M.S. Ramaiah University of Applied Sciences

New BEL Road, MSR Nagar, Bangalore – 560054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

PO, PSO, PEO & CO

Programme: M.Tech. in Automotive Engineering

Programme Code: 021

Programme Outcome (PO)

Programme Specific Outcome (PSO)

Program Educational Objectives (PEO)

Course Outcomes (CO)

Dean
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

Faculty of Engineering and Technology (FET)

Programme Name: M.Tech. (Automotive Engineering)

Programme Outcomes (POs)

M.Tech. graduates will be able to:

PO-1. Acquire, comprehensive knowledge and understanding of the methodologies, principles, practices and technologies of the engineering domain to solve complex problems with technical competence

PO-2. Conceptualize, apply, analyze, synthesize and evaluate information related to complex engineering problems using principles of mathematics, science and engineering to create new and innovative solutions

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. Review research literature, standards, guidelines, best practices, research methods and laboratory techniques to solve engineering problems through experimental investigations, analysis and interpretation of results

PO-5. Create, select and apply appropriate techniques and IT tools to model and solve complex engineering activities and utilize available resources effectively

PO-6. Understand the effect of engineering solutions on legal, cultural, social, public health and 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 projects in multi-disciplinary environments with consideration to cost and time

PO-12. Engage in lifelong learning and adapt to changing engineering/technology and societal requirements

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

M.S.Ramaiah University of Applied Sciences * Bangalore - 560054 *

Program Educational Objectives (PEOs)

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

PEO-1. To provide in-depth knowledge in the specialized engineering domain to enable them to deliver efficient solutions for complex engineering problems by critical thinking

PEO-2. To enable students to design and develop sustainable innovative solutions for industry and societal requirements through applied research 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

Programme Specific Outcomes (PSOs)

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

PSO-1. Apply the knowledge and principles of aerospace design to conceptualize and develop efficient solutions to complex engineering problems through critical analysis

PSO-2. Design and develop sustainable aerospace design solutions to industry and societal requirements through applied research, concepts and techniques involving experimentation and usage of modern design and modelling tools

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

Course Outcomes (COs)

Course Title & Code: Modern Automotive Systems **(19AUC501A)**

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

CO-1. Discuss the basic principles of working of various automotive systems / subsystems.
CO-2. Examine and identify the functional limitations of conventional systems / subsystems.
CO-3. Review working principle, interfacing requirements
CO-4. Discuss theoretical aspects and principle of working of various electronicallycontrolled automotive systems.
CO-5. Suggest a configuration of electronic system for a given automotive application.
CO-6. Prepare systems layouts of a modern car indicating the names of the componentswith their technical specifications.

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

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Course Outcomes (COs)

Course Title & Code: Automotive Materials and Manufacturing Processes **(19AUC502A)**

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

- **CO-1.** Discuss different type of materials and their properties for automotive applications.
- **CO-2.** Identify materials and manufacturing processes used for automotive components.
- **CO-3.** Review different types of heat treatments used for automotive components and corrosion observed in automotive systems.
- **CO-4.** Analyse functional requirements of automotive components and suggest suitable material and manufacturing process for the same.
- **CO-5.** Analyse component failures and suggest remedies in terms of materials and processes.
- **CO-6.** Use appropriate database to select suitable combination of materials and manufacturing process for a specified application

Course Outcomes (COs)

Course Title & Code: Noise, Vibration and Harshness **(19AUC503A)**

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

- **CO-1.** Discuss the phenomena of Noise and Vibration, their sources in an automotive, the need for their control and test methodology to be used for their measurement.
- **CO-2.** Identify the sources and paths of the problem related to NVH and explain the approach to solve the problem.
- **CO-3.** Analyze structures to assess its dynamic characteristics and problematic areas in design
- **CO-4.** Design Automotive systems with NVH refinement, identify sources, cause for NVH and apply acquired skills for vehicle refinement.
- **CO-5.** Measure noise and vibration and create, solve mathematical models for NVH analysis using multi-body dynamics and model-based programmes
- **CO-6.** Use analytical and simulation means to develop design for specified functional and operational requirements, assess various options to come up with the most suitable solution.

