RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M S Ramaiah University of Applied Sciences

Program Structure and Course Details

of

M. Tech. (Automotive Engineering) Degree Programme

Program Code: 021

Batch: 2019 Onwards

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054.

Department of Automotive and Aeronautical Engineering
Faculty of Engineering and Technology
M S Ramaiah University of Applied Sciences

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

Approved by the Academic Council at its 18th meeting held on 20th Nov 2018

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Programme Specifications

M.Tech. (Automotive Engineering) Degree Programme

Programme Code: 021

Faculty of Engineering and Technology

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 0

Batch 2019 Onwards

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society
3. To promote health, human well-being and provide holistic healthcare
4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences
5. To instill the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in
7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental programmes

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

Programme Specifications: M. Tech. (Automotive Engineering)

Faculty	Engineering and Technology
Department	Aerospace Engineering
Programme Code	021
Programme Name	M.Tech. (Automotive Engineering)
Dean of the Faculty	Prof. H. M. Rajashekara Swamy
Head of the Department	Prof. Raja R

1. **Title of the Award:** M.Tech. (Automotive Engineering)
2. **Mode of Study:** Full-Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** Faculty of Engineering and Technology, M. S. Ramaiah University of Applied Sciences, Bengaluru
6. **Date of Programme Specifications:** October 2019
7. **Date of Programme Approval by the Academic Council of MSRUAS:** 24-July-2019
8. **Next Review Date:** May 2021
9. **Programme Approving Regulating Body and Date of Approval:** All India Council for Technical Education, New Delhi, 30-Jun-2019
10. **Programme Accredited Body and Date of Accreditation:** Not Applicable
11. **Grade Awarded by the Accreditation Body:** Not Applicable
12. **Programme Accreditation Validity:** Not Applicable
13. **Programme Benchmark:** Not Applicable
14. **Rationale for the Programme**

Mobility plays an important role in the development of economy of the world. Particularly, the road transport is very important for day to day movement of people and goods. It is estimated that there will be 1.4 billion vehicles on road by 2020 and around a 50% of them in non OECD countries including India and China. Though the road vehicles have a history of more than a century, the development of newer vehicles, creating new designs, improving the existing designs, adoption of new materials and manufacturing methods and introduction of new technologies to improve their performance is a continuing process.

The road transport vehicles are automobiles and commercial vehicles. Normally, we refer the personal transport vehicles as automobiles and the bigger vehicles used for transportation of goods and public as commercial vehicles. Developed countries like the USA, the UK, Germany, France, Italy, Sweden, Japan and South Korea have made a mark in design and production of road vehicles. Automotive companies like GM, Ford, Chrysler, Jaguar, Daimler-Benz, BMW, Volkswagen, Renault, Volvo, Toyota, Honda, Suzuki, Nissan, Hyundai, Tata Motors, Mahindra and Mahindra are well known worldwide. Almost all of these companies have established their operations in India too. In addition, companies

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

which provide technology support for automobile development like Robert Bosch, Delphi, Continental and a number of engineering service companies are operating in India. India is one of the largest two wheeler producers in the world; Hero Motors, Bajaj, TVS Motors are the famous two wheeler manufacturers in India.

These companies are involved in development of technologies to meet stringent emission norms, development of systems for electric and autonomous vehicles, safety standards and ease of driving with more comfort.

Automotive companies have been recruiting a considerable number of graduates in India for the last 8-9 years. Each company recruits around 200-800 fresh engineering graduates annually and 25 % of them are postgraduates specialized in automotive engineering.

It is the primary responsibility of the universities to produce quality graduates to sustain growth of automobile sector. The department has been offering automotive engineering programme at the postgraduate level since 2001. The programme focuses on automotive structural design, analysis, evaluation, development and physical testing of automotive systems. The programme teaches courses like modern automotive systems, powertrain, vehicle dynamics, handling and simulation, noise, vibration and harshness, structural safety and impact, electric and hybrid electric vehicle, intelligent vehicle technology, vehicle aerodynamics and thermal management and modern CAE methods. The graduates are getting opportunities in the well-known automotive companies mentioned earlier; a few of them are taking entrepreneurship route and many of them have taken research route for growth.

In fact, Automotive Engineering is one of the flagship courses of Faculty of Engineering and Technology of MSRUAS. Over the years, the department has grown intellectually as well, created excellent infrastructure and has developed a reputation amongst students, parents, industry and research sponsors.

The faculty of engineering and technology plans for further development of automotive engineering programme and compete with the best universities in the world and attracthigh quality graduates as well as teaching talent from all over the country and abroad..

15. Programme Mission

The purpose of the programme is creation of innovative problem solvers in multi-disciplinary settings, entrepreneurs and leaders applying the knowledge, understanding, cognitive abilities, practical skills and transferrable skills gained through systematic, flexible and rigorous learning in the chosen academic domain.

16. Graduate Attributes (GAs)

GA-1. Engineering knowledge: Ability to apply knowledge of mathematics, science, and Engineering fundamentals to solve complex problems in engineering

GA-2. Problem Analysis: Ability to analyse engineering problems, interpret data and arrive at meaningful conclusions involving mathematical inferences

GA-3. Design and Development of Solutions: Ability to design an engineering system, component, or process to meet desired needs considering public health and safety, and the cultural, societal, and environmental considerations

GA-4. Conduct Instigations of Complex Problems: Ability to understand and solve complex engineering problems by conducting experimental investigations

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

GA-5. Modern Tool Usage: Ability to apply appropriate tools and techniques and understand utilization of resources appropriately to complex engineering activities

GA-6. The Engineer and Society: Ability to understand the effect of engineering solutions on legal, cultural, social, and public health and safety aspects

GA-7. Environment and Sustainability: Ability to develop sustainable solutions and understand their effect on society and environment

GA-8. Ethics: Ability to apply ethical principles to engineering practices and professional responsibilities

GA-9. Individual and Teamwork: Ability to work as a member of a team, to plan and to integrate knowledge of various engineering disciplines and to lead teams in multidisciplinary settings

GA-10. Communication: Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means

GA-11. Project Management and Finance: Ability to lead and manage multidisciplinary teams by applying engineering and management principles

GA-12. Life-long learning: Ability to adapt to the changes and advancements in technology and engage in independent and life-long learning

17. 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

Dean
Faculty of Engineering & Technol
M.S. Ramaiah University of Applied Scie

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

18. Programme Goal

The programme goal is to produce post graduates having critical, analytical and problem-solving skills, and ability to think independently, and to pursue a career in Automotive Engineering.

19. 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

20. 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 automotive design to conceptualize and develop efficient solutions to complex engineering problems including electric and hybrid vehicle through critical analysis

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

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

21. Programme Structure:

SEMESTER 1

Sl. No	Course Code	Name of the Course	hours (h/W/S)			Credits	Max. Marks
			Theory	Tutorial	Practical		
1	19AUC501A	Modern Automotive Systems	4	0	0	4	100
2	19AUC502A	Automotive Materials and Manufacturing Processes	4	0	0	4	100
3	19AUC503A	Noise, Vibration and Harshness	4	0	0	4	100
4	19AUC504A	Vehicle Dynamics, Handling and Simulation	3	1	2	5	100
5	19AUC505A	Computer Aided Engineering	3	1	2	5	100
6	19FET508A	Research Methodology and IPR	2	0	0	2	50
7	19FET509A	Professional Communication	2	0	0	0	0
Total			22	2	4	**24**	**550**
Total Number of Contact Hours per Week			**28**	**Hours**			

SEMESTER 2

Sl. No	Course Code	Name of the Course	hours (h/W/S)			Credits	Max. Marks
			Theory	Tutorial	Practical		
1	19AUC506A	Vehicle Aerodynamics and Thermal Management	4	0	0	4	100
2	19AUE5X1A	Professional Elective -1	4	0	0	4	100
3	19AUE5X2A	Professional Elective -2	4	0	0	4	100
4	19AUE5X3A	Professional Elective -3	4	0	0	4	100
5	19AUE5X4A	Professional Elective -4	4	0	0	4	100
6	19FET510A	Value Education	2	0	0	0	0
Total			22	0	0	**20**	**500**
Total Number of Contact Hours per Week			**22**	Hours			

SEMESTER 3

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19AUP521A	Internship			8	4	100
2	19AUP522A	Group project			**16**	8	200
3	19AUP523A	Dissertation and Publication Phase-1					
Total					**24**	**12**	**300**
Total number of contact hours per week			**24 hours**				

Dean
Faculty of Engineering & Technol
M.S. Ramaiah University of Applied Scie
Bangalore - 560 058.

SEMESTER 4

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19AUP524A	Dissertation and Publication Phase-2			48	24	400
Total					**48**	**24**	**400**
Total number of contact hours per week			**48 hours**				

Group ▼ / Stream ▸		Automotive Product Design	Automotive System Design	Advance Vehicle Technology
PCE-1	Course Code	19AUE511A	19AUE521A	19AUE531A
	Course Title	Elements of Design for Automotive Products	Automotive Structures and Occupant's Safety	Electric and Hybrid Vehicle
PCE-2	Course Code	19AUE512A	19AUE522A	19AUE532A
	Course Title	Automotive Concepts and Product Development Process	Automotive Powertrain	Energy Storage Systems
PCE-3	Course Code	19AUE513A	19AUE523A	19AUE523A
	Course Title	Automotive Interior and Exterior Design	Intelligent Vehicle Technology	Intelligent Vehicle Technology
PCE-4	Course Code	19AUE514A	19AUE524A	19AUE534A
	Course Title	Automotive Product Visualization and Animation	Automotive System Design	Electric Vehicle Structures and Safety

Note:

1. Students are required to choose any 4 professional core electives from the list. There is no restriction that they should stick to only one stream and stream is provided as an opportunity for students to choose particular

22. Course Delivery: As per the Timetable

23. Teaching and Learning Methods

1. Face to Face Lectures using Audio-Visuals
2. Workshops, Group Discussions, Debates, Presentations
3. Demonstrations
4. Guest Lectures
5. Laboratory work/Field work/Workshop
6. Industry Visit
7. Seminars
8. Group Exercises
9. Project Work
10. Project
11. Exhibitions
12. Technical Festivals

M.S. Ramaiah University of Applied Sciences

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

24. Assessment and Grading

24.1. Components of Grading

There shall be **two components** of grading in the assessment of each course:

Component 1, Continuous Evaluation (CE): This component involves multiple subcomponents (SC1, SC2, etc.) of learning assessment. The assessment of the subcomponents of CE is conducted during the semester at regular intervals. This subcomponent represents the formative assessment of students' learning.

Component 2, Semester-end Examination (SEE): This component represents the summative assessment carried out in the form an examination conducted at the end of the semester.

Marks obtained CE and SEE components have equal weightage (CE: 50% and SEE: 50%) in determining the final marks obtained by a student in a Course.

The complete details of Grading are given in the Academic Regulations.

24.2. Continuous Evaluation Policies

Continuous evaluation depends on the type of the course as discussed below:

24.2.1 Theory Courses

The following **TWO options** are available for each Faculty to perform the CE exercise.

Option 1 for a Theory Course:

Theory Course			
SC1	SC2	SC3	SC4
25 Marks	25 Marks	25 Marks	25 Marks

In Option 1, there shall be four subcomponents of CE (SC1, SC2, SC3 and SC4). Each subcomponent is evaluated individually for 25 marks. It is mandatory that two of the four subcomponents are term-tests. The remaining two subcomponents can be of any of the following types:

a) Online Test
b) Assignments/Problem Solving
c) Field Assignment
d) Open Book Test
e) Portfolio
f) Reports
g) Case Study
h) Group Task
i) Any other

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

After the four subcomponents are evaluated, the CE component marks are determined as:
CE Component Marks = (Total of the marks obtained in all the four subcomponents) ÷ 2

An additional subcomponent (SC5) may be used at the discretion of the Faculty/Department. The department can conduct the 5th subcomponent SC5 if this subcomponent gives benefit to students. If the Department/Faculty conducts the SC5 subcomponent of evaluation, and the score obtained by the student in SC5 is greater than the lowest score of the previous four subcomponents SC1 to SC4, then it replaces the lowest of the four scores.

Option 2 for a Theory Course:

Theory Course			
SC1	SC2	SC3	SC4
25 Marks	25 Marks	25 Marks	25 Marks

In Option 2, there shall be four subcomponents, each carrying 25 marks. Out of these, there shall be two assignments and two term-tests. The assignments can be of any of the following types:

a) Online Test
b) Problem Solving
c) Field Assignment
d) Open Book Test
e) Portfolio
f) Reports
g) Case Study
h) Group Task
i) Any other

After the four subcomponents of CE are evaluated, the CE component Marks are determined as:

CE Component Marks = (Best of two Assignment Marks) + (Best of two Term-Test Marks)
Each Faculty Dean, in consultation with the heads of all departments in the Faculty and the Faculty Academic Registrar, decides whether Option 1 or Option 2 is adopted for each programme offered by the Faculty. He/she notifies the students about the option at the beginning of the semester.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

24.2.2 Course Having a Combination of Theory and Laboratory

For a course that contains the combination of theory and laboratory sessions, the scheme for determining the CE marks is as under:

For a Course having a Combination of Theory and Laboratory Sessions			
SC1 (Theory)	SC2 (Theory)	SC3 (Theory)	SC4 (Laboratory)
25 Marks	25 Marks	25 Marks	25 Marks

There shall be four subcomponents, each carrying 25 marks. Out of these, there shall be two term-tests and an assignment to evaluate the students' performance in theory. The fourth subcomponent shall be set to evaluate the students' performancein the laboratory.
The theory assignment can be of any of the following types:

a) Online Test
b) Problem Solving
c) Field Assignment
d) Open Book Test
e) Portfolio
f) Reports
g) Case Study
h) Group Task
i) Any other

The laboratory subcomponent can be of any of the following types:

a) Laboratory / Clinical Work Record
b) Experiments
c) Computer Simulations
d) Creative Submission
e) Virtual Labs
f) Viva / Oral Exam
g) Lab Manual Report
h) Any other (e.g. combinations)

After the four subcomponents are evaluated, the CE component marks are determined as:
CE Component Marks = (Total of the marks obtained in all the four subcomponents) ÷ 2

25. Student Support for Learning

1. Course Notes
2. Reference Books in the Library
3. Magazines and Journals
4. Internet Facility
5. Computing Facility
6. Laboratory Facility
7. Workshop Facility

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

8. Staff Support
9. Lounges for Discussions
10. Any other support that enhances their learning

26. Quality Control Measures

1. Review of Course Notes
2. Review of Question Papers and Assignment Questions
3. Student Feedback
4. Moderation of Assessed Work
5. Opportunities for students to see their assessed work
6. Review by external examiners and external examiners reports
7. Staff Student Consultative Committee meetings
8. Student exit feedback
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

