M.S. Ramaiah University of Applied Sciences

New BEL Road, MSR Nagar, Bangalore – 560054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

PO, PSO, PEO & CO

Programme: B. Tech. in Automotive Engineering

Programme Code: 013

Programme Outcome (PO)
Programme Specific Outcome (PSO)
Program Educational Objectives (PEO)
Course Outcomes (CO)

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Faculty of Engineering and Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560058

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Approved in 23rd ACM (Resolution 23.05) held on 15th July 2021

Faculty of Engineering and Technology (FET)

Programme Name: B. Tech. (Automotive Engineering)

Programme Outcomes (POs)

B. Tech. graduates will be able to:

PO-1. Apply knowledge of mathematics, science, basic engineering fundamentals and engineering specialization concerned for the solution of complex engineering problems

PO-2. Identify, formulate and analyze engineering problems using first principles of mathematics, science and engineering to interpret data and reach substantiated conclusions

PO-3. Provide solutions to engineering problems by designing systems, components or processes to meet the specified needs considering public health, safety, societal and the environmental considerations

PO-4. Apply the knowledge of laboratory techniques and research methods to solve complex engineering problems through experimental investigations, analysis and interpretation of results

PO-5. Gain proficiency in modelling complex engineering activities by selecting appropriate techniques and IT Tools and utilize available resources effectively

PO-6. Understand the effect of engineering solutions on legal, cultural, social, public healthand safety aspects and the consequent responsibilities

PO-7. Develop sustainable engineering solutions and assess their effect on society and environment

PO-8. Understand and apply ethical principles to engineering practices and professional responsibilities

PO-9. Function effectively as an individual or a team player to handle diverse problems in multi-disciplinary settings

PO-10. Make oral and written presentations to communicate technical ideas effectively to engineering community and society at large

PO-11. Apply the knowledge of engineering and management principles to manage projectsin multi-disciplinary environments with consideration to cost and time

PO-12. Recognize and engage in lifelong learning to adapt to changing needs and advancements in technology

Programme Specific Outcomes (PSOs)

At the end of the B.Tech. (Automotive Engineering) program, the graduate will be able to:

PSO-1. Dynamics, Automotive Structures, Vehicle Aerodynamics, Materials, Electronic Control and safety systems, Product Design, Electric and Hybrid Vehicles, Autonomous Systems, NVH and Automotive advanced technologies to develop efficient solutions for complex problems in automotive engineering and allied areas

PSO-2. Design and develop the sustainable solutions using automotive engineering principles, concepts, experimentation and appropriate tools to address industry andsocietal requirements

PSO-3. Demonstrate ethics, leadership qualities, communication, entrepreneurial skills and involvement in lifelong learning for betterment of organisation, environment and society

Program Educational Objectives (PEO's)

The Programme educational objectives of the B.Tech. (Automotive Engineering) Programme are:

PEO-1. To provide students with knowledge in mathematics, science and core engineering area to enable them to deliver efficient solutions for complex engineering problemsusing analytical and cognitive skills

PEO-2. To enable students to design and develop the sustainable innovative solutions for industry and societal requirements by conducting engineering investigations through experimentation and usage of modern tools.

PEO-3. To inculcate ethics, communication, leadership, soft, managerial and entrepreneurial skills for successful career in industries and to engage in lifelong learning

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Course Outcomes (COs)

Course Title & Code: Engineering Mathematics - 1 (MTB101A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and discuss basic concepts related to single, two variable calculus and matrix algebra
- **CO-2.** Perform basic operations of matrix algebra and apply them to solve systems of linear equations
- **CO-3.** Solve simple mathematical problems associated with linear algebra, single and two variable calculus
- **CO-4.** Demonstrate competence with the basic ideas of linear systems, independence, bases and dimension, linear transformations, eigenvalues, eigenvectors anddiagonalization
- **CO-5.** Solve complex real-world problems associated with linear algebra, single and two variable calculus

Course Outcomes (COs)

Course Title & Code: Engineering Physics and Laboratory (PYB102A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State, explain the concepts of mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser and fiber optics
- **CO-2.** Derive standard relationships in mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser & fiber optics, and interpret them
- **CO-3.** Discuss the applications of mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser and fiber optics
- **CO-4.** Solve problems in mechanics, electrical conductivity, quantum mechanics, crystal structure, material science, laser and fiber optics
- **CO-5.** Plan the experimental set-up, conduct experiments, calculate and plot the graphs to obtain the results and write a laboratory report as per the prescribed format.

