VISHNU INSTITUTE OF TECHNOLOGY:: BHIMAVARAM
(Autonomous)
Approved by AICTE, Accredited by NBA, NAAC & Affiliated to JNTUK, Kakinada
MECHANICAL ENGINEERING DEPARTMENT

SPECIALIZED MINOR TRACK B. Tech. (MINOR: ADVANCEMENT IN AUTOMOBILE ENGINEERING) in MECHANICAL ENGINEERING		
S.No	**Course Title**	**Pre- requisites**
1	Advanced Manufacturing Techniques for automobile Components	Manufacturing Processes
2	Vehicle Ergonomics and Styling	NIL
3	Automated, Connected, and Intelligent Vehicles	Elements of Electrical & Electronics Engineering, Automobile Engineering
4	Automotive Aerodynamics	Computational Fluid Dynamics
5	Vehicle Testing and Automotive Standards	Automobile Engineering
6	Noise, Vibration and Harshness	Kinematics of Machines, Dynamics of Machines

B.Tech

MINOR: Advancement in Automobile Engineering

in

Mechanical Engineering

Syllabus

ADVANCED MANUFACTURING TECHNIQUES FOR AUTOMOBILE COMPONENTS

(Minors: Advancement in Automobile Engineering)

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PRE-REQUISITES: Manufacturing processes

COURSE OBJECTIVES:

- To introduce basic engine components and its manufacturing process.
- To introduce manufacturing of air filters and catalytic converter of spark plugs.
- To study various metal forming processes.
- Plastic deformation during forming processes.
- Different laws and equations developed for solving metal forming problems.

UNIT I

Introduction to Automotive Engine Components- Introduction to automotive Engines-overview of parts, their function requirement, Materials used in the automotive sector. Manufacturing of an engine block of cylinder head- Functional requirement of an engine block & cylinder head-Materials used in engine block casting. Manufacturing process – Low pressure die casting, High pressures die casting, expendable pattern casting. Manufacturing of crankshaft-Materials used in crankshaft manufacturing, Production requirement-Process requirement – Forging, Precision machining - Heat treatment.

UNIT II

Manufacturing of Automotive Engine Components : Manufacturing of main bearing – Description, Purpose, Consistent wall thickness, Precise crush height, process requirement – Centrifugal casting, Mold material, Surface finishing for main bearing. Manufacturing of main bearing cap-Special treatment materials for cap-Hot & Cold chamber die casting-Precision drilling operation. Vibration damper-Functional requirement-Production requirement, Process description.

Manufacturing process–Hot rolling, oil tempering, cold oiling, stress relieving, nitriding, Strain aging. Inlet Manifold-Description, Injection molding. Exhaust manifold Description, Process – Welded tubular, Investment casting.

UNIT III

Introduction Metal forming as a manufacturing process and its relation with other processes – Classification based on type of stresses – Examples.

Theoretical analysis (theory of plasticity), Stress-strain relationship, Strain hardening, Material incompressibility, Work of plastic deformation, Work hardening, Yield criteria, Flow rule, Yield criterion and flow rule for Anisotropic material, Initiation and extent of plastic flow- Problems.

UNIT IV

Overview of various metal forming operations: Mechanics of Various Plastic Flow Problems Introduction to; Theory of slip lines, Upper bound theorem, Lower bound theorem.

Forging processes: Metal flow in forging, Analysis of plane strain compression, Analysis of compression of circular disc with slab method. Extrusion Processes: Calculation of extrusion load using slab method, slip line method and upper bound method.

UNIT V

Wire Drawing Processes: Introduction, wire drawing load calculation using slab method.

Rolling Processes: Analysis of longitudinal strip or sheet rolling process (calculation of roll separating force, torque & power, angle of bite, maximum reduction in rolling), rolling defects.

Sheet forming: Mechanics – Flow Rules – Anisotropy - Formability of sheet, Formability tests, forming limit diagrams.

COURSE OUTCOMES:

On completion of the course, student will be able to:

1. Understand the functional requirement of automotive component for the required manufacturing process.
2. Design considerations for the manufacturing process for various automotive components.
3. Apply the theory of plasticity and its application for analyzing various metal forming Processes.
4. Analyze effect of parameters influencing metal forming and compare hot working and cold working with applications.
5. Estimate formability limits for sheets and bulk metals.

TEXT BOOKS:

1. Surender Kumar, Technology of Metal Forming Processes, Prentice - Hall, 1st Edition, 2008.
2. Mohammed A. Omar, The Automotive Body Manufacturing System and Processes, John Wiley & Sons, 1st Edition 2011.

