strategy
- CO4 Understand Innovation process and operation management of new product development

**TEXT BOOKS/REFERENCES:**


18AT710 AUTOMOTIVE HVAC, CABIN COMFORT AND ERGONOMICS 3-0-0-3


Applications of HVAC fundamentals to analysis and design of automotive air conditioning systems. Psychometrics, passenger thermal comfort, refrigeration cycles and system design, central and Unitary systems, heating system design, air flow circuits, Air cleaning, ventilation, air space diffusion, compact heat exchanger design, controls and instrumentation. Cabin comfort- In-car air conditioning - overall energy efficiency - air management.

**Vehicle Ergonomics** : Introduction to human body - Anthropometrics and its application to vehicle ergonomics and cockpit design- Driver comfort – seating, visibility, man-machine system- consideration of women drivers-Psychological factors – stress, attention- Passenger comfort - Ingress and egress, spaciousness, ventilation, temperature control, dust and fume prevention and vibration - Interior features and conveniences .

**COURSE OUTCOMES**

- CO1 Understand the operating principle of automotive HVAC Systems and troubleshooting
- CO2 Analyze the operating cycles and Design the HVAC system
- CO3 Evaluate the cabin comfort and analyze the energy efficiency
- CO4 Examine the passenger ergonomics and understand the Psychological factors
TEXT BOOKS/REFERENCES:

4. ASHRAE Handbooks.
5. B. Peacock, Waldemar Karwowski; “Automobile ergonomics.” Publisher: CRC; 1 edition, 1993

18AT711       MEMS (MICRO-ELECTRO-MECHANICAL SYSTEMS), 3- 0- 0- 3
SENSORS AND TECHNOLOGIES FOR AUTOMOTIVE APPLICATIONS
(Prerequisite 18AT708)

Micro electro mechanical systems (MEMS), devices, and technologies. Micro-machining and microfabrication techniques, including planar thin-film processing, silicon etching, wafer bonding, photolithography, deposition, and etching.

Transduction mechanisms and modeling in different energy domains. Analysis of micromachined capacitive, piezoresistive, and thermal sensors/actuators and applications.

Computer-aided design for MEMS layout, fabrication, and analysis. MEMS for automotive applications. Different type of sensors and actuators. Control systems for various applications.

COURSE OUTCOMES

CO1 Introduced to process and various techniques involved in MEMS device fabrication
CO2 Understand transduction mechanisms and modeling in different energy domains
CO3 Analyse micromachined sensors/actuators
CO4 Design and analyse MEMS using CAD

TEXT BOOKS/REFERENCES:


18AT712       TRIBOLOGY 3- 0- 0- 3
Tribological considerations in design of gears, cams, reciprocating components, Engine tribology, transmission drive line-transmission, traction drive, universal and constant velocity joints, wheel bearings, drive chains, lubrication regimes in the engine. Friction and Wear - surface properties, surface parameters and measurements, sliding friction, rolling friction, modified adhesive theory, engine friction, losses and engine design parameters- mechanism of wear, wear testing and methods of wear measurements.

Bearings, Lubrication and Automotive Lubricants - hydrodynamics, generalized Reynold’s equation & physical significance of terms, pressure distribution and load carrying capacity equations for hydrodynamic journal bearing- thrust bearings, Raleigh bearing sintered bearings.

Automotive Lubricants and additives- Type of lubricants, properties and testing, service, classification of lubricants, lubrication of tribological components standard tests, engine oil performance designations, transmission fluids, gear, axle, solid, EP lubricants, ferrography and other rapid testing methods of lubricant contamination Hydrostatic bearings, bearing pad coefficients, squeeze film lubrication Elastohydrodynamic Lubrication, rolling of two cylinders, fatigue and diagnosis.

Road tyre contacts, hydroplaning. Preventive Maintenance - schedule, Noise, wear, corrosive maintenance. Signature analysis of Bearings and Gears, real time condition monitoring using vibration analysis - Periodic Maintenance - Maintenance of batteries, Maintenance of auxiliaries Lubrication system, lubrication charts, Cooling system Maintenance, Maintenance of Electrical system, testing of starters, alternators, ignition coils, wiring harness, horns, wipers, maintenance of drive line system.

**COURSE OUTCOMES**

CO1 To analyse the wear and friction behaviour in various automotive transmission systems
CO2 To understand pressure distribution and load carrying capacity in various bearings
CO3 To understand the effect of automotive lubricants on tribological components
CO4 To implement the preventive and periodic maintenance in various automotive systems

**TEXT BOOKS/REFERENCES:**