27. Programme Map (Course-PO-PSO Map)

Sem.	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
1	Modern Automotive Systems	3	3	3	3									3	3	
1	Automotive Materials and Manufacturing Processes	3	3	3	3	3	3	2	2	1	2	2	1	3	3	2
1	Noise, Vibration and Harshness	3	3	1	2									3	2	
1	Vehicle Dynamics, Handling and Simulation	3	3	3	3	3	3	3		3	3	2	3	3	3	3
1	Computer Aided Engineering	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
1	Research Methodology and IPR				3		3	3	3	2	3	3	1		3	3
1	Professional Communication					2					2					2
2	Vehicle Aerodynamics and Thermal Management	3	3	3	3	3	3	3	3	3	3	1	2	3	3	3
2	Elements of Design for Automotive Products	2	3	3	3	2	2	2	2	2	2	2		3	3	2
2	Automotive Concepts and Product Development Process	2	2	2	2	3		2			3	2	2	2	3	3
2	Automotive Interior and Exterior Design	3		3	3	3	2	3			2			3	3	2
2	Automotive Product Visualization and Animation	3	3	3	3	3	2				2			3	3	2
2	Automotive Structures and Occupant's Safety	3	3	3	3	3								3	3	
2	Automotive Powertrain	3	3	2	3	2	3	2	1	1	2	2	1	3	3	2
2	Intelligent Vehicle Technology	3	3	3	2	2	1	2	1	1	1	1	1	3	2	1
2	Automotive System Design	3	3	3		3	3	3				2	2	3	3	2
2	Electric and Hybrid Vehicle	3	3		2									3	2	
2	Energy Storage Systems	3	3	1	2									3	2	
2	Electric Vehicle Structures and Safety	3	3	3	3	3								3	3	
3	Internship	3	3	3	3	3	3	3	2	3	3	3	2	3	3	3
3	Group project	3	3	3	3	3	2	2	2	2	2	1	2	3	3	2
4	Dissertation and Publication	3	3	3	3	3	1	3	1	3	3	3	1	3	3	3

28. Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposia, paper writing, attending industry exhibitions, project competitions and related activities for enhancing their knowledge and networking.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

29. Cultural and Literary Activities

Annual cultural festivals are held to showcase the creative talents in students. They are involved in planning and organizing the activities.

30. Sports and Athletics

Students are encouraged to take part in sports and athletic events regularly. Annual sports meet will be held to demonstrate sportsmanship and competitive spirit.

ಶುಭಂ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

Course Specifications

M. Tech. Programme

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Programme: Automotive Engineering

Department: Automotive and Aeronautical Engineering

Faculty of Engineering & Technology

M. S. Ramaiah University of Applied Sciences

University House, New BEL Road, MSR Nagar, Bangalore – 560 054

www.msruas.ac.in

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specification

Course Details				
Course Code	19AUC501A			Course Category
Course Title	Modern Automotive Systems			
Programme	M.Tech in Automotive Engineering			PC
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May- 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	The aim of this Course is to prepare the students to study and critically evaluate the automotive systems, sub-systems and identify the need for electronics and software systems in modern automobiles. Basic automotive systems are discussed in terms of underlying principles of construction, working, limitations of the conventional systems. Also, students are encouraged to explore the opportunities in using electronics for new functions / applications to improve the performance of the systems / subsystems by studying the physical systems, interacting with experts and users.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Discuss the basic principles of working of various automotive systems / subsystems		X	X
2	Examine and identify the functional limitations of conventional systems / sub systems		X	X
3	Review working principle, interfacing requirements and applications of various sensors and actuators used in vehicle		X	X
4	Discuss theoretical aspects and principle of working of various electronically controlled automotive systems		X	X
5	Suggest a configuration of electronic system for a given automotive application	X	X	X
6	Prepare systems layouts of a modern car indicating the names of the components with their technical specifications	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
Introduction to automotive industry and Modern Automotive Systems: Vehicle classifications and specifications, Introduction to modern automotive systems and need for electronics in automobiles. Application areas of electronic systems in modern automobiles. Sensors and actuators. Opportunities and challenges in the automotive industry, enabling technologies and industry trends **(3 Hours)**
Spark and Compression Ignition Engines: Ignition systems, Fuel delivery systems, Engine control functions, Fuel control, Calculation of injector pulse width and injection strategies, Ignition timing control, Lambda control, Engine control modes, OBD concepts. **(8 Hours)**
Transmission Control: Automotive transmissions: Transmission fundamentals, Types-MT, AT, CVT and DCT. Components, Introduction to electronic transmission control- Shift point control, Lockup control/torque converter clutch, Engine torque control during shifting, Safety and diagnostic functions, Improvement of shift quality. **(6 Hours)**
Braking and Electronic Stability Control: Vehicle braking fundamentals, Vehicle dynamics during braking, hydraulic brake system components, Introduction to antilock braking systems, Components, principle of working and control logic, Electronic stability control and other technologies. Steering Control: Steering system basics, Fundamentals of electronically controlled power steering: type, Electronically controlled hydraulic systems and Electric power steering systems. **(7 Hours)**
Automotive Electronics for Passenger Safety and Convenience: Active and Passive Safety systems. Air bag and seat belt pre-tensioner systems: Sensor functions, Distributed front air bag sensing systems and future occupant protection systems, Tire pressure monitoring systems. Passenger Comfort and Convenience Systems: Configurations of systems such as power seats, Power windows, Remote keyless entry systems, Wiping systems, Immobilizers, etc. laboratory demonstration and exercises on Body electronic systems **(8 Hours)**
Overview of Hybrid Vehicles: Types of hybrid vehicles, configurations, main components of hybrid vehicles such as - energy storage and re-generative braking, motors, hybrid transmission configurations. Industry trends and case studies. **(4 Hours)**
Practical/Laboratory content: Study of engine and its subsystems, Performance testing of IC Engines. **(10 Hours)**
Practical/Laboratory content: Laboratory demonstrations and exercises on braking and Steering systems. OBD and Electronics Fuel Injection systems demonstration. **(4 Hours)**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		40
Demonstrations		10
1. Demonstration using Videos	4	
2. Demonstration using Physical Models/ Systems	6	
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems	0	
Practical Work		4
1. Course Laboratory	4	
2. Computer Laboratory		
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		6
1. Assignment Discussion / Related Activities		
2. Case Study Presentation	3	
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations	3	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S. No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills						x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

4. Course Resources	
a. **Essential Reading**	1. Erjavaec, 2004, Automotive Technology – A system approach, 3rd Edn, Thomson Delmar Learning 2. Class Notes
b. **Recommended Reading**	1. Jurgen R. K. (1999) Automotive Electronics Handbook, 2nd Edn, McGraw-Hill. 2. Bosch. (1999) Automotive Electrics and Electronics, 3rd Edn, Robert Bosch. 3. Bosch. (2000) Automotive Hand Book, Society of Automotive Engineers. 4. Denton T. (2004) Automotive Electrical and Electronic Systems, 3rd Edn, SAE. 5. Bauer H. (2004) Gasoline Engine Management – Systems and Components, 2nd Edition, Robert Bosch. 6. Bauer H. (2005) Diesel-Engine Management – Systems and Components, 3rd, Edn, Robert Bosch
c. **Other Resources**	

ಹಂಚಿಕೆ

M.S. Ramaiah University ... Bangalore

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specification

Course Details				
Course Code	19AUC502A			Course Category
Course Title	Automotive Materials and Manufacturing Processes			
Programme	M.Tech in Automotive Engineering			PC
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course deals with critical evaluation of materials as well as manufacturing process, and select appropriate materials and processes for automotive applications. The course will impart knowledge about different classes of materials, advanced materials, manufacturing processes, structure-property-processing correlation, matching manufacturing processes and materials, corrosion and its prevention, painting and failure analysis of materials. The students will be trained in selection of materials and manufacturing techniques for different components using the materials and manufacturing database.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Discuss different type of materials and their properties for automotive applications		X	X
2	Identify materials and manufacturing processes used for automotive components		X	X
3	Review different types of heat treatments used for automotive components and corrosion observed in automotive systems	X	X	
4	Analyse functional requirements of an automotive component and suggest suitable material and manufacturing process for the same	X	X	X
5	Analyse component failures and suggest remedies in terms of materials and processes	X		
6	Use appropriate database to select suitable combination of materials and manufacturing process for a specified application	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
Automotive components and materials: Component categories, property evaluation of materials for different components, classification of materials, factors influencing selection of materials **(02 Hours)**
Metallic materials in automotive environment: Metallurgical principles used for strengthening metals and alloys, Properties and application of ferrous and non-ferrous alloys in automotive, advanced high strength steels, different lightweight metals and alloys, heat treatment for ferrous and nonferrous alloys, analysis of merits and demerits of metallic materials for automotive applications with case studies **(06 Hours)**
Manufacturing processes for automotive application: Casting, forging, sheet metal forming, Powder metallurgy, Additive Manufacturing **(09 Hours)**
Joining technologies for automotive application: TIG and MIG welding, Resistance spot welding, mechanical fastening, Advanced techniques like plasma technique, laser welding, adhesive joining etc. Joining of dissimilar materials; **(03 Hours)**
Non-metallic Materials in automotive: Properties of polymers, Thermo plastic and thermoset usage based on the functionality requirement, Ceramic materials: Properties and applications in automotive, Advantages and limitations of non-metallic materials for automotive applications and remedies to overcome these Processing of Non-metallic Materials for automotive: Processing of polymer materials like injection moulding, extrusion, compression moulding etc. Processing of ceramics like slip casting, powder metallurgy technique etc. **(06 Hours)**
Composite materials and Processing for Automotive: Classification and properties of composite materials, Polymer and Metallic Matrix (PMC/MMC) in automotive Applications; Processing techniques for PMC, MMC: laminate structures, hand layup, resin transfer moulding, SMC and BMC, gas pressure infiltration etc. Advantages and disadvantages of composite materials for automotive applications with case studies **(06 Hours)**
Corrosion and Failure analysis: Surface finish of components, corrosion and its prevention, painting procedures for automotive components, Importance of failure modes for automotive components, case studies on failure analysis of components **(06 Hours)**
Practical/Laboratory content: Selection of materials and manufacturing techniques: Identification of materials and manufacturing processes for automotive components/systems; Correlation of functionality of the component with material properties, derivation of performance index based on functionality of the component, selection of materials and manufacturing based on functionality, manufacturing feasibility, adoption of suitable joining technique, Use of software tool for selection of materials and manufacturing **(12 Hours)**

M.S. Ramaiah University of Applied Sciences Bangalore

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		40
Demonstrations		10
1. Demonstration using Videos	4	
2. Demonstration using Physical Models/ Systems	6	
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems	0	
Practical Work		4
1. Course Laboratory		
2. Computer Laboratory	4	
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		6
1. Assignment Discussion / Related Activities		
2. Case Study Presentation	3	
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations	3	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x	x		x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

4. Course Resources		
d.	**Essential Reading**	1. M. F. Ashby and H. Shercliff, D. Cubon, (2007) Materials Engineering Science, Processing and Design, Butterworth Publications 2. Serope Kalpakjian and Steven R. Schmid. (2004) Manufacturing Processes for Engineering Materials, Pearson Education 3. W. D. Callister. (2005) Materials Science and Engineering an Introduction, 6th Edition, John Wiley & Sons 4. Class Notes
e.	**Recommended Reading**	1. C. Brian, G. Patrick and Colin. (2007) Automotive Engineering: Light Weight, Functional and Novel Materials, Taylor and Francis 2. H. Yamagata. (2005) The Science and technology of Materials in Automotive Engines, Yamaha Motor Co. Ltd., Japan Woodhead Publishing Limited 3. G. Davies. (2003) Materials for Automobile Bodies, Butterworth-Heinemann Publications 4. M. P. Groover. (2005)Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 2nd Edition, John Wiley & Sons
f.	**Other Resources**	

ಅಂಶ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specification

Course Details				
Course Code	19AUC503A			Course Category
Course Title	Noise, Vibration and Harshness			
Programme	M. Tech. in Automotive Engineering			PC
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	05-2019	Course Next Review Date	05-2021	
Department Responsible for Course Delivery	Automotive and Aeronautical Engineering			

1. Course Size and Credits	
Number of Credits	3
Duration (Hrs)	60
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	The aim of this Course is to prepare the students to analyse noise and vibration in automobiles and recommend design improvements for their control. The students will be taught concepts of noise, vibration and harshness, modelling, solving and analysing multi-degree freedom dynamic systems. The students will be taught the techniques of attenuation of noise, damping and isolation of vibrations. The students will be trained to measure noise and vibrations in a given situations and also to identify the source and cause of vibration and noise and their path from the source to the area of interest. During the course, students will be trained to use MATLAB/SIMULINK and finite element software for vibration analysis.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other Activities
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		X	X
2	Identify the sources and paths of the problem related to NVH and explain the approach to solve the problem		X	X
3	Analyse structures to assess its dynamic characteristics and problematic areas in design		X	X
4	Design Automotive systems with NVH refinement, identify sources, cause for NVH and apply acquired skills for vehicle refinement		X	X
5	Measure noise and vibration and create, solve mathematical models for NVH analysis using multi-body dynamics and model-based programmes	X	X	X
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	X		X

IMPORTANT: Details of Component Weightages, Assessment and Re-assessment are indicated in M. Tech. Programme Specification document for the given category of the course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

3.2 Course Content
Introduction to Noise, Vibration and Harshness: NVH and need for NVH considerations in design, Terminology used in NVH domain, Brief introduction of vibration phenomena, Need for study of vibration/noise in automotive **(03 Hours)**
Sources of Noise and Vibration in Vehicle: Sources of vibrations in an automobile, Different types of vibrations, Sources of noise and audible range, Examples of vibrations and noise generation and transmission, Need for NVH testing, Typical testing for NVH, Role of NVH in Vehicle development **(03 Hours)**
Vibrations: Key elements of a vibrating system, Modeling for vibration and governing equations, Response to general periodic loading, Response to irregular periodic force, Response to non-periodic loading, Characteristics of a 2 degree of freedom system. **(05 Hours)**
Structural Dynamics and Modal Analysis: Signal and System approaches to dynamic analysis, Modal parameters, properties and analysis, using test results to extract modal parameters, Experimental modal analysis – methods, considerations and devices **(05 Hours)**
Vibrations and Sounds: Vehicle interior noise: structure-borne noise, airborne noise, wind noise, Buzz, Squeak and Rattle (BSR) **(03 Hours)**
Instrumentation, Testing and Signal Processing: Sensors (accelerometers, microphones etc.), Data Acquisition Systems, Test Setups, Signal Analysis **(02 Hours)**
Sources & Control: Sources of Vibration & Control, Sources of Interior Noise & Control, Sources of Exterior Noise & Control, Transfer Path Analysis **(03 Hours)**
NVH in Automotive Industry: Vehicle Refinement, Need for refinement, Standard Tests, Regulations, Diagnostics **(03 Hours)**
NVH Testing and Data Acquisition **(10 Hours)**
FEM Simulations for Structural Analysis **(03 Hours)**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		27
Demonstrations		
1. Demonstration using Videos	XX	
2. Demonstration using Physical Models/ Systems	XX	
3. Demonstration on a Computer	XX	
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		13
1. Course Laboratory	10	
2. Computer Laboratory	03	
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		
1. Assignment Discussion / Related Activities	XX	
2. Case Study Presentation	XX	
3. Guest Lecture	XX	
4. Industry / Field Visit	XX	
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations		
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		XX