REFERENCES BOOKS:

1. Henry S. Valberg, Applied Metal Forming, Including FEM Analysis, Cambridge University Press, Rev. Edition, 2010.
2. William F. Hosford and Robert M. Caddell, Metal Forming, Mechanics and Metallurgy, Prentice - Hall, 4th Edition, 2012.
3. Mikell P. Groover, Fundamentals of Modern Manufacturing, John Wiley & Sons Inc, 4th Edition 2010.

VEHICLE ERGONOMICS AND STYLING

(Minors: Advancement in Automobile Engineering)

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PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To impart knowledge on Ergonomics in design of Automotive Vehicles.
- To provide the knowledge of safety and styling in Automotive Vehicles.

UNIT I

Introduction to Automotive Ergonomics and Biomechanics

Ergonomics in Vehicle Design and its Approach its Origin of Ergonomics and Human Factors Engineering, Human Characteristics and Capabilities, Implementing Ergonomics, Anthropometry and Biomechanics: Anthropometry, Applications of Biomechanics. Driving Posture and Healthy Design, Driving Simulators.

UNIT II

Occupant Packaging

Vehicle Packaging, Sequence in Development of Vehicle Package, Definition of Key Vehicle Dimensions and Reference Points, Driver Package Development Procedures. Digital Human Modelling (DHM).

UNIT III

Driver Information Acquisition and Processing

Importance of Time, Understanding Driver Vision Considerations, Information Processing, Human Errors, Psychophysics, Visual Capabilities, Information Acquired through Other Sensory Modalities, Applications of Information Processing for Vehicle Design.

UNIT IV

Design and Styling of Automobile Interiors

Design considerations of Controls, Displays, and Interior Layouts, methods to evaluate controls and displays, Field of view, Forward-Field-of-View Evaluations, Mirror Design Issues, Methods to measure.

Fields of View. Automotive Lighting, Design considerations of Lighting equipment like Headlight, Signal Light, Photometric measurements of Lamp

outputs, headlamp evaluation. Entry and Exit of vehicles, Features and Dimensions related to Entry and Exit and methods to evaluate.

UNIT V

Design and Styling of Automobile exteriors

Study of Exterior Interfaces, design and their issues. Automotive Craftmanship, its importance, attributes, measurement methods. Human response to Vibration, thermal environments.

Design Exercises: Implementation of the ergonomics and styling to help build a package of a vehicle.

COURSE OUTCOMES:

On completion of the course, student will be able to:

1. Develop fundamental concepts related to Ergonomics in Automotive Design.
2. Demonstrate the fundamentals of Biomechanics in Automotive Design.
3. Design for Occupant packaging and safety.
4. Estimate design constraints while styling Automobile Interiors.
5. Estimate design constraints while styling Automobile Exteriors.

TEXTBOOKS:

1. Bhise, V.D. Ergonomics in the automotive design process. CRC Press, 1st Edition, 2016.
2. Stuart, M. and H-Point, The fundamentals of car design and packaging. Art Center College of Design, 1st Edition, 2009.

REFERENCE BOOKS:

1. Automotive Ergonomics: Driver-Vehicle Interaction. United States: CRC Press. 1st Edition, 2016.
2. Harvey, C. and Stanton, N.A., Usability evaluation for in-vehicle systems. CRC Press, 1st Edition, 2016.

AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES

(Minors: Advancement in Automobile Engineering)

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PRE-REQUISITES: Elements of Electrical & Electronics Engineering, Automobile Engineering

COURSE OBJECTIVES:

- To understand working of Connected, automated and Intelligent cars.
- To provide knowledge related to Sensor Technology for Advanced Driver Assistance Systems.
- To study fundamentals of Wireless Technology.
- To know about recent driver assistance system technology and recent development in automated technology.

UNIT I

INTRODUCTION

Introduction to Connected, automated and Intelligent cars: Automotive Electronics Overview, Advanced Driver Assistance Electronic Systems, Connected Car Technology: Connectivity Fundamentals, Navigation and Other Applications, Connected Car Display Technology, Connected and Autonomous Vehicle Technology: Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles.

UNIT II

Sensor Technology

Sensor Technology for Advanced Driver Assistance Systems: Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Impaired Driver Technology: Driver Impairment Sensor Technology, Sensor Technology for Driver Impairment Detection, Transfer of Control Technology.

UNIT III

Communication

Classification, Applications in the Vehicle, Coupling of Networks, Examples of Networked Vehicles. Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex ray, Diagnostic Interfaces.

Vehicle Motion Control

Antilock Brake System (ABS), Electronic Stability Program (ESP), Traction Control System (TCS), Active Steering, and Electronic Transmission Control.