Course Outcomes (COs)

Course Title & Code: Vehicle Dynamics, Handling and Simulation **(19AUC504A)**

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

- **CO-1.** Discuss vehicle dynamics metrics like performance, ride and handling
- **CO-2.** Discuss design requirements of suspension system
- **CO-3.** Estimate the dynamic forces and predict their effect on vehicle behaviour
- **CO-4.** Create virtual model of a vehicle and through simulation, compute the forces and the vehicle responses for various vehicle system parameters
- **CO-5.** Evaluate performance, ride and handling behaviour of a vehicle through vehicle

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

M.S. Ramaiah University of Applied Sciences
Bangalore - 560054

dynamic tests

CO-6. Propose design requirements for enhanced performance, ride and handling

Course Outcomes (COs)

Course Title & Code: Computer Aided Engineering **(**19AUC505A**)**

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

- **CO-1.** Discuss the need and usage of CAE tools in product development cycle.
- **CO-2.** Create geometrical models of complex engineering components and assemblies.
- **CO-3.** Formulate 1-D, 2-D and 3-D elements for finite element modelling.
- **CO-4.** Synthesize finite element models and solve linear, non-linear, dynamic and thermal problems as applied to engineering.
- **CO-5.** Analyze for design requirements and redesign the given component.
- **CO-6.** Use of CAE tools like CATIA/UG, HYPERMESH and ANSYS and operate 3D scanner and RapidPrototyping machines

Course Outcomes (COs)

Course Title & Code: Research Methodology and IPR **(**19FET508A**)**

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

- **CO-1.** Describe the value, scope, relevance and mandatory steps of research as well as principles of effective research, Nature of Intellectual Property.
- **CO-2.** Discuss the guidelines to progress from the choice of broad field of research to specific topic of research, patent rights, process of patenting at National and International level, New Developments in IPR.
- **CO-3.** Demonstrate the application and utility of the Systematic approach and out of box thinking concepts for research to be effective.
- **CO-4.** Adapt, analyze and prepare well-structured research proposal and research paper invoking clearly outlined principles

Course Outcomes (COs)

Course Title & Code: Professional Communication **(**19FET509A**)**

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

- **CO-1.** Compose effective written business communication
- **CO-2.** Practice the techniques of presentation

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

M.S. Ramaiah University of Applied Sciences
Bangalore - 560054

Course Outcomes (COs)

Course Title & Code: Value Education **(19FET510A)**

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

- **CO-1.** Discuss the role of Values and Ethics in Self-Development
- **CO-2.** Appreciate the importance of Universal Brotherhood

Course Outcomes (COs)

Course Title & Code: Vehicle Aerodynamics and Thermal Management **(19AUC506A)**

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

- **CO-1.** Discuss the principles of aerodynamics and thermal management as applied to road vehicles
- **CO-2.** Identify the factors responsible for enhancement of aerodynamic performance as well asaesthetics for different class of road vehicles
- **CO-3.** Design aerodynamic body shapes for passenger vehicles, commercial vehicles and race carsand experimental procedure for testing
- **CO-4.** Analyze under hood airflow and thermal interactions for effective cooling
- **CO-5.** Select and recommend the most appropriate air-flow management system for climatecontrol in passenger cars
- **CO-6.** Analyze aerodynamic performance of vehicles using CFD tools and validate by testing scaled models in a wind tunnel

Course Outcomes (COs)

Course Title & Code: Elements of Design for Automotive Products **(19AUE511A)**

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

- **CO-1.** Describe the organization structure of the industry/business.
- **CO-2.** Discuss the evolution of design process
- **CO-3.** Apply sketching and digital techniques for product concept ideation
- **CO-4.** Perform form exploration to generate concepts for automotive components
- **CO-5.** Demonstrate physical model making abilities using various materials

Course Outcomes (COs)