Course Outcomes (COs)

Course Title & Code: Engineering Drawing (MEF103A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the conventions used in projections of geometric entities and interpret thesame
- **CO-2.** Draw orthographic projections for the geometric entities in specified positions
- **CO-3.** Develop lateral surfaces of un-sectioned and sectioned regular solids
- **CO-4.** Develop orthographic projections for given applications
- **CO-5.** Draw isometric projections for the solids and their combinations
- **CO-6.** Demonstrate competency in using CAD tool for drawing projections of geometric entities

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Course Outcomes (COs)

Course Title & Code: Constitution, Human Rights and Law (LAN101A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the key principles of the Indian Constitution
- **CO-2.** Explain Indian legal system and judicial structure that govern the citizens
- **CO-3.** Discuss UN Declaration of Human Rights
- **CO-4.** Discuss the scope and application of Human Rights Principles and Law
- **CO-5.** Suggest strategies for protection of human rights and resolving legal issues in compliancewith applicable laws

Course Outcomes (COs)

Course Title & Code: Engineering Mathematics - 2 (MTB102A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the fundamentals of ordinary differential equations and Laplace transform
- **CO-2.** Solve standard forms of ordinary differential equations
- **CO-3.** Solve simple problems in ordinary differential equations and Laplace transform
- **CO-4.** Model real world problems using ordinary differential equations and solve complexproblems associated with ordinary differential equations using Laplace transform
- **CO-5.** Apply Laplace transform in solving complex real world engineering problems

Course Outcomes (COs)

Course Title & Code: Engineering Chemistry and Laboratory (CYB104A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the basic concepts of electrochemistry, conversion of chemical energy into electrical energy, theory of corrosion and principles of metal finishing
- **CO-2.** Differentiate renewable - nonrenewable fuels, primary - secondary electrodes & primary - secondary batteries, batteries - fuel cells, electroplating – electroless plating, thermosetting – thermoplastic polymers and dry corrosion - wet corrosion
- **CO-3.** Discuss the reaction chemistry and stoichiometry of combustion of fuels, remedial measures to control oxides of nitrogen, sulphur and carbon, polymerization – methods, mechanism, preparation, properties and applications of some polymers, concepts of nano science and nanotechnology
- **CO-4.** Identify the types of corrosion and methods to prevent corrosion, suitable polymers and nanocomposite materials for engineering applications
- **CO-5.** Derive kinetic rate equations for various chemical systems and equation for electromotive force
- **CO-6.** Analyze the suitability of polymers & composites for various applications and solve problems related to storage devices, chemical kinetics, electro chemistry, corrosion and metal finishing
- **CO-7.** Plan the experimental set up, conduct experiments, calculate and plot the graphs to

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Course Outcomes (COs)

Course Title & Code: Elements of Mechanical Engineering and Workshop Practice (MEF104A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Demonstrate the understanding on Classification of energy sources, energy conversion systems, mechanical power transmission systems, machine tools and processes
- **CO-2.** Describe various energy conversion systems, mechanical power transmission systems and machine tools
- **CO-3.** Explain the working principle of refrigeration systems, biomass conversion technologies and machining operations
- **CO-4.** Solve numerical problems on IC engines and mechanical power transmission systems
- **CO-5.** Apply principles of energy conversion systems, power transmission systems, machining processes and mechanical joints to practical applications

Course Outcomes (COs)

Course Title & Code: Elements of Electrical Engineering and Laboratory (EEF105A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and explain various laws of electric circuits, magnetic circuits and their significance, phasor diagrams for electrical elements
- **CO-2.** Explain construction, principle of operation, working and characteristics of DC machines, transformers, AC rotating machines and their applications
- **CO-3.** Derive equations for electrical circuits, magnetic circuits and performance of various AC and DC machines
- **CO-4.** Solve problems on electric circuits, magnetic circuits, DC machines, transformers and AC rotating machines
- **CO-5.** Conduct experiments as per the standard procedures and tabulate/calculate/plot the measured values
- **CO-6.** Interpret and compare with standard results, and draw conclusions and Write report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Elements of Computer Science and Engineering and Laboratory (CSF106A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the elements and methodology of Computer Science and Engineering
- **CO-2.** Explain the basic principles and techniques of algorithms and programming
- **CO-3.** Select appropriate approach to solve a computational problem
- **CO-4.** Design an algorithmic solution and draw a flow chart of the solution
- **CO-5.** Develop computer programs for moderately complex problems
- **CO-6.** Test and validate developed computer programs

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Course Outcomes (COs)

Course Title & Code: Professional Communication (TSN101A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply the concepts of grammar for communication
- **CO-2.** Compose precise paragraphs
- **CO-3.** Demonstrate professional etiquette
- **CO-4.** Demonstrate appropriate verbal and non-verbal communication in the given context
- **CO-5.** Develop professional written document

Course Outcomes (COs)

Course Title & Code: Engineering Mathematics - 3 (MTF201A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and explain the important theorems in Fourier series, transforms and vectorintegral calculus
- **CO-2.** Solve simple problems in Fourier series, transforms and vector calculus
- **CO-3.** Apply Fourier series, transforms and vector calculus in solving complex real worldengineering problems
- **CO-4.** Implement the programs to solve system of linear equations and non-linear equations ofsingle variable using MATLAB
- **CO-5.** Apply interpolation and numerical integration method in analyzing some real world problems