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	X		X						
2.	Understanding	X		X						
3.	Critical Skills					X				
4.	Analytical Skills	X		X		X				
5.	Problem Solving Skills			X		X				
6.	Practical Skills			X		X				
7.	Group Work			X		X				
8.	Self-Learning					X				
9.	Written Communication Skills					X				
10.	Verbal Communication Skills						X			
11.	Presentation Skills						X			
12.	Behavioural Skills	X								
13.	Information Management		X		X		X			
14.	Leadership Skills									

Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

4. Course Resources	
a. **Essential Reading**	1. **Class Notes** 2. Gang Sheng, (2012), Vehicle Noise, Vibration, and Sound Quality, Warren dale, PA 15096-0001 USA, SAE International 3. M. Harrison, (2004), Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Warren dale, Butterworth-Heinemann
b. **Recommended Reading**	1. W.T. Thomson, (1995), Mechanical Vibrations, Prentice- Hall 2. S.S. Rao., (1995), Mechanical Vibrations, Addison Wesley 3. M.P. Norton., (1994), Fundamentals of Noise and Vibrations Analysis for Engineers, Cambridge, University Press
c. **Other Resources**	1. International Journal of Vehicle Noise and Vibration, Inder-science Publishers 2. The Journal of Sound and Vibration, Elsevier 3.http://vw.nateonline.com/techdocs/Noise,%20Vibration,%20and%20Harshness.pdf

ಐ೦ಆ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specification

Course Details				
Course Code	19AUC504A			Course Category
Course Title	Vehicle Dynamics, Handling and Simulation			
Programme	M.Tech in Automotive Engineering			PC
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits

Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary

Aim and Summary	The aim of this course is to understand ground vehicle dynamic response and engineer methods to achieve desired vehicle behaviour. The students will be taught the principles of longitudinal and lateral load transfer and their effect on vehicle behaviour. The underlying concepts and design methods for vehicle performance, ride and handling will be dealt in detail. Students will be taught to develop virtual vehicle models and simulate vehicle behaviour for various road inputs using multi body dynamic (MBD) software. The student will also be given experience of testing a ground vehicle in the laboratory and as well as on road to analyse performance, ride and handling behaviour of the vehicle.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S. No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Discuss vehicle dynamics metrics like performance, ride and handling		X	X
2	Discuss design requirements of suspension system		X	X
3	Estimate the dynamic forces and predict their effect on vehicle behaviour		X	X
4	Create virtual model of a vehicle and through simulation, compute the forces and the vehicle responses for various vehicle system parameters and answer what if questions	X	X	X
5	Evaluate performance, ride and handling behaviour of a vehicle through vehicle dynamic tests	X	X	X
6	Propose design requirements for enhanced performance, ride and handling	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
Vehicle Dynamics and Fundamentals of Load Transfer: Explaining Vehicle Dynamics, Vehicle performance- Acceleration& Braking; Ride and Handling, Estimation of Road Loads, Tractive Resistance and Tractive Force, Newton's Law and developing equations for forces acting on vehicle axles, longitudinal and lateral load transfer, estimating load on individual wheel, gradeability, Static Stability Factor. Example on basic vehicle specifications and design calculations. **(3 Hours)**
Vehicle Performance- Acceleration and Braking: Engine power limited acceleration, ideal engine characteristics, tractive force, and improving tractive force by transmission design, power train weight for acceleration performance, effect of power to weight ratio on acceleration performance and development models for traction limited acceleration, traction control system, Vehicle braking, deceleration, time to stop, stopping distance, brake types, brake fading, panic braking, braking force calculations, wheel locking, brake proportioning, antilock brakes. **(6 Hours)**
Wheel Alignment and Vehicle Steering Performance: Wheel alignment angles- Camber, toe, caster, steering axis inclination, scrub radius, thrust angle , their effect on vehicle handling, compliance and suspension bushes, Demonstration of wheel alignment angles in the laboratory, Ackermann principle for vehicle steering, Steering systems and steering errors, Steering system performance-central feel, steering returnability, steering ratio, steering effort, Calculation of steering effort, Designing steering assist systems, Active Steering System. **(3 Hours)**
Vehicle Suspension Design Requirements: Design requirements of a suspension system, Roll Centre, Roll Axis, Roll Moment, Roll Moment Distribution and Setting, Roll Centre Height , Calculating roll angle, Calculating roll rate and roll stiffness, Squat and dive and designing suspension linkages for anti-squat, anti-dive, anti-pitch, lateral slide, Calculating pitch rate, Suspension types and their relative merits and limitations and applications, Designing suspension for ground vehicles. **(3 Hours)**
Steady State and Transient Handling: Low speed Vs Steady State Handling, Cornering Equation, Under, Neutral and Over Steer conditions and effects, Calculating understeer gradient, Measuring vehicle yaw Suspension effects on Handling, Transient handling, and Electronic stability program. **(6 Hours)**
Vehicle Ride: Excitation Sources, Ride Rate and Vehicle natural frequency, Damping coefficient and variable damping ratio, Quarter car models and response analysis, Half car models, Vehicle pitch and roll analysis, Characterising suspension springs and dampers, Calculating ride rate, Calculating bounce frequency, Calculating Pitch and Roll Frequency. **(3 Hours)**
Suspension Types and Technologies: Suspension types and their relative merits and limitations and applications, Passive suspension limitations, Semi active and active suspension technologies. **(3 Hours)**
Tyres: Automotive tyres, specifications and designs, Tyre modelling and analysis, Technology trends in tyre designs. **(3 Hours)**
Practical/Laboratory content: Study of engine and its subsystems, Performance testing of IC Engines. **(10 Hours)**
Practical/Laboratory content: Laboratory demonstrations and exercises on braking and Steering systems. OBD and Electronics Fuel Injection systems demonstration. **(4 Hours)**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		36
Demonstrations		04
1. Demonstration using Videos	2	
2. Demonstration using Physical Models/ Systems	2	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		20
1. Course Laboratory		
2. Computer Laboratory	20	
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		0
1. Assignment Discussion / Related Activities		
2. Case Study Presentation		
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations		
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

4. Course Resources	
a. **Essential Reading**	1. Thomas D. Gillespie (1992), Fundamentals of Vehicle Dynamics, SAE 2. Class Notes
b. **Recommended Reading**	1. W. Milliken and D. Milliken. (1995) Race Car Vehicle Dynamics, Society of Automotive Engineers (SAE) 2. W. Milliken and D. Milliken. (2002) Chassis Design – Principles and Analysis, Society of Automotive Engineers (SAE) 3. J.Y. Wong. (2001) Theory of Ground Vehicles, 3rd edition, John Wiley & Sons. 4. H. Rahnejat. (1998) Multi-body Dynamics-Machines, Vehicle and Mechanisms, Mechanical Engineering Publications 5. M. Blundell and D. Harty. (2004) The Multibody Systems Approach to Vehicle Dynamics, Elsevier Science. 6. G. Genta. (1997) Motor Vehicle Dynamics. Modeling and Simulation, World Scientific.
c. **Other Resources**	

Course Specification

Course Details				
Course Code	19AUC505A			Course Category
Course Title	Computer Aided Engineering			
Programme	M.Tech in Automotive Engineering , Aircraft design			PC
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	3
Duration (Hrs)	60
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course is aimed at preparing students to use CAE concepts to develop geometric model of engineering components for analyzing structural behaviour under different conditions so that the design can be refined and optimized. The students will be taught advanced geometric modelling techniques; data exchange formats to use CAD model for downstream applications, reverse engineering method to generate engineering data. The principles of finite element modelling, problem solving approaches using finite element methodology to solve linear, non-linear, dynamic and thermal problems will be explained. The student will also be trained to use CAE tools like Hypermesh and ANSYS to solve industry specific practical problems and Rapid prototyping technique to build prototype models.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Discuss the need and usage of CAE tools in product development cycle.		X	
2	Create geometrical models of complex engineering components and assemblies.	X		X
3	Formulate 1-D, 2-D and 3-D elements for finite element modelling.		X	
4	Synthesize finite element models and solve linear, non-linear, dynamic and thermal problems as applied to engineering	X	X	
5	Analyze for design requirements and redesign the given component.	X		
6	Use CAE tools like CATIA/UG, HYPERMESH and ANSYS and operate 3D scanner and	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

3.2 Course Content

Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

CAE Systems- introduction to CAD/CAM/CAE systems, the role of CAE in product development cycle, CAD system environment, Introduction to PDM systems, CAD/CAM/CAE integration **5 Hours**
Geometric modeling: Co-ordinate systems in CAD environment, transformation features, solid modeling and assembly modeling techniques, advanced curve and surface generation techniques, surface curvature analysis, Data exchange in CAE and Neutral file formats **5 Hours**
Reverse Engineering methods- data generation techniques, contact and non-contact type scanning, Rapid prototyping techniques for product development **5 Hours**
Introduction to Finite Element Methodology- Use of engineering analysis for solution of complex problems, Mathematical model approach and its limitations, Numerical solution approaches, Finite element approach 5 **Hours**
FEM for Linear Static Structural Problems: Basic structural (stiffness) problem, Discretized structural problem, FE approach for structural problem, Idealization, Terminology, Requirement for representation of stiffness of discrete structural components, Basic Strength of Materials and its importance in carrying out the FE analysis **5 Hours**
Element Formulation and Modelling Considerations: Element stiffness, Different approaches for element formulation, Use of energy approach for element formulation, Local, global stiffness, Shape functions and natural coordinates, Gauss Quadrature, Linear and quadratic elements, 1D/2D/3D/Bending/Other special elements. Element selection (kind, type, size, order), Representation of geometry, Application of loads, Representation and application of boundary conditions **7 Hours**
Thermal Analysis and Introduction to Non-linear Analysis: Extension of FE methodology for structures to thermal problems, "Loads" and boundary conditions for thermal problems, Sources and types of non-linearity, techniques for solving non-linear problems **5 Hours**
Dynamic Analysis: Static versus Dynamic analysis – loads and response, Dynamics and methodologies for dynamic problems **3 Hours**
Practical/Laboratory content: CATIA/UG-NX, HYPERMESH and ANSYS software will be used for geometric modeling, finite element modeling and solving of complex linear, non-linear, thermal and dynamic problems **20 Hours**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

M.S. Ramaiah University of Applied Sciences Bangalore

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		30
Demonstrations		10
1. Demonstration using Videos		
2. Demonstration using Physical Models/ Systems		
3. Demonstration on a Computer	10	
Numeracy		5
1. Solving Numerical Problems	5	
Practical Work		3
1. Course Laboratory		
2. Computer Laboratory	3	
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		2
1. Assignment Discussion / Related Activities	2	
2. Case Study Presentation		
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations		
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		60

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

M.S. Ramaiah University of Applied Sciences Bangalore

4. Course Resources		
a.	**Essential Reading**	1. Class Notes 2. Vince Adams and Abraham Askenazi. (1999) Building Better Products with Finite Element Analysis, Onward Press 3. Ibrahim Zeid and R Sivasubramanian. (2008) CAD/CAM Theory and Practice, Tata McGraw-Hill
b.	**Recommended Reading**	1. Zeid I., (2005), "Mastering CAD/CAM", McGraw-Hill ISBN 2. K.J. Bathe. (2008) Finite Element Procedures, Prentice-Hall India Pvt. Ltd., New Delhi 3. Emad Abouel Nasr, Ali K. Kamrani (2007), Computer-Based Design and Manufacturing - An Information-Based Approach, Springer Publication, ISBN: 0-387-23323-7 4. Robert D. Cook, David S. Malkus, Michael E. Plesha and Robert J. Witt. (2001) Concepts and Applications of Finite Element Analysis, 4th Edition, John Wiley & Sons. 5. Chandraputla, T. R. and Ashok D. Belegundu. (2001) Introduction to Finite Elements in Engineering, 2nd Edition, Prentice-Hall of India, New Delhi 6. J.N. Reddy. (1993) An Introduction to the Finite Element Method, 2nd Edition, McGraw- Hill International Editions 7. L.J. Segerland. (1984) Applied Finite Element Analysis, John Wiley & Sons Inc 8. M.J. Fagan. (1992) Finite Element Analysis, Theory and Practice, Longman Scientific and Technical 9. S. Rajashekaran. (1994) Finite Element Analysis in Engineering Design, Wheeler Publishing 10. W.T. Thomson. (1996) Theory of Vibrations with Applications, Nelson Thornes Ltd 11. Bryan J Mac Donald. (2007) Practical Stress Analysis with Finite Elements, Glasnevin Publishing 12. Kenneth H. Huebner, Donald L. Dewhirst, Douglas E. Smith and Ted G. Byrom. (2001) The Finite Element Method for Engineers, 4th edition, Wiley-Interscience 13. Daryl L. Logan. (2006) A First Programme in the Finite Element Method, 4th edition, CL- Engineering 14. O. C. Zienkiewicz, R. L. Taylor and J.Z. Zhu. (2005) The Finite Element Method: Its Basis and Fundamentals, 6th edition, Butterworth-Heinemann 15. Erdogan Madenci and Ibrahim Guven. (2005) The Finite Element Method and Applications in Engineering Using ANSYS
c.	**Other Resources**	**Magazines and Journals** 1. https://www.nafems.org/publications/benchmark/ 2. http://www.feainformation.com/1_pages/magazine.shtml **Websites** 1. http://www.mece.ualberta.ca/tutorials/ansys/ 2. https://confluence.cornell.edu/display/SIMULATION/ANSYS+Learning+Modules 3. http://fea-cfd.simutechgroup.com/acton/media/1891/ansys-simcafe-org-webinar **Other Electronic Resources** 1. http://resource.ansys.com/Resource+Library 2. http://www.nenastran.com/fea/freeDemo.php 3. http://www.plm.automation.siemens.com/plmapp/fe/en_IN/online/