Course Title & Code: Automotive Concepts and Product Development Process **(19AUE512A)**

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

- **CO-1.** Discuss need for new or improved automotive product development through market research
- **CO-2.** Discuss Quality Function Deployment based on market research

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

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

CO-3. Apply Quality Function Deployment (QFD) to arrive at Product Design Specification (PDS)
CO-4. Develop automotive concepts based on PDS
CO-5. Select concept for refinement based on feedback
CO-6. Use appropriate tools and techniques for generation and refinement of concepts for automotive product / components

Course Outcomes (COs)

Course Title & Code: Automotive Interior and Exterior Design **(19AUE513A)**

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

CO-1. Discuss the importance of styling, design principles, ergonomics, comfort and aesthetics.
CO-2. Recognize the body design requirements for different classes of vehicles.
CO-3. Design automotive interior and exterior based on identified themes.
CO-4. Analyze and discuss current trends in automotive interior and exterior design.
CO-5. Create physical clay models of interior and exterior design.
CO-6. Build and visualize virtual interior and exterior model.

Course Outcomes (COs)

Course Title & Code: Automotive Product Visualization and Animation **(19AUE514A)**

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

CO-1. Discuss the importance of concept cars and its development process.
CO-2. Discuss the need for visualization and various principles of visualization.
CO-3. Differentiate various product visualization and animation techniques.
CO-4. Create models to visualize the products virtually in a 3D environment using suitable visualization techniques.
CO-5. D Develop animations and render 3D models with suitable textures and light source.
CO-6. Model and animate mechanisms used in automobile product / component development.

Course Outcomes (COs)

Course Title & Code: Automotive Structures and Occupant's Safety **(19AUE521A)**

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

CO-1. Discuss typical constructions of automotive structures, sources of forces acting on it, working of safety systems in an automobile,
CO-2. Use knowledge of potential failure modes of automotive structures and mechanics of structure-occupants-pedestrian interaction in an automotive collision
CO-3. Calculate response of a design for prescribed functional and operational loads,

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

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

considering structural layouts

CO-4. Design, model, simulate and analyse "safe" structures using knowledge from different areas of mechanics and biomechanics

CO-5. Assess structural response to non-linear transient dynamic loading using simulation software, analyse results and suggest design modifications

CO-6. Develop design for specified functional and operational requirements and assess various options to come up with the most suitable solution using analytical and simulation techniques

Course Outcomes (COs)

Course Title & Code: Automotive Powertrain **(**19AUE522A**)**

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

CO-1. Elucidate the working principles of automotive power-train components andsub-systems

CO-2. Elucidate the combustion in SI and CI engine

CO-3. Estimate the size of an IC engine for automotive application

CO-4. Design clutch, transmission, and other drive train components

CO-5. Discuss the recent trends for the improvement of engine performance andemission reduction

CO-6. Recommend suitable power train technologies to meet the emission norms

Course Outcomes (COs)

Course Title & Code: Intelligent Vehicle Technology **(**19AUE523A**)**

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

CO-1. Describe need, requirements, basic elements, and communication technologies and data fusion for intelligent vehicle system.

CO-2. Explain the working of components and features in intelligent vehicle system.

CO-3. Discuss various techniques for lateral and longitudinal sensing in vehicles and control applications

CO-4. Discuss various communication protocol / technologies in IV systems and applications

CO-5. Discuss the enabling technologies, application and developments in Intelligent transportation systems

CO-6. Select the appropriate sensors, control system and interface required for development of an intelligent vehicle to meet the specific requirements.

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

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Course Outcomes (COs)

Course Title & Code: Automotive System Design **(19AUE524A)**

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

- **CO-1.** Discuss the design procedure for automotive systems including chassis, transmission, braking, steering and suspension systems
- **CO-2.** Arrive at the best possible chassis design for the given power-train layout considering safety and structural aspects of the vehicle.
- **CO-3.** Design an efficient braking system for a given class of automobile based on application.
- **CO-4.** Identify and select transmission system layout for a given class of automobile to meet the power, performance and fuel economy
- **CO-5.** Design of steering and suspension system for a given class of automobile based on application.
- **CO-6.** Create geometric models and detailed drawings for the designed automotive systems layout and components using CAD software.