Course Outcomes (COs)

Course Title & Code: Materials Science for Engineers (AAC202A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain different types of diffusion mechanisms, engineering materials and its properties.
- **CO-2.** Describe phase diagrams and heat treatment processes of metals.
- **CO-3.** Identify the different types of strengthening mechanisms and compositions in metals and alloys
- **CO-4.** Discuss the various types of defects in material and relate it to the material behavior.
- **CO-5.** Assess the different properties of materials and characterization techniques.
- **CO-6.** Analyse different methods for improving the properties of materials for specific requirements and applications

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Course Outcomes (COs)

Course Title & Code: Elements of Automotive Systems and Autonomous Vehicle (AUC203A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the need, functional requirements of automotive systems, types of layout, dimensions and safety systems in a vehicle.
- **CO-2.** Explain construction and working principle of automotive engines, engine accessories and transmission systems.
- **CO-3.** Explain the working of driveline, chassis systems and their components.
- **CO-4.** Discuss the electrical and electronics systems and their applications.
- **CO-5.** Discuss the importance and requirements of safety systems.
- **CO-6.** Discuss and suggest the appropriate technologies required for a given application.

Course Outcomes (COs)

Course Title & Code: Thermodynamics for Engineers (AAC204A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe thermodynamic processes, laws, concepts of heat, work, and energy
- **CO-2.** Derive and apply the laws of thermodynamics to thermodynamic systems
- **CO-3.** Explain the merits, limitations and equivalence of laws of thermodynamics
- **CO-4.** Compute the parameters for thermodynamics processes and systems
- **CO-5.** Analyze thermodynamic cycles, mixture of gases using thermodynamic relations and draw conclusions
- **CO-6.** Solve complex thermodynamic problems using various thermodynamic relations

Course Outcomes (COs)

Course Title & Code: Fluid Mechanics and Machines (AAC205A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe different types of fluid flows, fluid machines and principle of dimensional homogeneity
- **CO-2.** Derive important fluid mechanics relations, governing equations, Bernoulli's equation, Euler equation and Euler turbine equation
- **CO-3.** Explain the working principle of flow meters and fluid machines using the appropriate governing equations
- **CO-4.** Apply Buckingham π-theorem for problems in fluid mechanics and fluid machines
- **CO-5.** Solve practical fluid flow problems like flow through ducts/pipes, flow meters, pumps and turbines
- **CO-6.** Select a suitable type of fluid machine for a given application

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Course Outcomes (COs)

Course Title & Code: Automotive Systems Laboratory (AUL206A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Identify automotive engine, transmission, drive line and chassis components.
- **CO-2.** Describe the functionalities of engine, transmission, driveline and chassis system components.
- **CO-3.** Perform dismantle and assembly of automotive engine and its subsystem.
- **CO-4.** Perform dismantle and assembly of driveline systems.
- **CO-5.** Perform dismantle and assembly of disc and drum brake systems.
- **CO-6.** Write laboratory report as prescribed format

Course Outcomes (COs)

Course Title & Code: Fluid Mechanics and Machines Laboratory (AUL207A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Plan the experimental setup to achieve the stated aim
- **CO-2.** Conduct experiments as per the standard procedures and tabulate the measured values
- **CO-3.** Calculate the required parameters and plot the results
- **CO-4.** Interpret, compare with standard results and draw conclusions.
- **CO-5.** Write the laboratory report as per prescribed format.

Course Outcomes (COs)

Course Title & Code: Environmental Studies (BTN101A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Illustrate the multidisciplinary nature of environmental studies and recognize the need for public awareness
- **CO-2.** Explain the various natural resources and their associated problems, ecosystem, and environmental pollution
- **CO-3.** Analyse the concept of ecosystem and classify various types
- **CO-4.** Compare biodiversity at local, national and global levels
- **CO-5.** Discuss various social issues pertaining to environment including sustainable development and energy issues

Course Outcomes (COs)

Course Title & Code: Additional Mathematics - 1 (MTB103A)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and explain the important theorems and solve simple mathematical problems in one variable calculus and vector algebra

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CO-2. State theorems and solve simple problems in two variable calculus

CO-3. Solve complex real world problems associated with one and two real analysis

CO-4. Illustrate fundamentals of MATLAB programming and write simple programs

CO-5. Solve complex mathematical problems associated with linear algebra and compare the results with that of solutions obtained using MATLAB

Course Outcomes (COs)

Course Title & Code: Engineering Mathematics - 4 (MTF202A)

After the successful completion of this course, the student will be able to:

CO-1. Define and explain the concepts of correlation, regression, random variables, probability distribution, partial differential equations and complex analysis

CO-2. State theorems and solve simple problems in partial differential equations, complex analysis, probability , probability distributions

CO-3. Apply numerical methods to solve ordinary and partial differential equations using MATLAB

CO-4. Solve complex engineering problems associated with numerical methods usingMATLAB

CO-5. Analyze real world problems associated with probability, probability distributions, partial differential equations and complex analysis

CO-6. Construct the Bar chart, pie chart, Histogram, Box-plot and fitting of curves byusing MATLAB

Course Outcomes (COs)

Course Title & Code: Strength of Materials (AAC212A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the types of stresses and strain, stress-strain relationship, strain energy, theories of failure, elastic constants and their relations.