UNIT IV

Wireless Technology

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts – Demodulation/Decoding, Signal Propagation Physics, Basic Transmission Line and Antenna Theory, Wireless System Standards and Standard Organizations. Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks.

UNIT V

Recent Driver Assistance System and Vehicles

Basics of Theory of Operation, Applications – Legacy, Applications – New, Applications – Future, Integration of ADAS Technology into Vehicle Electronics, System Examples, Role of Sensor Data Fusion, Recent Driver Assistance System Technology applied in various automobile companies dealing with Non-Passenger Car, mini project to apply knowledge of various technologies related to connected vehicles.

COURSE OUTCOMES

On completion of the course, student will be able to

1. Explain basics and advancement in Automated and intelligent Cars.
2. Explore basics related to sensor technology in automated vehicles.
3. Understand the communication protocols and diagnostics of the sub systems.
4. Learn fundaments related to wireless technology in connected vehicles.
5. Understand recent driver assistance system technology associated with automated vehicles.

TEXT BOOKS:

1. Dimitrakopoulos, G, Tsakanikas A, Panagiotopoulos E, Autonomous Vehicles: Technologies, Regulations, and Societal Impacts, Elsevier Science, 2021.
2. G. Mullett, Wireless Telecommunications Systems and Networks, Thomson – Delmar Learning, ISNB#1-4018-8659-0, 2006.

REFERENCE BOOKS:

1. Dietmar P.F. Möller, Roland E. Haas, Guide to Automotive Connectivity and Cybersecurity: Trends, Technologies.
2. G. Mullett, Basic Telecommunications: The Physical Layer, Thomson – Delmar Learning, ISBN#1-4018-4339-5, 2003.
3. Ponnaluri, R., Alluri, P, Connected and Automated Vehicles: Developing Policies, Designing Programs, and Deploying Projects: From Policy to Practice, Elsevier Science, 2021.

AUTOMOTIVE AERODYNAMICS

(Minors: Advancement in Automobile Engineering)

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PRE-REQUISITES: Computational Fluid Dynamics

COURSE OBJECTIVES:

Students undergoing this course are expected to:

- Provide guidance to industry on reducing the aerodynamic drag in heavy truck vehicles.
- Develop innovative drag reducing concepts that are operationally and economically sound.
- Establish a database of experimental, computational, and conceptual design information.
- Demonstrate the potential of new drag-reduction concepts.

UNIT I

Introduction: Scope and Historical Development Trends - Fundamental of Fluid Mechanics - Flow Phenomenon Related To Vehicles - External & Internal Flow Problem - Resistance To Vehicle Motion - Performance - Fuel Consumption And Performance - Potential of Vehicle Aerodynamics.

UNIT II

Aerodynamic Drag Of Cars: Cars as a Bluff Body - Flow Field Around Car - Drag Force - Types of Drag Force - Analysis of Aerodynamic Drag -Drag Coefficient of Cars - Strategies for Aerodynamic Development – Low Drag Profiles, Lift, Body Styling.

UNIT III

Shape Optimization Of Cars: Front End Modification - Front And Rear Wind Shield Angle - Boat Tailing - Hatch Back, Fast Back And Square Back - Dust Flow Patterns at the Rear - Effects of Gap Configuration - Effect of Fasteners.

The Origin of Forces and Moments on Vehicle - Side Wind Problems - Methods to Calculate Forces and Moments - Vehicle Dynamics Under Side Winds - The Effects of Forces and Moments.

UNIT IV

Vehicle Handling: Characteristics of Forces and Moments - Dirt Accumulation on the Vehicle - Wind Noise – Drag Reduction in Commercial Vehicles.

UNIT V

Wind Tunnels For Automotive Aerodynamic: Introduction – Principle of Wind Tunnel Technology – Limitation of Simulation – Stress with Scale Models – Full Scale Wind Tunnels – Measurement Techniques – Equipment and Transducers – Road Testing Methods – Numerical Methods.

COURSE OUTCOMES:

Upon the successful completion of the course, learners will be able to:

1. Evaluate basic fluid theory.
2. Apply CFD to a range of problems.
3. Understand lift, drag and down force definitions and calculations.
4. Demonstrate a knowledge and understanding of aerodynamics in automotive field.
5. Explain the principles and functions of wind tunnel.

TEXT BOOK:

1. Wolf – Heinrich Hucho, Aerodynamics of Road Vehicles: From Fluid Mechanics to Vehicle Engineering, Elsevier Ltd., 4th Edition, 1998.
2. Heinz Heisler, Advanced Vehicle Technology, Butterworth –Heinemann 2nd Edition, 2002.