Course Outcomes (COs)

Course Title & Code: Electric and Hybrid Vehicle **(20AUE531A)**

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

- **CO-1.** Describe functional requirements of components of electric vehicles
- **CO-2.** Explain configurations of electric and hybrid electric vehicles
- **CO-3.** Discuss the design principles for improved electric vehicle performance
- **CO-4.** Predict power and torque characteristics of motor for various vehicle applications
- **CO-5.** Discuss the impact of electric vehicles on vehicle fleet, electricity and fuel use, electricity production, emission and government revenues
- **CO-6.** Suggest the specification of the components required for given specification of electric and hybrid electric vehicles

Course Outcomes (COs)

Course Title & Code: Energy Storage Systems **(19AUE532A)**

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

- **CO-1.** Discuss the different energy storage systems in an automotive vehicle
- **CO-2.** Examine and Identify the functional limitation of different batteries
- **CO-3.** Discuss the battery construction, battery parameters, modelling techniques, battery testing, maintenance, failure modes and recycling procedures.
- **CO-4.** Analyze the need of battery pack management and battery thermal management system
- **CO-5.** Review working principle of fuel cell model, hydrogen fuel cell model, hydrogen storage systems, reformers, fuel cell electric vehicle
- **CO-6.** Suggest the suitable energy storage system and management techniques for given specification

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

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Course Outcomes (COs)

Course Title & Code: Electric Vehicle Structures and Safety **(19AUE534A)**

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

- **CO-1.** Discuss passive safety concepts, technologies and systems, safety regulations and ratings, injury criteria and approaches to design of structures crashworthiness of the electric vehicle structure
- **CO-2.** Study the physics of collision, vehicle crashworthiness and crash testing requirements and compute the impact energy during collision
- **CO-3.** Analyse the physics of vehicle structural, occupants and pedestrian response during vehicle crash
- **CO-4.** Suggest the design changes in the vehicle for enhanced vehicle safety rating and requirements
- **CO-5.** Discuss passive safety concepts, technologies and systems, safety regulations and ratings, injury criteria and approaches to design of structures crashworthiness of the electric vehicle's structure

Course Outcomes (COs)

Course Title & Code: Internship **(20AUP521A)**

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

- **CO-1.** Describe the organization structure of the industry/business
- **CO-2.** Identify Business objectives of the organization
- **CO-3.** Describe the various departments of the organization and their activities and responsibilities to meet the business objectives
- **CO-4.** Discuss the limitations and new opportunities for growth of the organization
- **CO-5.** Express the education and skill requirement of graduates to pursue their career in industry

Course Outcomes (COs)

Course Title & Code: Group Project **(19AUP522A)**

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

- **CO-1.** Work in a team and undertake a project in their area of specialization
- **CO-2.** Apply their knowledge of general and automotive engineering and application, develop a system for automotive application
- **CO-3.** Apply appropriate research methodology while formulating a project.
- **CO-4.** Prepare specifications, design, analyse, synthesize, prototype and assess the system
- **CO-5.** Prepare and present appropriate forms of audio-visual and verbal presentations, and written document, to describe the project, its execution and outcome

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

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Course Outcomes (COs)

Course Title & Code: Dissertation and Publication **(19AUP524A)**

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

- **CO-1.** Critically review scholarly literature collected from various sources for the project purpose and formulate a research problem
- **CO-2.** Prepare and present a research proposal
- **CO-3.** Conduct research to achieve research objectives
- **CO-4.** Propose new ideas/methodologies or procedures for further improvement of the research undertaken
- **CO-5.** Create research document and write research papers for publications
- **CO-6.** Defend the research findings in front of scholarly audience

***

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

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

M.S.Ramaiah University of Applied Sciences
Bangalore - 560054


M.S.Ramaiah University of
Bangalore - 560054