CO-2. Explain various methodologies to determine reaction forces, deformation, stress, strain, strain energy on various structures such as rod, bar, beam for different types of loading and buckling load on columns.

CO-3. Solve simple numerical problems to compute the deformation, stress, strain for various structures with different loading and buckling load on columns.

CO-4. Calculate dimensions of structural members including bars and beams using appropriate method and stress distribution in thick and thin cylinders.

CO-5. Draw SFD and BMD for different beams subjected to different loads and couples.

CO-6. Calculate deformation, stress, strain for given aerospace component and draw BMD, SFDwith appropriate assumption.

Course Outcomes (COs)

Course Title & Code: Manufacturing Processes for Automotive Systems (AUC213A)

After the successful completion of this course, the student will be able to:

CO-1. Describe casting, forming, additive manufacturing, machining, and joining processes.

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CO-2. Explain the principle of operation and equipment required for different casting,forming, additive manufacturing, machining and joining techniques.

CO-3. Calculate power requirements for forging and cutting forces.

CO-4. Explain design guidelines and features in components for different processes.

CO-5. Examine the need and suitability of non-conventional machining and CNC machining processes

CO-6. Select suitable casting, forming, additive manufacturing, machining and joining process to meet the design requirement of the component.

Course Outcomes (COs)

Course Title & Code: 3D Modeling and Machine Drawing (AAC214A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the role of CAD in product development cycle.

CO-2. Apply geometric modeling techniques to build complex geometric models and assemblies of Mechanical components.

CO-3. Use drawing standards and principles, symbolic representation of mechanical components, sign conventions, sectional views, and bill of material for developing machine drawings.

CO-4. Create representative drawings of riveted joint, welded joints, pipe joints, bearings, couplings and fasteners, transmission system components.

CO-5. Create 3D assembly models and draw 2D detailed drawings with sectional details wherever required and prepare BOM for IC engine, transmission system, aircraft components, machine tool with components.

CO-6. Read and interpret the industrial drawing which includes limits-fits-tolerance information, datum references, GD & T symbols, surface roughness.

Course Outcomes (COs)

Course Title & Code: Automotive Electrical and Electronic Systems (AUC215A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the need, requirements, features of various automotive electronic systems, OBD, HVAC, electric and hybrid electric vehicle.

CO-2. Explain the workingprinciple of various sensors, actuators, HVAC and communication networks used in automotive applications.

CO-3. Discuss the functions of electronic control units in various applications such as Starting system, EMS, lighting systems, chassis electronics systems.

CO-4. Discuss types of EVs and HEVs and compare their advantages and disadvantages.

CO-5. Discuss recent and future trends in electronic systems in automotive applications.

CO-6. Suggest configuration of an electronically controlled system for a given automotive application.

Course Outcomes (COs)

Course Title & Code: Materials and Testing Laboratory (AUL216A)

After the successful completion of this course, the student will be able to:

CO-1. Plan the experimental setup to achieve the stated aim.

CO-2. Conduct experiments as per the standard procedures and tabulate the measured values.
CO-3. Calculate the required parameters and plot the results.
CO-4. Interpret, compare with standard results and draw conclusions.
CO-5. Write laboratory report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Manufacturing Process Laboratory (AUL217A)

After the successful completion of this course, the student will be able to:

CO-1. Identify forging and foundry tools, machine tools, cutting tools and accessories for turning, milling, drilling, sawing and grinding.
CO-2. Test for moulding sand properties and recommend suitable composition
CO-3. Prepare sand mould cavity, melt and pour the casting and perform forging operations.
CO-4. Operate the machine tools and perform machining operations like turning, milling, gear cutting, drilling and grinding
CO-5. Perform turning and machining operations on CNC turn center and machining center
CO-6. Write laboratory report as per the prescribed format.