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

M.S. Ramaiah University

Course Specification

Course Details				
Course Code	19AUC506A			Course Category
Course Title	Vehicle Aerodynamics and Thermal Management			
Programme	M.Tech in Automotive Engineering			PC
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	3
Duration (Hrs)	60
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course is aimed to prepare students to use the concepts of aerodynamics and heat transfer to design streamlined aerodynamic body, interior cabin thermal comfort and motor compartment ventilation for the road vehicles. The students will be taught aerodynamic design of passenger cars, commercial vehicles, sports cars, thermal management of passenger cabin, under hood thermal management, climate control, wind- tunnel testing and experimental methods. The student will be trained on industry specific CFD tools like ICEM CFD and ANSYS FLUENT to solve practical problems on external aerodynamics, under-hood thermal management and climate control analysis. The student will also be given exposure to use to wind-tunnel facility to test the aerodynamic behaviour of road vehicles.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S. No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other Activities
1	Discuss the principles of aerodynamics and thermal management as applied to road vehicles		X	
2	Identify the factors responsible for enhancement of aerodynamic performance as well as aesthetics for different class of road vehicles		X	
3	Design aerodynamic body shapes for passenger vehicles, commercial vehicles and race cars and experimental procedure for testing	X	X	
4	Analyze under hood airflow and thermal interactions for effective cooling	X	X	
5	Select and recommend the most appropriate air-flow management system for climate control in passenger cars	X		
6	Analyze aerodynamic performance of vehicles using CFD tools and validate by testing scaled models in a wind tunnel	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Contents
Computational Fluid Dynamics - Fundamentals of CFD, Basics of finite difference and finite volume methods, Governing equations, Boundary conditions, Initial conditions, Choice of turbulence models, Merits and limitations of commercial CFD tools **5 Hours**
Aerodynamic design of Vehicles - History of aerodynamic development of road vehicles, Aerodynamic body design approaches , Effect of shape and size of various exterior parts of the vehicle on the drag force, Aerodynamics of various vehicles like passenger car, SUV, utility van, mini bus, bus, cargo and truck **10 Hours**
Aerodynamics of commercial Vehicles – Aerodynamics of tractor–trailer trucks, add-on devices for drag reduction, aerodynamic drag and fuel consumption, Aerodynamics of Bus, Soiling effect and methods for reducing soiling, cross wind sensitivity and stability of vehicles **5 Hours**
Aerodynamics of Race Cars - Aerodynamic features of race cars, ground effect performance, down force, Front and rear wings, Stability consideration, add-on devices, drag reduction methods and aerodynamic performance **5 Hours**
Thermal Management in Vehicles - Engine cooling requirements, Under-hood cooling, Mechanism of drag production by the cooling system, under hood airflow management, heat generation sources and heat exchanger performance **5 Hours**
Climate Control in Vehicles - Estimation of cooling loads, Principles of comfort air- conditioning, Basics of heating, ventilation and Air-Conditioning (HVAC) in automobiles, Various AC configurations, Heating circuits, Cooling circuits, Air flow management, In-cabin air flow analysis, Case studies on the thermal comfort and HVAC performance in passenger cars **5 Hours**
Experimental Procedure and Facilities - Basics of wind tunnels, Types of wind tunnels, Instrumentation for wind tunnels: pressure measurement, velocity measurement, force and moment measurement devices, Flow visualization, sources of errors in wind tunnel tests, Case studies of different wind tunnels used for vehicle aerodynamics experimentation . **5 Hours**
Practical/Laboratory content: Modelling of road vehicles for aerodynamic analysis using CFD tools like ANSYS-FLUENT and ICEM-CFD and model testing in wind tunnel **20 Hours**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

M.S. Ramaiah University ... Bangalore

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		30
Demonstrations		5
1. Demonstration using Videos		
2. Demonstration using Physical Models/ Systems		
3. Demonstration on a Computer	5	
Numeracy		5
1. Solving Numerical Problems	5	
Practical Work		5
1. Course Laboratory		
2. Computer Laboratory	5	
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		5
1. Assignment Discussion / Related Activities	2	
2. Case Study Presentation	3	
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations		
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		60

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

4. Course Resources		
a.	**Essential Reading**	1. Class Notes 2. Barnard R.H. (1996) Road Vehicle Aerodynamic Design: An Introduction, Longman
b.	**Recommended Reading**	1. Hucho W. H. (1998) Aerodynamics of Road Vehicles, 4th edition, SAE International 2. Bruce R. Munson, Donald F. Young and Theodore H. Okishi. (2002) Fundamentals of Fluid Mechanics, 4th edition, John Wiley and Sons. 3. John F. Doughlas, Janusz M. Gasiorek and John A. Swaffield. (2006) Fluid Mechanics, 5th edition, Prentice Hall. 4. Joseph Katz. (1995) Race Car Aerodynamics, Robert Bentley Publishers. 5. Jewel B. Barlow, Willium H. Rae and Alan Pope. (1999) Low Speed Wind Tunnel Testing, 3rd Edition, Wiley Interscience. 6. Holman J.P. (2001) Heat Transfer, 8th edition, Mc Graw Hill Company. 7. Steven Daly. (2006) Automotive Air-Conditioning and Climate Control Systems, Butterworth, Heinemann, Elsevier
c.	**Other Resources**	**Magazines and Journals** 1. Automotive Engineer, Professional Engineering Publishing. 2. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering, Professional Engineering Publishing. 3. International Journal of Engine Research, Professional Engineering Publishing. 4. SAE Transactions, SAE (USA) 5. Automotive Engineering International 6. Autocar INDIA 7. Overdrive 8. ATZ Auto Technology **Websites** 1. http://www.carbodydesign.com/ 2. http://www.sciencedirect.com/science/book/9780750651318 **Other Electronic Resources** 1. https://confluence.**cornell**.edu/display/SIMULATION/FLUENT+Learning+Modules 2. www.cd-adapco.com › Academic

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specification

Course Details				
Course Code	19AUC521A			Course Category
Course Title	Internship			
Programme	M.Tech in Automotive Engineering			I
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	220
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	The aim of this course is to make a student experience an industrial or business environment. The student will visit various departments of an industry/business and observe the activities in each department for a certain duration of time and try to relate his/her experience with the theory practiced back at the faculty. The student should develop a report and make a presentation on his/her experience at the industry/business.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S. No.	ILO	Report	Presentation
1	Describe the organization structure of the industry/business	X	X
2	Identify Business objectives of the organization	X	X
3	Describe the various departments of the organization and their activities and responsibilities to meet the business objectives	X	X
4	Discuss the limitations and new opportunities for growth of the organization	X	X
5	Express the education and skill requirement of graduates to pursue their career in industry	X	

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

3.2 Course Contents
Industry Internship in the relevant organization

3.3 Teaching and Learning Methods		
Topics	**Teaching methods**	**Hours**
Industry Internship	Field work	145.00
	Report writing	30.00
	Presentation preparations	30.00
	Evaluation of Report and Presentations	15.00
	Total	220.00

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Report	Presentations	Tutorials		
1.	Knowledge					x	x			
2.	Understanding					x	x			
3.	Critical Skills					x	x			
4.	Analytical Skills					x	x			
5.	Problem Solving Skills					x	x			
6.	Practical Skills					x	x			
7.	Group Work					x	x			
8.	Self-Learning					x	x			
9.	Written Communication Skills					x	x			
10.	Verbal Communication Skills					x	x			
11.	Presentation Skills					x	x			
12.	Behavioural Skills					x	x			
13.	Information Management					x	x			
14.	Leadership Skills					x	x			

4. Course Resources	
a. **Essential Reading**	1. Organization Website 2. Discussions with Managers/Mentor/Supervisor of different departments of the organization

ಶುಭಂ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

M.S. Ramaiah University of Applied Sciences ★ Bangalore

Course Specification

Course Details				
Course Code	19AUC522A			Course Category
Course Title	Group Project			
Programme	M. Tech. in Automotive Engineering			GP
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	MAY -2019	Course Next Review Date	MAY-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	10
Duration (Hrs)	330
Course Marks	200
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course is intended to provide student an opportunity to synergise their learning from the earlier courses through working in a team, sharing responsibilities, to conceiving, designing and fabricating a working prototype of a system related to an automotive application. The students will learn skills related to project identification, planning, management and execution, working in teams and verbal and written communication. During design, analysis and synthesis stage, they will get an opportunity to apply theoretical knowledge to develop real life product and prototyping stage will provide them experience of converting a design into a working system through use of various fabrication techniques available

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S. No.	ILO	Report	Presentation
1	Work in a team and undertake a project in their area of specialization	X	X
2	Apply their knowledge of general and automotive engineering and application, develop a system for automotive application	X	X
3	Apply appropriate research methodology while formulating a project	X	X
4	Prepare specifications, design, analyse, synthesize, prototype and assess the system	X	X
5	Prepare and present appropriate forms of audio-visual and verbal presentations, and written document, to describe the project, its execution and outcome	X	X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.2 Course Content
Team building, Team work and Leadership skills Preparing design specifications, design, analysis and synthesis, design evaluation Costing, Finance Management, Project management Procurement, prototype building and related manufacturing methods Preparing and presenting audio-visual and verbal presentations and preparing written documents

3.3 Teaching Learning Methods		
Topics	**Teaching methods**	**Hours**
Critical Review, Problem Formulation and stating Objectives	Reading Journal papers , books and other relevant materials and problem formulation	20.00
	Presentation to Reviewers	5.00
System Design	Group work with supervisors guidance	30.00
System Modelling, Simulation and Analysis	Group work with supervisors guidance	60.00
Model Building, Instrumentation, Testing and Evaluation	Group work with supervisors guidance	100.00
Verification/Validation	Group work with supervisors guidance	50.00
Drawing Conclusions	Group work with supervisors guidance	10.00
Video creation, Presentation ,Thesis/Report Writing and Viva Voce	Presentation and Viva voce - Group	5.00
	Thesis/Report writing - Group	30.00
	Project Exhibition and Video creation - Group	10.00
	Tests/Examinations/Presentations	10.00
	Total	330.00
Note: The above time calculation is for each student and a group can consists of 4 students and total hours can be computed accordingly. . The project chosen should justify the time allotted.		

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.4 Meeting Programme Objectives through Course Objectives										
S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials	Report	
1.	Knowledge						X		X	
2.	Understanding						X		X	
3.	Critical Skills						X		X	
4.	Analytical Skills						X		X	
5.	Problem Solving Skills						X		X	
6.	Practical Skills						X		X	
7.	Group Work						X		X	
8.	Self-Learning						X		X	
9.	Written Communication Skills						X		X	
10.	Verbal Communication Skills						X		X	
11.	Presentation Skills						X		X	
12.	Behavioural Skills						X		X	
13.	Information Management						X		X	
14.	Leadership Skills						X		X	

4. Course Resources	
a. Essential Reading	1. Assigned reading relevant to the group project

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

Course Specification

Course Details				
Course Code	19AUC523A			Course Category
Course Title	Dissertation and Publication			
Programme	M. Tech. in Automotive Engineering			DP
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	MAY -2019	Course Next Review Date	MAY-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	10
Duration (Hrs)	600
Course Marks	400
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course is intended to give an insight to the students on application of principles of research methodology, preparation of research project proposal, research project management, execution of research project and effective technical communication and presentation. It also emphasizes the need and the relevance of a structured approach to identify a research topic and undertake research. This course provides an opportunity for students to apply theories and techniques learnt during programme work. It involves in-depth work in the chosen area of study.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S. No.	ILO	Report	Presentation
1	Critically review scholarly literature collected from various sources for the project purpose and formulate a research	X	X
2	Prepare and present a research proposal	X	X
3	Conduct research to achieve research objectives	X	X
4	Propose new ideas/methodologies or procedures for further improvement of the research undertaken	X	X
5	Create research document and write research papers for publications	X	X
6	Defend the research findings in front of scholarly audience		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
The course will cover the following: Research Methodology Information search, retrieval and review Project definition and project planning Use of conceptual models and frameworks Problem solving and Evaluation Interpretations and drawing conclusions Proposing ideas or methods for further work Thesis writing Oral presentation Authoring Research paper

3.3 Teaching Learning Methods

Topics	Teaching methods	Hours
Information search, retrieval and review, Project definition and project planning	Reading Journal papers , books and other relevant materials and problem formulation	50.00
	Presentation to Reviewers	20.00
Use of conceptual models and frameworks	Individual work with supervisors guidance	60.00
Problem solving and Evaluation	Individual work with supervisors guidance	120.00
Interpretations and drawing conclusions	Individual work with supervisors guidance	100.00
Proposing ideas or methods for further work	Individual work with supervisors guidance	40.00
Presentation ,Thesis/Report Writing and Viva Voce, Authoring Research paper	Presentation and Viva voce	30.00
	Thesis/Report writing, Authoring research paper	150.00
	Video creation	15.00
	Tests/Examinations/presentations	15.00
	Total	600.00

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.4 Meeting Programme Objectives through Course Objectives										
S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials	Report	
1.	Knowledge						X		X	
2.	Understanding						X		X	
3.	Critical Skills						X		X	
4.	Analytical Skills						X		X	
5.	Problem Solving Skills						X		X	
6.	Practical Skills						X		X	
7.	Group Work						X		X	
8.	Self-Learning						X		X	
9.	Written Communication Skills						X		X	
10.	Verbal Communication Skills						X		X	
11.	Presentation Skills						X		X	
12.	Behavioural Skills						X		X	
13.	Information Management						X		X	
14.	Leadership Skills						X		X	

4. Course Resources	
a. Essential Reading	1. Lecture Sessions on individual project, Thesis Preparation delivered by the concerned Head of Dept.