REFERENCE BOOKS:

1. Pope. A., Wind Tunnel Testing, John Wiley & Sons, 2nd Edition, 1974.
2. Sumantran. V, Gino Sovran, Vehicle Aerodynamics, Society of Automotive Engineers, U.S., 1st Edition, 1994.

VEHICLE TESTING AND AUTOMOTIVE STANDARDS
(Minors: Advancement in Automobile Engineering)

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PRE-REQUISITES: Automobile Engineering

COURSE OBJECTIVES:

- To understand the various facets of vehicle performance.
- To diagnose the factors affecting engine performance.
- To diagnose the factors affecting operations of a vehicle.
- To understand the various processes of Vehicle Testing.

UNIT I

Engine Performance Diagnosis: Engine leak and noise Diagnosis, Exhaust, Oil consumption and Temperature tests, Cooling System Diagnosis, Power balance tests and Compression tests, Valve timing and clearance tests.

UNIT II

Operational Performance: Engine Performance & Operating Characteristics, Operation at Full Load and Part Load Conditions, Effect of Vehicle Condition, Tire and Road Condition, Traffic Condition.

UNIT III

Vehicle Testing: NVH, Power and Fuel Consumption, Testing on Chassis Dynamometer, Road and Track Testing, Initial Inspection, Run-in, Durability and Extensive Driving, Maximum Speed and Acceleration, Brake Testing.

UNIT IV

Automotive Standards: Vehicle Pollution Norms, Bharat Stage Standards, NCAP Standards for Vehicle Crash testing. Vehicle Standardization.

UNIT V

Motor Vehicle Act: Schedules and sections, Registration of motor vehicles, Licensing of drivers, Control of permit, Limits of speed, traffic signs. Constructional regulations. Description of goods carrier, delivery van, tanker, tipper, Municipal, firefighting and break down service vehicle.

COURSE OUTCOMES:

On completion of the course, student will be able to:

1. Outline the factors affecting Engine performance.
2. Examine the function of various Engine components by appropriate testing.
3. Analyse the engine performance and operating characteristics.
4. Determine the effect of various operating factors on the performance of the vehicle.
5. Design tests for testing vehicles for various operating conditions.

TEXTBOOKS:

1. Martyr A. J, Plint M. A, Engine Testing Theory and Practice, 3rd edition, Butterworth-Heinemann, 2007.
2. Crouse. W. H, Anglin. D. L, Motor Vehicle Inspection, McGraw Hill, 1978.

REFERENCE BOOKS:

1. Giles J. G, Vehicle Operation & Performance, Illife Books Ltd., 1st Edition, 1989.
2. Advanced Vehicle Testing and Evaluation, United States: United States. Department of Energy, 2013.

NOISE, VIBRATION AND HARSHNESS
(Minors: Advancement in Automobile Engineering)

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PRE-REQUISITES: Kinematics of Machines, Dynamics of Machines

COURSE OBJECTIVES:

- To help the students to acquire in-depth knowledge of vibration and its control of an automobile.
- To make students to understand the different sources of engine and mechanical noises.
- To enable the students with the knowledge of noise, harshness and vibration control.

UNIT I

Vibration

Free and forced vibration, un-damped and damped vibration, linear and nonlinear vibration, response of damped and un-damped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II

Vibration Control

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT III

Engine Noise

Introduction noise dose level, legislation, measurement and analysis of noise in engines, Noise characteristics, overall noise levels, assessment of combustion noise, engine radiated noise.

Mechanical Noise

Assessment of mechanical noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

UNIT IV

Noise Control:

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

Harshness:

Harshness, sources. its effects, measurement and control.

UNIT V

Measuring Instruments

Vibration Instruments- Vibration Exciters, Analysers, Principle, Free and Forced Vibration test, Frequency and Domain Analysis, Sound Intensity and mapping and introduction to array technique. Digital Signalling Process. Recent Trends.

COURSE OUTCOMES:

Upon Successful Completion of this course, Students will be able to

1. Evaluate the single and two degree of freedom systems all types of vibrations and determining the natural frequencies.
2. Possess the knowledge of vibration control through dampers, isolators in IC Engines and calculating the modal analysis of the shock absorbers.
3. Prediction and measurement of engine and mechanical noise of an automobile.
4. Gain the knowledge of controlling the various sources of noise by different methods.
5. Ability to measure and control harshness, vibration using various methods.

TEXT BOOKS:

1. Malcom J. croker, Noise and Vibration Control, Wiley, 2007.
2. Norton MP, Fundamental of Noise and Vibration, Cambridge University Press, 2003.

REFERENCE BOOK:

1. Boris and Korney, Dynamic Vibration Absorbers, John Wiley, 1993.
2. Lewis L, Industrial Noise Control, McGraw Hill Inc, 1991.