Course Outcomes (COs)

Course Title & Code: Innovation and Entrepreneurship (BAU201A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the concepts and process of Innovation as well as entrepreneurship
CO-2. Construct and apply the idea generation techniques
CO-3. Discuss the opportunities for launching of new venture and various entry strategies
CO-4. Examine innovative ideas for the creation and management of entrepreneurship
CO-5. Formulate and present a viable business plan to the investors appraisal

Course Outcomes (COs)

Course Title & Code: Additional Mathematics - 2 (MTB104A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the fundamentals of ordinary differential equations State theorems and solve simple problems in two variable calculus
CO-2. Solve standard forms of ordinary differential equations Illustrate fundamentals of Linear algebra
CO-3. Model real world problems using ordinary differential equations and solve complex problems associated with ordinary differential equations
CO-4. Apply numerical methods to solve nonlinear equations in one variable, system of linear equations, interpolation and numerical quadrature, and implement the same using MATLAB
CO-5. Solve complex problems associated with nonlinear equations and linear systems, interpolation and numerical integration using MATLAB

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Course Outcomes (COs)

Course Title & Code: Propulsion Systems for Electric and Hybrid Vehicle (AUC301A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe types, concepts and working of hybrid and electric vehicles propulsion systems, alternate energy storage
- **CO-2.** Explain the parameters influencing selection of IC engine, Electric motors for electric and hybrid vehicle
- **CO-3.** Discuss the control strategy for hybrid and electric vehicle
- **CO-4.** Discuss the emission formation, methods for controlling emission in IC engine and latest trends in Hybrid Vehicle engine management
- **CO-5.** Solve simple problems IC engine performance and electric motors capacity
- **CO-6.** Suggest the propulsion system for given specific requirements

Course Outcomes (COs)

Course Title & Code: Theory of Machines and Mechanisms (ASC302A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe commonly used planar, spatial mechanisms and illustrate various constraints
- **CO-2.** Explain various principles used for kinematic and dynamic analysis of machines, and construction of cam profiles for desired motion
- **CO-3.** Solve simple problems to calculate the inertia forces at various joints, balancing force, gyroscopic forces using analytical and graphical methods
- **CO-4.** Analyze mechanisms for kinematic and dynamic properties like displacement, velocity, acceleration, force and torque
- **CO-5.** Perform static and dynamic balancing of rotating and reciprocating masses and assess the influence of gyroscopic effect
- **CO-6.** Solve complex problems to calculate inertia forces at various joints, balancing force and gyroscopic forces using appropriate method for a given application

Course Outcomes (COs)

Course Title & Code: Design of Automotive Components (AUC303A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the design procedure for automotive components
- **CO-2.** Design engine components
- **CO-3.** Design transmission and driveline components
- **CO-4.** Design brakes and chassis component
- **CO-5.** Design leaf spring and coil spring
- **CO-6.** Perform the design of automotive components for a given class of vehicle

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Course Outcomes (COs)

Course Title & Code: Automotive Noise, Vibration and Harshness (AUC304A)

After undergoing this course students will be able to:

- **CO-1.** Describe sources of vibration, noise, harshness in vehicles, effect on occupants and NVH testing procedures
- **CO-2.** Explain the methodologies to compute the various parameters such as displacement, velocity, acceleration, mode shapes for a given system
- **CO-3.** Explain the concepts of signal and systems analysis in solving NVH issues
- **CO-4.** Solve simple numerical problems to compute the parameters such as amplitude of displacement, velocity, acceleration and sound pressure level
- **CO-5.** Discuss the influence of parameters on noise and vibration propagation in vehicles
- **CO-6.** Suggest suitable test procedures to acquire NVH data for a given class of vehicles

Course Outcomes (COs)

Course Title & Code: Artificial Intelligence and Machine Learning (AAC305A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the techniques of solving problems by searching, adversarial search and constraint satisfaction problems.
- **CO-2.** Discuss Intelligent agents, knowledge, reasoning and planning as well as uncertain knowledge and reasoning
- **CO-3.** Apply Learning from examples, knowledge in learning, learning from probabilistic models and elementary concepts of reinforcement learning
- **CO-4.** Discuss application of AI in autonomous vehicles; communicating, perceiving and acting
- **CO-5.** Explain principles of localization, tracking and control with a focus on examples from Autonomous Vehicle /Self-driving cars

Course Outcomes (COs)

Course Title & Code: Control System Engineering and Laboratory (AAC306A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the basic concepts of control system and associated terminologies
- **CO-2.** Develop mathematical models of mechanical systems and determine their transfer functions
- **CO-3.** Discuss time and frequency response analysis and stability of a system
- **CO-4.** Design controller for a system and analyse performance of the system
- **CO-5.** Perform stability analysis for a given system and interpret results
- **CO-6.** Apply control system techniques to a given application and analyse the response for suitability of design using standard software

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Course Outcomes (COs)

Course Title & Code: Automotive Power Train Laboratory (AUL307A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Plan the experimental setup to achieve the stated aim
- **CO-2.** Conduct experiments as per the standard procedures and tabulate the measured values
- **CO-3.** Calculate the required parameters and plot the results
- **CO-4.** Interpret, compare with standard results and draw conclusions.
- **CO-5.** Write the laboratory report as per prescribed format.