ಇಂದ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specification

Course Details				
Course Code	Elements of Design for Automotive Products			Course Category
Course Title	19AUE511A			
Programme	M. Tech. in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	MAY-2019	Course Next Review Date	MAY-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This Course deals with basic industrial design principles as applied to automobiles. Students will apply the principles of design and design elements for improving aesthetics. Students will be taught the concepts of visualization through form generation, form transition, visual composition, radii transformation, topology, orientable and non•] orientable surfaces in 2D and 3D. Students will be trained on sketching and physical model making of basic forms.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other Activities
1	Describe the organization structure of the industry/business		X	X
2	Discuss the evolution of design process		X	X
3	Apply sketching and digital techniques for product concept ideation	X	X	X
4	Perform form exploration to generate concepts for automotive components	X		X
5	Demonstrate physical model making abilities using various materials	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
Design elements, Design Principles and visual literacy: Through Line, Shape, Form, Tone, Texture, Color, Unity, Variety, Rhythm, Harmony, Balance, Gestalt, Proportion and Golden section **(02 Hours)**
Visual factors in design: Color theory, color wheel, color classification, basic color schemes, color harmony, Color is artist's spectrum, applications of color in design **(02 Hours)**
Topology/ Non-orientable surfaces: Introduction to Surface topology, orientable and non-orientable surfaces, Surface characteristics of Mobius strip, Klein bottle and the real projective plane, Cross cap, the roman surface, the Boy's surface **(02 Hours)**
Form and expression: Form extraction and imitation, creation of metaphors, form and expression study **(02 Hours)**
Advance form: Development of form, nature of form, types of form, composition of fragments, construction in space, aspects of form **(02 Hours)**
Radii manipulation: Working with plaster, Development of templates, working for gradual transformation between shapes, Smooth finishing of plaster models **(02 Hours)**
Design History: Industrial revolution, Design reforms, Design movements such as art and craft movement, Aesthetic movement, Art Noveau, Deutsche Werkbund, De Stijl, Bauhaus, Ulm, Art deco, Streamlining, Emergence of American design profession, Overview of products from past 100 years **(02 Hours)**
Practical/Laboratory content Model making and its process: Design process, Types of model making and its importance in various design stages, Model making materials **(20 Hours)**
Practical/Laboratory content (please mention if Lab content doesn't exist for this Course) Sketching: Understanding perspectives, sketching of 2D component and composition, 3D objects using various mediums like pencils, pencils colors, Dry pastels, Markers etc. **(16 Hours)**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		24
Demonstrations		16
1. Demonstration using Videos	02	
2. Demonstration using Physical Models/ Systems	14	
3. Demonstration on a Computer	XX	
Numeracy		XX
1. Solving Numerical Problems	XX	
Practical Work		20
1. Course Laboratory	20	
2. Computer Laboratory	XX	
3. Engineering Workshop/ Course Workshop/Kitchen	XX	
4. Clinical Laboratory	XX	
5. Hospital	XX	
6. Model / Model Studio	XX	
Others		XX
1. Assignment Discussion / Related Activities	XX	
2. Case Study Presentation	XX	
3. Guest Lecture	XX	
4. Industry / Field Visit	XX	
5. Brain Storming Sessions	XX	
6. Group Discussions	XX	
7. Discussing Possible Innovations	XX	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	X		X						
2.	Understanding	X		X						
3.	Critical Skills					X				
4.	Analytical Skills	X		X		X				
5.	Problem Solving Skills			X		X				
6.	Practical Skills			X		X				
7.	Group Work			X		X				
8.	Self-Learning					X				
9.	Written Communication Skills		X			X				
10.	Verbal Communication Skills						X			
11.	Presentation Skills						X			
12.	Behavioural Skills	X								
13.	Information Management		X		X		X			
14.	Leadership Skills			X			X			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

4. Course Resources		
a.	**Essential Reading**	1. Class Notes 2. Hannah, G. (2002) Elements of Design: Rowena Reed Kostellow & The structure of visual relationship. Princeton Architectural Press. 3. Dondis, D. A. (2003) Primer of Visual Literacy. MIT Press
b.	**Recommended Reading**	1. DORLING KINDERSLEY, (2011) Car – The definitive visual history of the automobile, DK 2. Bernhard E. Bürdek, (2005) Design: History, Theory and Practice of Product Design, Springer 3. Fiell, C. and Fiell, P. (1999) Design of 20th Century. Taschen. 4. Raizman, D. (2003) History of Modern Design. London: Laurence King Publishing
c.	**Other Resources**	1. Journal of Experimental Psychology: Human Perception and Performance, APA Journals 2. Journal of Design History, Oxford University Press 3. www.core77.com

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

Course Specification

Course Details				
Course Code	19AUE512A			Course Category
Course Title	Automotive Concepts and Product Development Process			
Programme	M.Tech in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May-2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course deals with identification of need and to arrive at design brief/ PDS through research and design methodology. The Students will be taught approaches such as literature survey, ethnography, participatory research, case studies, story board analysis, questionnaires and interviews design presentation. Sketching, modelling and rendering skills are imparted to create conceptual designs using modern digital tools.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Discuss need for new or improved automotive product development through market research		X	
2	Discuss Quality Function Deployment based on market research	X	X	
3	Apply Quality Function Deployment (QFD) to arrive at Product Design Specification (PDS)	X	X	
4	Develop automotive concepts based on PDS	X	X	
5	Select concept for refinement based on feedback	X		
6	Use appropriate tools and techniques for generation and refinement of concepts for automotive product / components	X		

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
Automotive Product Development Management: Overview, Simple and Complex products, Product Development Activity, Product Development Process, Organization Structures, Marketing and Sales, Problems affecting Product Management **03 Hours**
Automotive Design Process and Business: Stages in product lifecycle, Product and User, Economic Value and number of features, Design and Business, Ideal Product Design, Superior product design process Product Planning: The need for product planning, Classification of Product Development Projects, The Product Planning Process, Mission Statements **03 Hours**
Questionnaire Survey for Quantitative Data Collection: Types of quantitative data, various techniques to collect quantitative data, Design of questionnaire, Formal and informal interview Design Management: Quality Function Deployment, Design brief, identifying customer voice and converting to technical voice, Case studies to understand QFD, Product Design Specification **05 Hours**
Design Expressions: Lifestyle board, Mood board, Theme board, Design trends, Design movements, Application of design principles, metaphors and product aesthetics **05 Hours**
Automotive product / component concept generation and selection Design Presentation: Explanatory sketches, Instructional sketches, Info graphics and case studies **06 Hours**
Practical/Laboratory content: Manual and digital Sketching using Sketch book pro/designer, Virtual 3d modeling using Alias studio tool. **(16 Hours)**
Sketching Practice: Using mediums like color pencils, dry pastels, markers, charcoal etc. Practice Alias Studio Tools. **(12 Hours)**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		32
Demonstrations		07
1. Demonstration using Videos	6	
2. Demonstration using Physical Models/ Systems	2	
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems	0	
Practical Work		16
1. Course Laboratory	4	
2. Computer Laboratory	6	
3. Engineering Workshop/ Course Workshop/Kitchen	6	
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		5
1. Assignment Discussion / Related Activities		
2. Case Study Presentation	3	
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations	2	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x	x			
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x				
5.	Problem Solving Skills	x	x			x				
6.	Practical Skills	x		x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

4. Course Resources	
a. **Essential Reading**	1. Alan Pipes. (2007) Drawing for Designers, Laurence King Publishers 2. Class Notes
b. **Recommended Reading**	1. Betty Edwards. (1999) The New Drawing on the Right Side of the Brain: A Programme in Enhancing Creativity and Artistic Confidence, Tarcher; Rev Exp edition 2. Betty Edwards. (2002) New Drawing on the Right Side of the Brain Workbook: Guided Practice in the Five Basic Skills of Drawing, Tarcher 3. Judy Martin. (2001) The Encyclopedia of Pastel Techniques: A Unique A-Z Directory of Pastel-Painting Techniques Plus Guidance on How Best to Use Them, Search Press 4. Gail Greet Hannah. (2002) Elements of Design: Rowena Reed Kostellow and the 5. Structure of Visual Relationship, Princeton Architectural Press 6. Craig M. Vogel. (2001) Creating Brakethrough products: Innovation from product planning to Programme approval, Prentice Hall 7. Ulrich, K.T. and Eppinger, S. D. (2003) Product Design and Development. 4th edition. McGraw-Hill 8. Otto, K. and Wood, K. (2001) Product design: Techniques in Reverse Engineering and New Product development. Prentice Hall 9. Barclay I. (2001) New Product Development. Butterworth 10. Hippel, E. V. (2006) Democratizing Innovation. The MIT Press
c. **Other Resources**	

Course Specification

Course Details				
Course Code	19AUE513A			Course Category
Course Title	Automotive Interior and Exterior Design			
Programme	M. Tech. in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	MAY-2019	Course Next Review Date	MAY-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course deals with the design of an automobile interior and exterior. Students are taught to extract the expressions and metaphors from nature to arrive with a new concept idea in terms of both interior and exterior design, occupant packaging and vehicle packaging requirements, ergonomic considerations and design principles, design various components in an automobile. Students are trained to express their design through manual sketches, digital models and clay models and validate the design through ergonomic study using appropriate anthropometric data and tools.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other Activities
1	Discuss the importance of styling, design principles, ergonomics, comfort and aesthetics		X	
2	Recognize the body design requirements for different classes of vehicles	X		X
3	Design automotive interior and exterior based on identified themes	X	X	
4	Analyze and discuss current trends in automotive interior and exterior design	X	X	
5	Create physical clay models of interior and exterior design	X		X
6	Build and visualize virtual interior and exterior model	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

3.2 Course Content

Automotive Design Terminology: Overview, Automotive design terminology, Automotive design process and factors influencing automotive design

Classification of cars based on body style: Different body styles, Micro cars, Hatchback and its sub types, Sedan and its sub-types, Coupe and its variants, Convertible and its variants, Station Wagon, Sports Utility Vehicles, Multi Utility Vehicles

(03 Hours)

Overview of Ergonomics: Introduction to ergonomics, History, Consideration, Ergonomic Research, Importance, Ergonomic Analysis

Occupant Packaging: Seating, Dimensions, Driving operations, Non Driving Operations, User interface; Responsibility in vehicle design

Automotive Packaging: Definition and different layout sectors in packaging, Interior dimensions, Exterior dimensions, Front end (engine compartment), Rear end (luggage space), Under-body, Major factors influencing automotive packaging, Regulatory requirements

(08 Hours)

Automotive Front End Design: Factors affecting the front end design, Front end design for better air cooling, Latest design trends, Bumper design theme, Regulation for bumper design, Evolution of grille design, Grille design as a new brand image, Hood design and new trends in exterior design.

Automotive Rear End Design: Tail lamp, Spoiler, Bumper design, Overall Rear design for Aerodynamics.

Platform technology and type of chassis: Versions of platform, Benefits of platform sharing and downside of platform technology, History of automotive chassis, Composite construction, Unibody construction, Tubular space frame, Glass-fibre monocoque chassis, Aluminium monocoque construction, Carbon fibre monocoque construction, ULSAB type.

(03 Hours)

Automotive Lighting System: History and Development in automotive lighting, Different types of optical system, Light sources used in lighting, Headlamp design and styling, Advanced lighting technology, Pedestrian friendly lights, Signal lamps, Latest trends in automotive lighting.

Automotive Glasses: Different types of automotive glasses, Recent development in automotive glass design, Importance of glass in car design, Role of glazing for car safety, Developments in automotive glass design

Surface Protection and Automotive Painting: Different types of corrosion on automotive bodies, Corrosion protection methods, Automotive body painting procedure, Paint components and latest trends in automotive body colors

(03 Hours)

Overview of Automotive Interior: Interior components, Dashboard Components, Present and future trends, Customer requirements .

Color and trim: Research, design, and development of all interior and exterior colors and materials.

Comfort, Convenience and safety: Night vision, Head-up displays, Implication of controls, Touch pads for drivers, Voice recognition, Console developments and innovations, Modular cockpits, Dashboard instruments, Advances in electronic displays, Importance of personal entertainment systems and positioning of output devices

(03 Hours)

Sketching exercises: 3d modeling and Visualization, Ergonomic Analysis

Model making and clay modeling

(30 Hours)

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		30
Demonstrations		XX
1. Demonstration using Videos	XX	
2. Demonstration using Physical Models/ Systems	XX	
3. Demonstration on a Computer	XX	
Numeracy		XX
1. Solving Numerical Problems	XX	
Practical Work		30
1. Course Laboratory	05	
2. Computer Laboratory	05	
3. Engineering Workshop/ Course Workshop/Kitchen	XX	
4. Clinical Laboratory	XX	
5. Hospital	XX	
6. Model / Model Studio	20	
Others		XX
1. Assignment Discussion / Related Activities	XX	
2. Case Study Presentation	XX	
3. Guest Lecture	XX	
4. Industry / Field Visit	XX	
5. Brain Storming Sessions	XX	
6. Group Discussions	XX	
7. Discussing Possible Innovations	XX	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	X		X						
2.	Understanding	X		X						
3.	Critical Skills					X				
4.	Analytical Skills	X		X		X				
5.	Problem Solving Skills			X		X				
6.	Practical Skills			X		X				
7.	Group Work			X		X				
8.	Self-Learning					X				
9.	Written Communication Skills		X			X				
10.	Verbal Communication Skills						X			
11.	Presentation Skills						X			
12.	Behavioural Skills	X								
13.	Information Management		X		X		X			
14.	Leadership Skills			X			X			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

4. Course Resources	
a. **Essential Reading**	1. Class Notes 2. J. Fenton. (2000) Handbook of Automotive Body and System Design, Professional Engineering Publishing 3. H-Point, The Fundamnetals of car design and Packaging, Stuart Macay Geoffrey Davies. (2003) Materials for Automobile Bodies, Butterworth-Heinemann Ltd 4. Vivek D. B. (2011) Ergonomics in Automotive Design, CRC Press 5. Nikolaos G. (2012) Automotive Ergonomics: Driver Vehicle Interaction, CRC Press 6.
b. **Recommended Reading**	1. Erik Eckermann. (2002) World History of the Automobile, SAE International 2. Hans-Hermann Brasess and Ulrich Seiffert. (2005) Handbook of Automotive Engineering, SAE International 3. Stephen Newbury. (2007) Car Design Year Book 1 to 5, Marrell, Landon 4. Tony Lewin. (2003) How to Design Car Like A Pro, Motor books International 5. Peter Vink, (2004) Comfort and Design: Principles and Good Design, CRC press 6. John Fenton (1998) Handbook of automotive body and system design, Professional Engineering Publishing 7. Peter WInk (2004) Comfort and Design: Principles and Good Design, CRC Press 8. Christopher (2009) Industrial Engineering and Ergonomics: Vision, Concepts, Methods and tools, Springer
c. **Other Resources**	1. Automotive Engineering (Society of Automotive Engineers) [www.sae.org] 2. Journal of Experimental Psychology: Human Perception and Performance, APA Journals 3. www.carbodydesign.com 4. www.style4cars.com 5. www.cardesignnews.com 6. www.designertechniques.com 7. www.humancenterdesign.org