Course Outcomes (COs)

Course Title & Code: Kinematics and Dynamics Simulation Laboratory (AUL308A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Construct mechanisms to perform kinematic and dynamic analysis.
- **CO-2.** Perform kinematic analysis for the given mechanisms through Multi-Body Dynamics (MBD) simulation.
- **CO-3.** Perform dynamic analysis of various mechanisms through MBD simulation.
- **CO-4.** Analyse the results and draw conclusions.
- **CO-5.** Write laboratory report as per the prescribed format

Course Outcomes (COs)

Course Title & Code: Vehicle Body Engineering and Crashworthiness (AUC311A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe types of body structures, aerodynamics design aspects, driver seat, safety systems used in different Vehicles.
- **CO-2.** Explain the influence of geometric modifications and add on devices to improve the aerodynamic performance of road vehicles.
- **CO-3.** Explain the concept generation through Gemba study, ideation sketches and style boards in vehicle body design process.
- **CO-4.** Discuss the effect of body design on performance and safety of the vehicle and driver visibility on vehicle Safety.
- **CO-5.** Develop geometric models, detailed design, mock up models and visualize the vehicle concepts.
- **CO-6.** Select the vehicle body construction and design process for a given specification of vehicle.

Course Outcomes (COs)

Course Title & Code: Finite Elements Analysis (AAC312A)

After undergoing this course students will be able to:

- **CO-1.** Describe the need, requirements, element types, loads, boundary conditions, modeling procedure, and analysis type for performing FE analysis
- **CO-2.** Explain the concepts of discretization, convergence requirements, analytical and numerical

methods required to solve engineering problems using FE Analysis

CO-3. Derive governing equations, stiffness matrix using various methods for different types of elements.

CO-4. Solve simple numerical problems in structural and thermal applications using finite element methods

CO-5. Discuss the selection of elements, analysis, and boundary condition for given engineering application

CO-6. Perform FE analysis for given aerospace components and assess the results

Course Outcomes (COs)

Course Title & Code: Vehicle Dynamics and Handling (AUC313A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the vehicle dynamics metrics like performance, ride and handling

CO-2. Explain various design parameters considered for achieving desired performance, ride and handling characteristics

CO-3. Discuss suspension design requirements for achieving improved handling and ride characteristics

CO-4. Solve problems related to load transfer, acceleration performance, braking performance, suspension system, steering system, Handling and Vehicle ride

CO-5. Propose design requirements for enhanced performance, ride and handling

CO-6. Instrument, Test the automotive systems and present the results for performance, ride and handling

Course Outcomes (COs)

Course Title & Code: Computational Intelligence in Automotive Applications (AUC314A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the underlying concepts of fuzzy systems, evolutionary computation, swarm intelligence and artificial immune systems.

CO-2. Explain the various algorithms of computational intelligence.

CO-3. Compare and contrast the use of different Computational Intelligence techniques to achieve particular functionalities.

CO-4. Discuss the performance issues of CI algorithms.

CO-5. Suggest a typical Computational Intelligence algorithms for given automotive engineering application(s).

Course Outcomes (COs)

Course Title & Code: Engineering Economics (AAC315A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the various costs, cash flow and cost estimation methods

CO-2. Explain various factors in value engineering and depreciation methods

CO-3. Discuss influence of interest rate, maintenance and replacement cost on economic life ofan asset

CO-4. Estimate the production cost for aerospace/automotive vehicle component

CO-5. Compare the methods for evaluation of depreciation

CO-6. Compute the total cost required for making the aerospace or automotive component / subsystem from concept to product

Course Outcomes (COs)

Course Title & Code: Vehicle Simulations Laboratory (AUL316A)

After the successful completion of this course, the student will be able to:

CO-1. Generate concept car sketches, build physical model of car and understand the procedure for conducting impact and crash simulations.

CO-2. Build scaled mockup model through form exploration process using model making materials.

CO-3. Conduct the experiment on scaled model car to measure drag force, lift forces using low speed wind tunnel.

CO-4. Perform CFD simulation of external flow over different geometric shapes and car body for the evaluation of aerodynamic forces and moments.

CO-5. Evaluate performance, handling and ride characteristics of passenger car by performing vehicle dynamics simulations

CO-6. Write laboratory report as per the prescribed format.

Course Outcomes (COs)

Course Title & Code: CAE Laboratory (AUL317A)

After the successful completion of this course, the student will be able to:

CO-1. Understand the importance and basics of finite element modelling and analysis procedures.

CO-2. Perform the different kinds of analysis and apply the basic principles to find out the stress and other related parameters.

CO-3. Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function.

CO-4. Interpret, compare with standard results and draw conclusions.

CO-5. Write the laboratory report as per prescribed format

Course Outcomes (COs)

Course Title & Code: Seminar (AUS311A)

After the successful completion of this course, the student will be able to:

CO-1. Prepare and deliver seminar on a given topic.