ಶುಭಂ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

M.S. Ramaiah University of Applied Sciences * Bangalore

Course Specification

Course Details				
Course Code	19AUE514A			Course Category
Course Title	Automotive Product Visualization and Animation			
Programme	M.Tech in Automotive Engineering			PC
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May - 2019	Course Next Review Date	May - 2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course deals with the development of concept cars, methods of 3D visualization and animation for automotive products. Students are taught the concepts of kinematics to develop various mechanisms. Students are imparted the various ways of visualizing a product, modeling for visualization, texturing, lighting, animation and rendering. Students are trained to use popular digital visualization and animation tools.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Discuss the importance of concept cars and its development process		X	
2	Discuss the need for visualization and various principles of visualization		X	X
3	Differentiate various product visualization and animation techniques	X	X	X
4	Create models to visualize the products virtually in a 3D environment using suitable visualization techniques	X		
5	Develop animations and render 3D models with suitable textures and light source	X		
6	Model and animate mechanisms used in automobile product / component development	X	X	

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
Automotive mechanisms: Link, joints, relative motion, degree of freedom required for modeling and animating the mechanisms such as hinge mechanism, telescopic mechanism, lifting mechanism, expanding mechanism, reverse mechanism, window winding mechanism, swiveling mechanism applications used in automobiles and its case studies
Rigging: Driver and Driven, Custom Attribute Creation, Joints and Bones, Types of Orientations, Joint hierarchies, Inverse and Forward Kinematics. Applications and limitations of IK and FK, Rig setup and Controllers and Binding Techniques.
Principles of Animation: Stretch and Squash, Timing, Anticipation, Slow in Slow out, Staging, Straight Ahead and Pose to Pose, Appeal, Overlapping Action, Follow Through, Arcs, Solid Drawing, Exaggeration.
Visualization: Importance and need of visualization, Types of visualization, Principles of a good visualization, Practical steps for good visualization, Applications of visualization, visualization techniques.
Texturing: Shading Group, Procedural and Map Textures, Types of Materials and Textures, Normal Map, Bump Map, Displacement Map, Transparency Map, Colour/Diffuse Map, Specular Maps, Node Linking, Understanding UV's, Texture Mapping process, Projection Mapping, UV Unwrap, Tweaking UV's.
Camera Staging, Framing and Lay outing: Camera Staging and Lay outing Principles, Rules of Composition, Golden Ratio, Rule of Thirds, Looking Space, Lead Room, Diagonal rule, Minimalism, Frame inside a Frame, Balancing Elements, Symmetry and Patterns
Lighting and Rendering: Direct Lighting, Indirect Lighting, Good Ways to Use Lights, 3 Point Lighting, Lights and Shadows and their interplay, Mood Lighting with one lights source, Hard and Soft Lighting, Lights and Shadows, Examples of Shadows, Components of Reflection -Ambient, Diffuse and Specular, Components of a Light Source, Light Controls, Render Engines, Rendering 3D models - Automobiles and its components
Practical/Laboratory content: Mechanism simulation of automotive components/systems
Practical/Laboratory content: Rendering and animation of automotive concepts/components

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		35
Demonstrations		10
1. Demonstration using Videos	4	
2. Demonstration using Physical Models/ Systems	6	
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems	0	
Practical Work		15
1. Course Laboratory	0	
2. Computer Laboratory	15	
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		0
1. Assignment Discussion / Related Activities		
2. Case Study Presentation		
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations		
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

4. Course Resources	
a. **Essential Reading**	1. R. L. Norton. (2004) Design of Machinery, 3rd edition, McGraw-Hill. 2. Class Notes
b. **Recommended Reading**	1. Alan Watt, Mark Watt. (1992) Advanced Animation and Rendering Techniques Theory and Practice, ACM Press, New York 2. Myszka, D H. (2002) Machines Mechanisms Applied Kinematic Analysis, Prentice Hall India, New Delhi. 3. Tufte, E. (2001) The Visual Display of Quantitative Information. 2nd edn. Graphics Press 4. Nass, P. (2012) Autodesk Maya 2013 Essentials. John Wiley & Sons, Inc
c. **Other Resources**	

ಶುಭಂ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specification

Course Details				
Course Code	Automotive Structures and Occupants Safety			Course Category
Course Title	19AUE521A			
Programme	M. Tech. in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	MAY -2019	Course Next Review Date	MAY-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	To design and analyse the automotive body structure for strength, durability and occupant and pedestrian safety. The students will be taught typical constructions of automotive structures, sources, types and characteristics of operational and functional loads and resulting failure modes. Methods and consideration used at different stages of structure development will be explained. Physics of collision, resulting response of the bodies involved in collisions will be discussed. The students will be trained to use non-linear transient dynamic software for simulation of automotive collision phenomena for safety. The students will also be taught about active and passive safety concepts, technologies and systems, safety regulations and ratings, injury criteria and approaches to design of structures/structural components for dynamic loading.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S. No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Discuss typical constructions of automotive structures, sources of forces acting on it, working of safety systems in an automobile,		X	X
2	Use knowledge of potential failure modes of automotive structures and mechanics of structure-occupants-pedestrian interaction in an automotive collision		X	X
3	Calculate response of a design for prescribed functional and operational loads, considering structural layouts		X	X
4	Design, model, simulate and analyse "safe" structures using knowledge from different areas of mechanics and biomechanics	X		X
5	Assess structural response to non-linear transient dynamic loading using simulation software, analyse results and suggest design modifications	X		X
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	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
Introduction to Automotive Structures - Sources of loads, Types of loads, Characteristics of loads and resulting failure modes, Quantification of loads and its problems, Typical body constructions used and their merits and demerits **(05 Hours)**
Design of Automotive Body Structures - Analysis of load flow through the structure, Simple Structural Surfaces, Component sizing for different types of loads and expected failure modes, Use of simplified analysis models, even for complex loads, in the initial design stage **(05 Hours)**
Crash and Collision - Physics of collision, Types of collision, Automotive collision, Structural and occupant/pedestrian response to crash, Key parameters for design for crash **(05 Hours)**
Design for Safety - Crashworthiness, Effect of impact forces on humans, Designing for human safety, Safety systems, Structural design considerations for occupant and pedestrian safety, Safety Standards and legislations **(05 Hours)**
Practical/Laboratory content: Crash Simulation - Tools for simulation of crash phenomena, Non-linear transient dynamic simulation for structural assessment, Consideration of modeling of Physics, Pre-processing, Selection of simulation parameters, Review and presentation of results and assessment of design. **(20 Hours)**

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		30
Demonstrations		XX
1. Demonstration using Videos	XX	
2. Demonstration using Physical Models/ Systems	XX	
3. Demonstration on a Computer	XX	
Numeracy		04
1. Solving Numerical Problems	04	
Practical Work		20
1. Course Laboratory	20	
2. Computer Laboratory	XX	
3. Engineering Workshop/ Course Workshop/Kitchen	XX	
4. Clinical Laboratory	XX	
5. Hospital	XX	
6. Model / Model Studio	XX	
Others		06
1. Assignment Discussion / Related Activities	XX	
2. Case Study Presentation	03	
3. Guest Lecture	03	
4. Industry / Field Visit	XX	
5. Brain Storming Sessions	XX	
6. Group Discussions	XX	
7. Discussing Possible Innovations	XX	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.4 Meeting Programme Objectives through Course Objectives										
S. No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	X		X						
2.	Understanding	X		X						
3.	Critical Skills					X		X		
4.	Analytical Skills	X		X		X		X		
5.	Problem Solving Skills			X		X		X		
6.	Practical Skills			X		X				
7.	Group Work			X		X				
8.	Self-Learning					X				
9.	Written Communication Skills					X				
10.	Verbal Communication Skills						X			
11.	Presentation Skills						X			
12.	Behavioural Skills	X								
13.	Information Management		X				X			
14.	Leadership Skills									

1. Course Resources		
a.	**Essential Reading**	1. Class Notes 2. Jason C. Brown, A. John Robertson and Stan S. Serpento, Motor Vehicle Structures: Concepts and Fundamentals, Warrandale, SAE International 3. Paul Du Bois et. al., (2004), Vehicle Crashworthiness and Occupant Protection, Automotive Application Committee, American Iron and Steel Institute
b.	**Recommended Reading**	1. J. Fenton, (1998), Handbook of automotive body construction and design analysis, London, Professional Engineering Publishing 2. J. Fenton, (1980), Vehicle body layout and analysis, London, Mechanical Engineering Publishing 3. J. Pawloski, (1969), Vehicle Body Engineering, London, Business Books Ltd. 4. Mathew Huang, (2002), Vehicle Crash Mechanics, CRC Press
c.	**Other Resources**	1. International Journal of Crashworthiness, Springer 2. International Journal of impact Engineering, Pergamon Press, Oxford 3. https://www.araiindia.com/downloads_catalogue_brochure.asp 4. http://www.nssmc.com/en/tech/report/nsc 5. http://www.nhtsa.gov/ 6. http://www.fmvss.com/

ಇಂದ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

Course Specification

Course Details				
Course Code	19AUE522A			Course Category
Course Title	Automotive Powertrain			
Programme	M.Tech in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May - 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	The aim of this Course is to prepare the students to study and critically evaluate the automotive power train and its sub systems. Students are taught sizing an engine for automotive application and design of various drive train components including transmission.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S. No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Elucidate the working principles of automotive power-train components and sub-systems	X	X	
2	Elucidate the combustion in SI and CI engine		X	
3	Estimate the size of an IC engine for automotive application	X		
4	Design clutch, transmission, and other drive train components	X		
5	Discuss the recent trends for the improvement of engine performance and emission reduction		X	
6	Recommend suitable power train technologies to meet the emission norms	X		

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
Review of automotive engines, engine peripherals and drive train; review and analysis of air-standard, fuel-air and actual Otto and Diesel cycles; **(09 Hours)**
Overall Engine Performance: Effect of engine and piston speed, air-fuel ratio and load; engine performance maps; effect of engine size on power, ignition, injection timing and compression ratio; engine design parameters, relationship between performance parameters; road-load power; auxiliary power requirements; estimate the road load and engine size, transmission. **(12 Hours)**
Combustion and emission: Combustion in SI and CI engines- normal and abnormal combustion, factors influencing combustion, combustion chamber designs, turbulence, swirl, squish, tumble influence on combustion; fuel spray characteristics and spray nozzle designs; pollutant formation and modification in engine design to reduce pollutant formation, MPFI, GDI and CRDI technologies; After-treatment technologies in vogue to control tail pipe emission; Alternate fuels for IC engines; **(12 Hours)**
Engine friction and lubrication: Component of engine friction, mechanical friction in major engine components, Blowby losses; effect of engine variables on friction; lubrication and lubricant principles; engine lubricating systems; engine performance and lubrication. Heat transfer in Engine: Necessity of engine cooling; engine and gas temperature distribution; effect of engine operating variable on heat transfer; engine cooling system and modern cooling concepts **(6 Hours)**
Automotive Transmission: Requirement of transmission system, need and objectives of gear box; determination of gear ratios for vehicles, performance characteristics in different speeds; resistance to motion, tractive effort, engine speed/power and acceleration; technologies to improve drive train efficiency to achieve improved fuel economy **(9 Hours)**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

M.S. Ramaiah U

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		40
Demonstrations		10
1. Demonstration using Videos	4	
2. Demonstration using Physical Models/ Systems	6	
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems	0	
Practical Work		4
1. Course Laboratory	4	
2. Computer Laboratory		
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		6
1. Assignment Discussion / Related Activities		
2. Case Study Presentation	3	
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations	3	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

4. Course Resources	
a. **Essential Reading**	1. Pulkrabek, W. W., (2003), Engineering Fundamentals of the Internal Combustion Engine, New Delhi, Pearson 2. Ferguson, C. R. and Kirkpatrick, A. T.,(2000), Internal Combustion Engine - Applied Thermoscience, United Kingdom, John Wiley
b. **Recommended Reading**	1. Heywood, J. B.,(1988), Internal Combustion Engine Fundamentals, New York, McGraw-Hill 2. Duffy, J. E., (2004), Modern Automotive Technology, Goodheart Willcox 3. Robert Bosch GmbH (editor), (2008), Automotive Handbook, Wiley 4. Lechner, G.,(1999), Automotive Transmission, Fundamentals, Selection, Design and Application, New York, Springer 5. Erjavec, J., (2006), Automotive Technology: A Systems Approach, Thomson
c. **Other Resources**	1. Automotive Engineering International, SAE 2. International Journal of Power Train, Inderscience Publishers Automotive Engineer, Professional Engineering Publishing 3. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering, Professional Engineering Publishing 4. International Journal of Engine Research, Professional Engineering Publishing 5. ATZ Autotechnology, International Federation of Automotive Engineering Societies 6. Autocar INDIA, Haymarket SAC Publishing (India) Private Ltd. 7. Overdrive, Infomedia 18 Ltd.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

Course Specification

Course Details				
Course Code	19AUE523A			Course Category
Course Title	Intelligent Vehicle Technology			
Programme	M.Tech in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	The aim of this Course is to prepare the students to study and critically evaluate the automotive systems, sub-systems and identify the need for electronics and software systems in modern automobiles. Basic automotive systems are discussed in terms of underlying principles of construction, working, limitations of the conventional systems. Also, students are encouraged to explore the opportunities in using electronics for new functions / applications to improve the performance of the systems / subsystems by studying the physical systems, interacting with experts and users.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Describe need, requirements, basic elements, communication technologies and data fusion for intelligent vehicle system.		X	
2	Explain the working of components and features in intelligent vehicle system.		X	
3	Discuss various techniques for lateral and longitudinal sensing in vehicles and control applications	X	X	
4	Discuss various communication protocol / technologies in IV systems and applications	X	X	
5	Discuss the enabling technologies, application and developments in Intelligent transportation systems	X	X	X
6	Select the appropriate sensors, control system and interface required for development of an Intelligent vehicle to meet the specific requirements.	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.2 Course Content
Introduction: Overview of Intelligent Vehicle Technology (IVT), safety goals and long term vision for road transportation networks. Application areas in convenience, safety, productivity and traffic assistance. Governments and Industry initiatives and strategies across the world.
Sensors technologies, sensor data fusion and actuators: Introduction to sensors, Automotive sensors - their classification, limitations, working principles and interaction with the environment; Role of automotive sensors in different ADASs and in autonomous vehicles Introduction to actuators, their classification and their use in advanced driving assistance systems; Introduction to sensors fusion; strategies for sensor fusion; Challenges related to automotive sensor fusion and connected vehicle.
Lateral Sensing and Control Systems: Introduction and need, configurations, principle of working and features of systems like- Lane departure warning, Lane keeping assistance, Lane change assist, Blind spot monitoring, parallel parking assist, Rollover avoidance, etc.
Longitudinal Sensing and Control systems: Introduction and need, configurations, principle of working and features of systems like –Parking assistance, Adaptive Lighting, Night vision, Adaptive Cruise Control, Forward collision warning, Collision avoidance system, Pre-crash assistance, Pedestrian safety systems, etc.
Vehicle Communication Systems: Need for communication in vehicle, Overview of vehicle communication protocols/ technologies. In-vehicle, Vehicle-to-vehicle, vehicle-to-infrastructure, Vehicle-to-cloud communications systems. Application areas / services.
Intelligent Transportation systems: Cooperative systems, digital maps and GPS, application areas of cooperative systems, traffic assist systems, traffic management, congestion avoidance, etc. Case studies.
Autonomous Vehicle: Introduction to autonomous vehicles, evolution and classification, enabling technologies, industry / academia initiatives, emerging trends and case studies.

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		40
Demonstrations		10
1. Demonstration using Videos	4	
2. Demonstration using Physical Models/ Systems	6	
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems	0	
Practical Work		4
1. Course Laboratory	4	
2. Computer Laboratory		
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		6
1. Assignment Discussion / Related Activities		
2. Case Study Presentation	3	
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations	3	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 058.

4. Course Resources	
a. Essential Reading	1. Erjavaec, (2004), Automotive Technology – A system approach, 3rd Edn, Thomson Delmar Learning 2. Class Notes
b. Recommended Reading	1. Markus Maurer, Barbara Lenz, (2015), Autonomous Driving - Technical, Leagal and Social Aspects, Springer Open
c. Other Resources	

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 058.

Course Specification

Course Details				
Course Code	19AUE524A			Course Category
Course Title	Automotive System Design			
Programme	M.Tech in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course deals with design of automotive systems and components. The students are taught design methods and procedures to develop automotive chassis, transmission, brakes, steering, suspension system components to meet the functional requirements of vehicles. Students are taught to create geometric models and detailed drawings for the selected automotive system/components for the designed dimensions.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S. No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other Activities
1	Discuss the design procedure for automotive systems including chassis, transmission, braking, steering and suspension systems		X	
2	Arrive at the best possible chassis design for the given power-train layout considering safety and structural aspects of the vehicle	X		
3	Design an efficient braking system for a given class of automobile based on application	X	X	
4	Identify and select transmission system layout for a given class of automobile to meet the power, performance and fuel economy	X		
5	Select the layout of steering and suspension systems with most the appropriate configurations and alignments to satisfy the	X	X	
6	Create geometric models and detailed drawings for the designed automotive systems layout and components using CAD software	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.2 Course Content
Automotive body and chassis design : Chassis design based on power-train layout, , chassis operating conditions, load distribution on chassis, Ladder frame chassis design, cruciform frames design, space-frame chassis, cross section selection, cross members reinforcements, chassis design for rigid axle and independent suspension system, design considerations for monocoque chassis **10 Hours**
Braking system Design: Braking system layout design, Braking effort calculations, Braking load distribution, Brake Proportioning, weight transfer during braking, braking torque, brake efficiency, performance of braking system, Design of fail-safe brakes, Adhesion utilization, selection of tyres for an efficient braking for different automotive applications, design of braking system for commercial vehicles, passenger cars and sports vehicles, Design methods for drum and disc brake components, brake fading, Brake squealing noise reduction methods **10Hours**
Transmission system components design: Transmission system layout for commercial vehicles, passenger cars, transmission system layout for longitudinal and transverse engine position, 4 wheel drive transmission layout, transmission system design based on engine characteristics (Power/performance/fuel economy), Design of synchromesh manual transmission, Design of CVT, performance of transmission system, design of Friction type clutch and torque convertor, propeller shaft design and universal joints design **10Hours**
Steering system components design: Steering system Layout, Design of Ackerman steering mechanism, Determination of steering torque and gear ratio, design procedure for steering wheel, column and gear box, steering linkages, forward and reverse efficiency of steering mechanisms, Steering geometry and alignment of steering system components **10 Hours**
Axles and Suspension system components design: Load distribution on front axle and rear axles, Design of Rigid axles, cross section for axles, design of semi floating, fully floating, floating and 3 quarter floating axles, constant velocity joints design, design of drive axles, design of leaf spring suspension, coil spring design, design of torsion bar, steering knuckle design, stub axle and wheel assembly. Design of independent suspension like McPherson and double wishbone **10 Hours**
Practical/Laboratory content: Use CAD software tool to create geometric models and detailed drawings for the designed automotive systems and components **10 Hours**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		40
Demonstrations		
1. Demonstration using Videos		
2. Demonstration using Physical Models/ Systems		
3. Demonstration on a Computer		
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		5
1. Course Laboratory		
2. Computer Laboratory	5	
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		5
1. Assignment Discussion / Related Activities	3	
2. Case Study Presentation	2	
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations		
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

4. Course Resources		
a.	**Essential Reading**	1. Class Notes 2. Julian Happian Smith,(2002), An Introduction to Modern Vehicle Design, Butterworth- Heinemann, Reed Educational and Professional Publishing Ltd,
b.	**Recommended Reading**	1. Jornsen Reimpell,(2001), The Automotive Chassis: Engineering Principles- second edition, Reed Elsevier and Professional Publishing Ltd 2. Automotive Transmission, Fundamentals, Selection, Design and Application, Springer, New York, 2001 3. William C. Orthwein,(2004) Clutches and brakes Design and selection, Southern Illinois University at Carbondale, Illinois, U.S.A., 4. David Barton, brakes (2000) Automotive Braking - Technologies for the 21st Century, Professional Engineering Publishing Limited , Bury St Edmunds and London, UK.
c.	**Other Resources**	**Magazines and Journals** 1. Automotive Engineer, Professional Engineering Publishing. 2. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of 3. Automobile Engineering, Professional Engineering Publishing. 4. International Journal of Engine Research, Professional Engineering Publishing. 5. SAE Transactions, SAE (USA) 6. Automotive Engineering International 7. Autocar INDIA 8. Overdrive 9. ATZ Auto Technology **Websites** 1. https://www.araiindia.com/pdf/CAE_Brochure.pdf 2. http://www.sciencedirect.com/science/books 3. http://www.cardesignnews.com/ **Other Electronic Resources** 1. www.dtic.mil/dtic/tr/fulltext/u2/817023.pdf 2. www.sae.org/images/books/toc_pdfs/R394.pdf 3. www.esdu.com/marketing/pdfs/brochures/esdu_automotive_collection.pdf

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

Course Specification

Course Details				
Course Code	19AUE531A			Course Category
Course Title	Electric and Hybrid Vehicles			
Programme	M.Tech in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering			
Faculty	Engineering and Technology			
Course Approval Date	May - 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course deals with electric and hybrid vehicle components, sub systems, systems and technologies. Students are taught to identify, understand functional requirements and functions of EVs and HEVs. Students will be able to select motor and battery pack requirements for various vehicular applications. Students are also taught to assess the impact of EVs and challenges that arise in near future

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other
1	Describe functional requirements of components of electric vehicles		X	X
2	Explain configurations of electric and hybrid electric vehicles		X	X
3	Discuss the design principles for improved electric vehicle performance		X	X
4	Predict power and torque characteristics of motor for various vehicle applications		X	X
5	Discuss the impact of electric vehicles on vehicle fleet, electricity and fuel use, electricity production, emission and government revenues	X	X	X
6	Design components of electric and hybrid electric vehicles	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the Course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.2 Course Contents
Introduction: Need for electric vehicles: Air pollution, Global warming and Petroleum resources, sustainable transportation, Components of EVs and HEVs, History of EVs and HEVs, advantages of EVs and HEVs, EV/ICEV Comparison, Well to wheel Analysis, EVs and HEVs market **(6 Hours)**
Motor and Batteries: Types of Motor: AC and DC motors, Motor Accessories, Types of Batteries and its significance, Power Electronic Converters **(8 Hours)**
Performance of Electric Vehicles: Configuration of electric vehicles, Power torque characteristics of motor, Calculations on motor power torque requirements, Acceleration performance, Regenerative braking, Mass Analysis and Packaging **(8 Hours)**
Hybrid Electric vehicles: Concept of HEV's, Present HEV's, HEV architectures, Series and parallel hybrid drive train. Plugin Hybrid Electric Vehicle, Limitations and issues with HEVS, Single mode and dual more transmission for Hybrid vehicle, DCT, Special Hybrid Vehicles , Power electronic convertor for HEVs **(8 Hours)**
Impact: Impact of EV's on vehicle fleet, Issues with electric propulsion, Electricity and fuel use, Electricity production, Emission, Charging point availability, Government policies **(8 Hours)**
Case Studies: Design of EV's and HEV's , Introduction to autonomous cars, challenges **(6 Hours)**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		40
Demonstrations		10
1. Demonstration using Videos	8	
2. Demonstration using Physical Models/ Systems	2	
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems	0	
Practical Work		0
1. Course Laboratory	0	
2. Computer Laboratory		
3. Engineering Workshop/ Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		10
1. Assignment Discussion / Related Activities		
2. Case Study Presentation	6	
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions		
6. Group Discussions		
7. Discussing Possible Innovations	4	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials	Visit to Industry	
1.	Knowledge	x	x			x				
2.	Understanding	x	x			x				
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x				
5.	Problem Solving Skills	x	x			x				
6.	Practical Skills								x	
7.	Group Work					x				
8.	Self-Learning					x	x			
9.	Written Communication Skills		x			x				
10.	Verbal Communication Skills					x	x			
11.	Presentation Skills		x			x	x			
12.	Behavioural Skills	x					x			
13.	Information Management		x			x	x			
14.	Leadership Skills						x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

4. Course Resources	
g. **Essential Reading**	3. Iqbal Hussein,(2003) Electric and Hybrid Vehicles: Design Fundamentals, CRC Press,. 4. Chiris Mi, Abdul Masrur, (2018), Hybrid Electric Vehicles : Principles and Application with Practical Aspects, John Wiley and Sons. 5. Class Notes
h. **Recommended Reading**	1. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, (2005), Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC PRESSm, Boca Raton London New York washington, D.C. 2. James Larminie, John Lowry, (2012), ELECTRIC VEHICLE TECHNOLOGY, EXPLAINED, 2nd Edition, John Wiley & Sons, Ltd., Publication 3. Denton T., (2016), Electric and Hybrid Vehicle, Institute of Motor Industry .
i. **Other Resources**	

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

Course Specification

Course Details				
Course Code	19AUE532A			Course Category
Course Title	Energy Storage Systems			
Programme	M.Tech. in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering Department			
Faculty	Faculty of Engineering and Technology			
Course Approval Date	May 2019	Course Next Review Date	May-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	04
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

3.2 Course Content	
Aim and Summary	The aim of this course is to prepare the students to study energy storage systems required in the automobiles. Different types of energy storage systems like batteries, fuel cell are discussed. The need of battery pack management and battery thermal management system are discussed along with battery construction, battery parameters, modelling techniques, battery testing, maintenance, failure modes and recycling procedures. Also students are trained to suggest the suitable energy storage system and management technology for given specification.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other Activities
1	Discuss the different energy storage systems in an automotive vehicle		X	
2	Examine and Identify the functional limitation of different batteries		X	
3	Discuss the battery construction, battery parameters, modelling techniques, battery testing, maintenance, failure modes and recycling procedures.		X	
4	Analyse the need of battery pack management and battery thermal management system	X	X	
5	Review working principle of fuel cell model, hydrogen fuel cell model, hydrogen storage systems, reformers, fuel cell electric vehicle	X	X	
6	Suggest the suitable energy storage system and management techniques for given specification	X	X	

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 058.

3.2 Course Content
Introduction: Introduction to Energy Storage Systems in Electric and Hybrid Vehicles. Batteries in Electric and Hybrid Vehicles, Battery Construction and Parameters: Battery Capacity, Open Circuit Voltage, Terminal Voltage, Practical Capacity, Discharge Rate, State of Charge, State of Discharge, Depth of Discharge, Battery energy, Specific Energy, Ragone Plots. Traction Batteries: Lead-Acid Battery, Nickel-Cadmium Battery, Nickel-Metal-Hydride Battery, Li-Ion Battery, Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulfur Battery, Sodium-Metal-Chloride Battery, Goals for Advanced Batteries
Battery Modelling: Electric Circuit Models: Basic Battery Model, Run-Time Model, Impedance-Based Model, First Principle Model Empirical Model: Range Prediction with Constant Discharge, Range Prediction with Power Density Approach
Battery Pack Management: Battery Management System, SoC Measurement, Battery Cell Balancing, Battery Charging, Battery Thermal Management System (BTMS): Technologies of BTMS: Air Cooling and Heating, Liquid Cooling and Heating, Direct Refrigerant Cooling and Heating, PCM, Thermoelectric Module, Heat Pipe, PTC Heater.
Battery Testing: General Test Conditions and Scaling, Capacity Test, Constant Power Discharge and Charge Tests, Hybrid Pulse Power Characterization Test, Self-Discharge Test, Cold Cranking Test, Thermal Performance Test, Energy Efficiency Test, Operating Set Point Stability Test, Cycle Life Test, Calendar Life Test. Battery Failure Modes: Thermal Abuse, Physical Damage, Charge and Discharge Failures, Short Circuit, Safety and Maintenance. Battery Safety Devices: Battery Management System (BMS), Cell Vent or Tear Away Tab, Current Interrupt Device, Current Limiting Fuses, Diodes Approaches to Improve Safety,Battery Maintenance, Recycling: Recycling Process for Different Types of Batteries, Regulations
Fuel Cells: Fuel Cell Types, Fuel Cell Characteristics, Fuel Cell Types, Fuel Cell Model, Hydrogen Fuel Cell Model, Hydrogen Storage Systems, Reformers, Fuel Cell Electric Vehicle Ultra-capacitors: Symmetrical Ultra-capacitors, Asymmetrical Ultra-capacitors, Ultra-capacitor Modeling

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		30
Demonstrations		08
1. Demonstration using Videos	05	
2. Demonstration using Physical Models/ Systems	03	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		10
1. Course Laboratory	05	
2. Computer Laboratory		
3. Engineering Workshop/ Course Workshop/Kitchen	05	
4. Clinical Laboratory		
5. Hospital		
6. Model / Model Studio		
Others		12
1. Assignment Discussion / Related Activities	03	
2. Case Study Presentation	03	
3. Guest Lecture		
4. Industry / Field Visit		
5. Brain Storming Sessions	03	
6. Group Discussions		
7. Discussing Possible Innovations	03	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	x		x		x				
2.	Understanding	x		x						
3.	Critical Skills	x	x			x				
4.	Analytical Skills	x	x			x		x		
5.	Problem Solving Skills	x	x			x		x		
6.	Practical Skills			x	x					
7.	Group Work					x		x		
8.	Self-Learning			x		x	x	x		
9.	Written Communication Skills		x		x	x				
10.	Verbal Communication Skills						x			
11.	Presentation Skills		x				x			
12.	Behavioural Skills	x					x			
13.	Information Management		x		x	x	x	x		
14.	Leadership Skills			x			x			