CO-2. Write a report on the seminar topic.

Course Outcomes (COs)

Course Title & Code: Autonomous Vehicles and Future Mobility (AUE311A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the need, requirements, configuration of autonomous vehicles, energy storage devices and their subsystems.

CO-2. Explain autonomous driving algorithms, localization, perception, prediction androuting.

CO-3. Discuss the influence of various factors on autonomous vehicle selection, performance and future trends.

CO-4. Discuss the impact of autonomous vehicle on environment and society.

CO-5. Select the suitable configuration of autonomous vehicle for specified userrequirements.

Course Outcomes (COs)

Course Title & Code: Automotive Control Systems (AUE312A)

After undergoing this course students will be able to:

CO-1. Describe the requirements, basic design process of automotive control system

CO-2. Explain the concepts of Powertrain control systems and factors influencing the performance

CO-3. Explain the control of hybrid vehicle and vehicle stability control systems

CO-4. Discuss the recent trends in intelligent transportation systems

CO-5. Discuss the control system for vehicle safety

CO-6. Develop the control systems for given automotive applications.

Course Outcomes (COs)

Course Title & Code: Light Weight and Novel Materials (AUE313A)

After the successful completion of this course, the student will be able to:

CO-1. Describe the importance, need, principles, properties and usage of light weight metals, alloys, polymers and ceramics for automotive applications.

CO-2. Explain the concepts, properties and application of composite materials for automotive applications.

CO-3. Discuss the various functional materials used for sensors and actuators and smart structures.

CO-4. Evaluate different forming operations, joining strategies for lightweight materials.

CO-5. Discuss Non-Destructive Testing (NDT) techniques used for determining flaws / defects.

CO-6. Select suitable materials and manufacturing processes for given applications.

Course Outcomes (COs)

Course Title & Code: Probability and Statistics (MTE301A)

After the successful completion of this course, the student will be able to:

CO-1. Explain the concepts of random variables, probability distribution, joint probability distribution and sampling distribution

CO-2. Explain the principles of convex optimization, regression, confidence interval and hypothesis testing

CO-3. Solve simple problems associated with probability distribution, regression, confidence interval and hypothesis testing

CO-4. Model real word problems by using probability distribution and regression

CO-5. Solve complex problems associated with probability distribution, regression, confidence interval and hypothesis testing

Course Outcomes (COs)

Course Title & Code: Advanced Mathematics (MTE302A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Define and explain Legendre and Bessel differential equation, curvature, torsion, geodesics, manifolds and tensors
- **CO-2.** State the results and theorems and solve simple problems in Legendre differential equations, Bessel differential equation, theory of curves and surfaces
- **CO-3.** Apply differential geometry techniques to compute Gaussian curvature, mean curvature, principal curvature and torsion
- **CO-4.** Solve complex engineering problems associated with Bessel differential equation, theory of curves and surfaces, orthogonal curvilinear coordinates and spherical curvilinear system
- **CO-5.** Analyze real world problems associated with Bessel differential equation and curvature of space curves

Course Outcomes (COs)

Course Title & Code: Sensing and Control for Autonomous Vehicles (AUE411A)

After undergoing this course students will be able to:

- **CO-1.** Describe the need for sensors and control, their role in autonomous Vehicle
- **CO-2.** Explain the construction, working principle and applications of various types of sensors and actuators used in autonomous vehicles
- **CO-3.** Explain the features of automotive microcontrollers and various interfacing techniques, networking protocols and their applications
- **CO-4.** Discuss the features of Maps and Path Planning in autonomous vehicles
- **CO-5.** Suggest electronically controlled system configuration for a given function in autonomous vehicles

Course Outcomes (COs)

Course Title & Code: Robust Control Systems (AUE412A)

After undergoing this course students will be able to:

- **CO-1.** Describe norms, uncertainties and robustness measures
- **CO-2.** Discuss the principles of stabilization, parametrization and H-design
- **CO-3.** Develop robust design specifications for given system
- **CO-4.** Evaluate the robust stability of the system using H-techniques
- **CO-5.** Design robust controllers for automotive applications using standard software tool

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Course Outcomes (COs)

Course Title & Code: Vehicle Aerodynamics and Styling (AUE413A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss the historical evolution of body shapes, present and future trends in body designof road vehicles, aerodynamic forces and moments acting on road vehicles.
- **CO-2.** Apply systematic geometric modifications at the appropriate locations of body and useadd on devices to improve the aerodynamic performance of road vehicles
- **CO-3.** Discuss the under-hood and in cabin airflow interactions for effective thermal management.
- **CO-4.** Generate aerodynamic and aesthetically pleasing vehicle body shapes through Gemba study, ideation sketches and style boards and concept sketches.
- **CO-5.** Develop geometric models, detailed design, mock up models and visualize the vehicle concepts.
- **CO-6.** Analyze aerodynamic performance of vehicles using CFD solver and validate with the available test data.

Course Outcomes (COs)

Course Title & Code: Data Sciences Foundation (CSE411A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the facilities—features, constructs, idioms, patterns and packages—of Python programming platform for building data science tasks
- **CO-2.** Explain the applicability of the Python programming constructs for a given task
- **CO-3.** Choose/recommend appropriate facilities of Python for data science tasks
- **CO-4.** Design data science tasks using the facilities of Python platform
- **CO-5.** Use parallelization and advanced programming constructs in the design of data sciencetasks
- **CO-6.** Synthesize and test data science tasks employing the Python platform facilities

Course Outcomes (COs)

Course Title & Code: Optimization Techniques – 1 (MTE401A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe fundamentals of convex and concave functions, linear programming and constraint nonlinear optimization
- **CO-2.** State and explain important classical techniques and numerical methods of constraint optimization
- **CO-3.** Demonstrate the skill to analyze a problem by choosing effective optimization tools
- **CO-4.** Apply optimization techniques to model real world problems
- **CO-5.** Solve complex problems associated with linear programming and constraint optimization of function of several variables

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Course Outcomes (COs)

Course Title & Code: Battery Management Algorithm for Electric Vehicle (AUE421A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the need, requirements, methodologies, strategies of battery management System.
- **CO-2.** Explain the various battery testing process and modeling of Battery.
- **CO-3.** Explain the methods and procedure for Battery SOC and SOH estimation.
- **CO-4.** Discuss the methods for Remaining Useful Life (RUL) prediction of Lithium Ion Batteries.
- **CO-5.** Discuss the algorithm development processes for battery management using RNN.
- **CO-6.** Develop algorithm to predict the life battery for the given specification.

Course Outcomes (COs)

Course Title & Code: Modeling, Dynamics and Control of Electrified Vehicles (AUE422A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the need, requirements of Modeling, Control strategies of Electrified Vehicles (EVs)
- **CO-2.** Explain generalized dynamic control of EVs
- **CO-3.** Discuss various methods for state and parameter estimation of EVs
- **CO-4.** Discuss the modeling of fault tolerant control techniques for EVs
- **CO-5.** Discuss the transmission design and control of EVs
- **CO-6.** Estimate velocity, slip angle and other parameters for the given electric vehicle specifications

Course Outcomes (COs)

Course Title & Code: Fatigue and Fracture Mechanics (AUE423A)

After undergoing this course students will be able to:

- **CO-1.** Describe the need, requirements, methodologies, strategies for fatigue based design of components and significance of fracture mechanics in design
- **CO-2.** Explain the various fatigue theories and their application for prediction of life and fatigue
- **CO-3.** Discuss methods and procedure of stress analysis of cracked components based on theory of fracture mechanics
- **CO-4.** Solve simple fatigue problems based on fracture mechanics approach
- **CO-5.** Apply different methods of fatigue analysis to design components against fatigue failure
- **CO-6.** Estimate the life of a given component by adopting suitable methodology and validate the result with virtual simulation

Course Outcomes (COs)

Course Title & Code: Data Analytics (CSE431A)

After the successful completion of this course, the student will be able to:

- **CO-1.** Discuss data analytics application development using knowledge representation, data warehousing, machine learning and data mining techniques.

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CO-2. Choose appropriate techniques and technology for data warehousing, machine learning and Data mining for knowledge discovery.

CO-3. Design data analytics processes using data warehousing, machine learning and data mining techniques for knowledge representation and discovery.

CO-4. Analyze the data and the performance of data analytics applications.

CO-5. Synthesize data analytics applications using machine learning and data mining techniques and enterprise platforms.

CO-6. Solve problems associated with large scale data analysis, machine learning and data mining.

Course Outcomes (COs)

Course Title & Code: Advanced Numerical Methods (MTE403A)

After the successful completion of this course, the student will be able to:

CO-1. Illustrate various methods of numerical computation of Eigen values

CO-2. Illustrate various methods to solve partial differential equations

CO-3. Apply numerical methods to solve partial differential equations using MATLAB

CO-4. Analyze real world problems associated with computing eigenvalues and partial differential equations

CO-5. Solve complex problems arising in real world using finite volume and finite elements methods to solve partial differential equations

Course Outcomes (COs)

Course Title & Code: Optimization Techniques – 2 (MTE402A)

After the successful completion of this course, the student will be able to:

CO-1. Describe fundamental of integral equations, variational problems and unconstrained optimization

CO-2. State and explain important classical techniques to solve integral equations and numerical methods of unconstrained optimization

CO-3. Demonstrate the skill to analyze variational problem and choose effective optimization tools

CO-4. Apply optimization techniques to model real world problems involving linear and non-linear optimization

CO-5. Solve complex problems associated with integral equations, calculus of variations and unconstrained optimization of function of several variables

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