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

4. Course Resources		
a.	**Essential Reading**	1. Iqbal Husain,(2011), Electric and Hybrid Vehicles Design Fundamentals, Boca Raton, Taylor and Francis Group 2. Class Notes
b.	**Recommended Reading**	1. Mehrdad Ehsani, Yimin Gao, (2018), Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press 2. Thaler, Watzenig, (2014), Automotive Battery Technology, Springer 3. Adam Stienecker, (2009), Hybrid Energy Storage Systems, VDM Verlag
c.	**Other Resources**	

ಶುಭಂ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences

Course Specification

Course Details				
Course Code	19AUE534A			Course Category
Course Title	Electric Vehicle Structures and Safety			
Programme	M. Tech. in Automotive Engineering			PE
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	May 2019	Course Next Review Date	May 2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	4
Duration (Hrs)	70
Course Marks	100
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	To design and analyse the automotive body structure for strength, durability and occupant safety. The students will be taught typical constructions of automotive structures, sources, types and characteristics of operational and functional loads and resulting failure modes. Methods and consideration used at different stages of structure development will be explained. Physics of collision, resulting response of the bodies involved in collisions will be discussed. The students will be trained to use non-linear transient dynamic software for simulation of automotive collision phenomena for safety. The students will also be taught about active and passive safety concepts, technologies and systems, safety regulations and ratings, injury criteria and approaches to design of structures/structural components for dynamic loading.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination	
			Theory	Laboratory / Other Activities
1	Discuss passive safety concepts, technologies and systems, safety regulations and ratings, injury criteria and approaches to design of structures crashworthiness of the vehicle structure		X	X
2	Study the physics of collision, vehicle crashworthiness and crash testing requirements	X		X
3	Compute the vehicle structural and occupants response during vehicle crash		X	X
4	Analyse the physics of vehicle structural, occupants and pedestrian response during vehicle crash	X		X
5	Suggest the design changes in the vehicle for enhanced vehicle safety rating and requirements	X		X
6	Discuss passive safety concepts, technologies and systems, safety regulations and ratings, injury criteria and approaches to design of structures crashworthiness of the vehicle structure	X		X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.2 Course Content
Introduction to Automotive Structures - Sources of loads, Types of loads, Characteristics of loads and resulting failure modes, Quantification of loads and its problems, Typical body constructions used and their merits and demerits **(04 Hours)**
Design of Automotive Body Structures - Analysis of load flow through the structure, Simple Structural Surfaces, Component sizing for different types of loads and expected failure modes, Use of simplified analysis models, even for complex loads, in the initial design stage **(04 Hours)**
Crash and Collision - Physics of collision, Types of collision, Automotive collision, Structural and occupant/pedestrian response to crash, Key parameters for design for crash **(04 Hours)**
Design for Safety - Crashworthiness, Effect of impact forces on humans, Designing for human safety, Safety systems, Structural design considerations for occupant and pedestrian safety, Safety Standards and legislations in-terms of electric vehicle and components Tests **(04 Hours)**
General Vehicle Safety - Safe installation of the RESS (rechargeable energy storage system), operational safety of the vehicle, electrical safety of the vehicle and the protection of personnel against electric shock, requirements for post-crash electrical safety, focusing on the risks present to emergency personnel interventions. **(04 Hours)**
Practical/Laboratory content: Crash Simulation - Tools for simulation of crash phenomena, Non-linear transient dynamic simulation for structural assessment, , Consideration of modeling of Physics, Pre-processing, Selection of simulation parameters, Review and presentation of results and assessment of design **(20 Hours)**

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		30
Demonstrations		XX
1. Demonstration using Videos	XX	
2. Demonstration using Physical Models/ Systems	XX	
3. Demonstration on a Computer	XX	
Numeracy		04
1. Solving Numerical Problems	04	
Practical Work		20
1. Course Laboratory	20	
2. Computer Laboratory	XX	
3. Engineering Workshop/ Course Workshop/Kitchen	XX	
4. Clinical Laboratory	XX	
5. Hospital	XX	
6. Model / Model Studio	XX	
Others		06
1. Assignment Discussion / Related Activities	03	
2. Case Study Presentation	03	
3. Guest Lecture	XX	
4. Industry / Field Visit	XX	
5. Brain Storming Sessions	XX	
6. Group Discussions	XX	
7. Discussing Possible Innovations	XX	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		70

3.4 Meeting Programme Objectives through Course Objectives

S.No	Curriculum and Capabilities Skills	Lectures	Theory Exam	Lab Sessions	Lab Exam	Assignment	Presentations	Tutorials		
1.	Knowledge	X	X	X						
2.	Understanding	X	X	X						
3.	Critical Skills		X			X				
4.	Analytical Skills	X	X	X		X		X		
5.	Problem Solving Skills		X	X		X		X		
6.	Practical Skills			X						
7.	Group Work			X		X				
8.	Self-Learning					X				
9.	Written Communication Skills					X				
10.	Verbal Communication Skills						X			
11.	Presentation Skills						X			
12.	Behavioural Skills	X								
13.	Information Management						X			
14.	Leadership Skills									

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

4. Course Resources	
a. **Essential Reading**	1. Class Notes 2. Jason C. Brown, A. John Robertson and Stan S. Serpento, Motor Vehicle Structures: Concepts and Fundamentals, Warrandale, SAE International 3. Paul Du Bois et. al., 2004, Vehicle Crashworthiness and Occupant Protection, Automotive Application Committee, American Iron and Steel Institute
b. **Recommended Reading**	1. J. Fenton, 1998, Handbook of automotive body construction and design analysis, London, Professional Engineering Publishing 2. J. Fenton, 1980, Vehicle body layout and analysis, London, Mechanical Engineering Publishing 3. J. Pawloski, 1969, Vehicle Body Engineering, London, Business Books Ltd. 4. Mathew Huang, 2002, Vehicle Crash Mechanics, CRC Press
c. **Other Resources**	1. International Journal of Crashworthiness, Springer 2. International Journal of impact Engineering, Pergamon Press, Oxford 3. https://www.araiindia.com/downloads_catalogue_brochure.asp 4. http://www.nssmc.com/en/tech/report/nsc 5. http://www.nhtsa.gov/ 6. http://www.fmvss.com/

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specification

Course Details				
Course Code	19FET508A			Course Category
Course Title	Research methodology and IPR			
Programme	M. Tech. in Automotive Engineering			M
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	MAY-2019	Course Next Review Date	MAY-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	2
Duration (Hrs)	30
Course Marks	50
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course deals with the principles of research, research methodology, significant phases of research, Intellectual property and its rights. Students are taught the realistic guidelines to be followed in the choice of field of research, topic of research and formulation of research problem. Key and careful considerations in the choice of tools for the solution of research problem are covered in this module. The module emphasizes the desirable close knit relation between innovation and concept of out of the box thinking. The principles of effective research and the need for a Proactive approach in a successful research programme are also explained. The course discusses the significant role of Literature Review in a research cycle and the expectations from good literature review as well as procedure for systematic literature review. Students will get an insight into the privilege, honour and the associated responsibilities of a researcher. This course gives insight of the intellectual property rights and over view of the benefits.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment	Examination
			Theory
1	Describe the value, scope, relevance and mandatory steps of research as well as principles of effective research, Nature of		X
2	Discuss the guidelines to progress from the choice of broad field of research to specific topic of research, patent rights,	X	X
3	Demonstrate the application and utility of the Systematic approach and out of box thinking concepts for research to be	X	X
4	Adapt ,Analyze and prepare well-structured research proposal and research paper invoking clearly outlined principles	X	X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the course.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.2 Course Content
Foundations of Research – Definitions of Research, Mandatory Steps in Research, Types of Research, Relevance of Research for Innovation and Technology Development, Effective Research and Self Discipline.
Formulation of Research Problem: Identification of problems, Narrowing down the problem, Factors to be considered for problem selection. History and Evolution of Science & Technology
Out Of the Box Thinking and Systematic approach in Research – Transformation to Impossible Thinking, Convergent and Divergent Thinking, Generation, Evaluation and Selection of Ideas, Critical Thinking Literature Review – Importance of Literature Review, Constituents of Good Literature Review, Strategies for Literature Search, Referencing, Paraphrasing, and Summarizing Academic Standards and Ethics Research Proposal – Structure of a Good Research Proposal, Getting Started, Tips for Compilation of Good Research Proposal.
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases, Geographical Indicators
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Copy rights for Software's Traditional knowledge Case Studies.

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		20
Demonstrations		XX
1. Demonstration using Videos	XX	
2. Demonstration using Physical Models/ Systems	XX	
3. Demonstration on a Computer	XX	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	XX	
2. Computer Laboratory	XX	
3. Engineering Workshop/ Course Works	XX	
6. Model / Model Studio	XX	
Others		10
1. Assignment Discussion / Related Activities	03	
2. Case Study Presentation	03	
3. Guest Lecture	04	
4. Industry / Field Visit	XX	
5. Brain Storming Sessions	XX	
6. Group Discussions	XX	
7. Discussion on Possible Innovations	XX	
Student Presentation, Laboratory Examination, Written Examination		10
Total Duration in Hours		40

4. Course Resources	
a. Essential Reading	1. Class Notes 2. Dr. Chakroborty, S.K. "ValuStuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'" 3. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" 4. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 5. Halbert, (2007) "Resisting Intellectual Property", Taylor & Francis Ltd .
b. Recommended Reading	1. Mayall, (1192),"Industrial Design", McGraw Hill. 2. Niebel, (1972), "Product Design", McGraw Hill. 3. Asimov, (1962), "Introduction to Design", Prentice Hall. 4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, (2016)," Intellectual Property in New Technological Age". 5. T. Ramappa, (2008)"Intellectual Property Rights Under WTO", S. Chand.
c. Other Resources	

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 058.

Course Specification

Course Details				
Course Code	19FET509A			Course Category
Course Title	Professional Communication			
Programme	M. Tech. in Automotive Engineering			Audit
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	MAY-2019	Course Next Review Date	MAY-2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	audit
Duration (Hrs)	10
Course Marks	25
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course aims at sensitising students to the essentials of professional communication. Professional Communication is essential to achieve the objectives of an organisation.

3. Teaching, Learning and Assessment

3.1 Intended Learning Outcomes (ILO) and Mapping of Assessment

After undergoing this Course students will be able to:

S.No.	ILO	Assignment/ other methods
1	Compose effective written business communication	X
2	Practice the techniques of presentation	X

IMPORTANT: Details of *Component Weightages, Assessment* and *Re-assessment* are indicated in M. Tech. Programme Speciation document for the given category of the course.

3.2 Course Content
Introduction to Professional Communication, Conversation and Listening
Reading Skills for Effective Professional Communication: Introduction, SQ3R (Survey, Question, Read, Retrieve, and Review) Technique of Reading
Written Business Communication: Writing Memos, Letters, Circulars and Notices, Communicating through Email
Presentation Skills: Message development, content, projection, inflection, and delivery

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		5
Demonstrations		XX
1. Demonstration using Videos	XX	
2. Demonstration using Physical Models/ Systems	XX	
3. Demonstration on a Computer	XX	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	XX	
2. Computer Laboratory	XX	
3. Engineering Workshop/ Course Workshop	XX	
Others		04
1. Assignment Discussion / Related Activities	04	
2. Case Study Presentation	XX	
3. Guest Lecture	XX	
4. Industry / Field Visit	XX	
5. Brain Storming Sessions	XX	
6. Group Discussions	XX	
7. Discussion on Possible Innovations	XX	
Student Presentation, Laboratory Examination, Written Examination		01
Total Duration in Hours		10

4. Course Resources	
d. Essential Reading	1. Class Notes 2. Dr. C.S.G. Krishnamacharyulu (2016) Business Communication, Himalaya Publishing House
e. Recommended Reading	3. V. Lesikar, John D. Pettit, Jr., Marie E. Flatley. (1999), Basic Business Communication, 8th Edition, Tata McGraw Hill
f. Other Resources	

ಶುಭಂ

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

Course Specification

Course Details				
Course Code	19FET510A			Course Category
Course Title	Value Education			
Programme	M. Tech. in Automotive Engineering			Audit
Department	Automotive and Aeronautical Engineering			
Faculty	Faculty of Engineering & Technology			
Course Approval Date	May 2019	Course Next Review Date	May 2021	
Department Responsible for Course Delivery				

1. Course Size and Credits	
Number of Credits	audit
Duration (Hrs)	10
Course Marks	50
Attendance Requirement	As per M.Tech. Programme Academic Regulations
Course Pass Criteria	As per M. Tech. Programme Specification Document (Annexure-1)

2. Course Summary	
Aim and Summary	This course aims at sensitising students to learn the importance of value education. It gives an insight about the Universal Brotherhood.

3. Teaching, Learning and Assessment

No.	Intended Learning Outcome	Assignment/ other methods
1	Discuss the role of Values and Ethics in Self-Development	X
2	Appreciate the importance of Universal Brotherhood	X

3.2 Course Content
Values, Ethics and Self-Development; Awareness of self-destructive habits, Power of faith, Positive Thinking Value judgements – Stereotypes, prejudices and biases
Sense of duty, Self-reliance, Confidence, Concentration, Discipline, Honesty, Truthfulness National Unity, Patriotism, Love for nature
Universal brotherhood and religious tolerance Character and Competence –Rational Thinking vs Blind faith

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.

3.3 Teaching and Learning Methods		
Methods	**Duration in Hrs.**	**Total Duration in Hrs.**
Face to Face Lectures		5
Demonstrations		XX
1. Demonstration using Videos	XX	
2. Demonstration using Physical Models/ Systems	XX	
3. Demonstration on a Computer	XX	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	XX	
2. Computer Laboratory	XX	
3. Engineering Workshop/ Course Workshop	XX	
Others		04
1. Assignment Discussion / Related Activities	04	
2. Case Study Presentation	XX	
3. Guest Lecture	XX	
4. Industry / Field Visit	XX	
5. Brain Storming Sessions	XX	
6. Group Discussions	XX	
7. Discussion on Possible Innovations	XX	
Student Presentation, Laboratory Examination, Written Examination		01
Total Duration in Hours		10

4. Course Resources	
g. Essential Reading	1. Class Notes 2. Dr. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi
h. Recommended Reading	3. Mike W.Marin, Roland Schinzige,"Ethics in Engineering", Tata Mcgraw Hill
i. Other Resources	

ಇಂದ

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

Dean
Faculty of Engineering & Technology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058.