VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Electronics Engineering

M. Tech. – Automotive Electronics

Curriculum and Syllabus

2022-23

VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OFTECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.
Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.

Impactful People: Happy, accountable, caring and effective workforce and students.

Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.
Service to Society: Service to the region and world through knowledge andcompassion.

VISION STATEMENT OF THE SCHOOL OF ELECTRONICS ENGINEERING

To be a leader by imparting in-depth knowledge in Electronics Engineering, nurturing engineers, technologists and researchers of highest competence, who would engage in sustainable development to cater the global needs of industry and society.

MISSION STATEMENT OF THE SCHOOL OF ELECTRONICS ENGINEERING

- Create and maintain an environment to excel in teaching, learning and applied research in the fields of electronics, communication engineering and allied disciplines which pioneer for sustainable growth.
- Equip our students with necessary knowledge and skills which enable themto be lifelong learners to solve practical problems and to improve the quality of human life

.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The graduates of the programme will be able to

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems

2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry

3. Graduates will function in their profession with social awareness and responsibility

4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country

5. Graduates will be successful in pursuing higher studies in engineering or management

6. Graduates will pursue career paths in teaching or research

.

PROGRAMME OUTCOMES (POs)

On completion of the Programme the students will have the

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_02: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment

PO_03: Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information

PO_04: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

PO_05: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO_06: Having adaptive thinking and adaptability in relation to environmental context and sustainable development

PO_07: Having a clear understanding of professional and ethical responsibility

PO_08: Having a good cognitive load management skills related to project management and finance

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of M. Tech. Automotive Electronics, graduates will be able to:

PSO1. Apply advanced concepts of Automotive Electronics to design and develop components and systems for applications in automotive systems.

PSO2. Use state-of-art hardware and software tools to experiment the automotive electronics systems to solve industry and real-world problems.

PSO3. Independently carry out research on diverse Automotive Electronics strategies to address practical problems and present a substantial technical report.

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Electronics Engineering (SENSE)

M. Tech. – Automotive Electronics

Curriculum and Course Content

[Curriculum for Applied Learning (CAL)]

S. No	Category	Credits
1	Discipline Core	24
2	Skill Enhancement	05
3	Discipline Elective	12
4	Projects and Internship	26
5	Open Elective	03
Total Credits		70

Master of Technology in Automotive Electronics

School of Electronics Engineering

Programme Credit Structure	**Credits**
Discipline Core Courses	24
Skill Enhancement Courses	05
Discipline Elective Courses	12
Open Elective Courses	03
Project/ Internship	26
Total Graded Credit Requirement	70

Discipline Core Courses **24**

		L	T	P	C
MAME501L	Sensors and Engine Management Systems	3	0	0	3
MAME502L	Microcontrollers for Vehicular Systems	3	0	0	3
MAME502P	Microcontrollers for Vehicular Systems Lab	0	0	2	1
MAME503L	Vehicle Control Systems	3	0	0	3
MAME504L	Automotive Networking and Protocols	3	0	0	3
MAME504P	Automotive Networking and Protocols Lab	0	0	2	1
MAME505L	Electric and Electronic Power Systems for Vehicles	3	0	0	3
MAME506L	Automotive Power Electronics and Motor Drives	3	0	0	3
MAME506P	Automotive Power Electronics and Motor Drives Lab	0	0	2	1
MAME507L	Alternative Drives, Traction and Controls	3	0	0	3

Skill Enhancement Courses **05**

MENG501P	Technical Report Writing	0	0	4	2
MSTS501P	Qualitative Skills Practice	0	0	3	1.5
MSTS502P	Quantitative Skills Practice	0	0	3	1.5

Discipline Elective Courses **12**

MAME601L	Data Acquisition and Signal Conditioning	3	0	0	3
MAME601P	Data Acquisition and Signal Conditioning Lab	0	0	2	1
MAME602L	AUTOSAR and ISO Standards for Automotive Systems	2	0	0	2
MAME603L	Soft Computing Techniques for Automotive Applications	3	0	0	3
MAME604L	Automotive EMI and EMC Standards	3	0	0	3
MAME605L	Vehicular Information and Communication Systems	3	0	0	3
MAME606L	Parallel Programming using Multi cores and Graphical Programming Units	3	0	0	3
MAME607L	Digital Signal Processing and its Applications	3	0	0	3
MAME607P	Digital Signal Processing and its Applications Lab	0	0	2	1
MAME608L	Open Source Hardware and Software System Design	3	0	0	3
MAME609L	Machine Vision System for Automotive	3	0	0	3
MAME609P	Machine Vision System for Automotive Lab	0	0	2	1
MAME610L	Automotive Fault Diagnostics	3	1	0	4
MAME611L	Emission Control and Diagnosis	3	0	0	3
MAME612L	Vehicle Safety Systems	2	0	0	2
MAME613L	Vehicle Bodies	2	0	0	2
MAME614L	Engine Peripherals	2	0	0	2
MAME615L	Vehicle Security and Comfort Systems	3	0	0	3

Open Elective Courses **03**

Engineering Disciplines | Social Sciences

Project and Internship **26**

MAME696J	Study Oriented Project	02
MAME697J	Design Project	02
MAME698J	Internship I/ Dissertation I	10
MAME699J	Internship II/ Dissertation II	12

Course Code	Course Title	L	T	P	C
MAME501L	Sensors and Engine Management Systems	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at

1. Giving details of the Engine sensor waveforms and methods to analyze the same.
2. Providing an overview of petrol and diesel engines using Engine Control Unit (ECU).
3. Giving insights into the operation of ECU with the suitable mapping of sensors.

Course Outcome

At the end of the course, the student will be able to

1. Comprehend the concepts of ECU design for automotive applications.
2. Analyze response of Transducers and sensors for automotive applications
3. Understand the various after treatment and alternative fuel-based systems.
4. Comprehend the operation of petrol engine management systems.
5. Understand the operation of automotive sensors and fuel injection systems.
6. Comprehend the Electronic control unit pertaining to chassis and body.
7. Illustrate the various Automotive subsystems.

Module:1	Electronic Control Unit(ECU) Design	6 hours

The concepts of ECU design for automotive applications, Need for ECUs, advances in ECUs for automotive, design complexities of ECUs, V-Model for Automotive ECU's Architecture, analog and digital interfaces.

Module:2	Basics of Engine Control systems	6 hours

IC engines operation – Petrol and Diesel; IC engine as a propulsion source for Automobiles; the need for engine controls and management; Control objectives linked to fuel efficiency, emission limits and vehicle performance; advantages of using Electronic engine controls.

Module:3	Petrol Engine Management Systems	7 hours

Evolution of Petrol engine controls, Electronic ignition, multi-point fuel injection, direct injection; Basics of ignition system and fuel injection system; Architecture of a EMS with multi point fuel injection.

Module:4	Diesel Engine Management Systems	6 hours

Basics of Diesel engine Controls ; Evolution of diesel engine controls; in-line fuel pump; rotary fuel pump; EGR control; Electric motor driven fuel pump; electronic fuel injection control and timing.

Module:5	After Treatment and Alternate Fuel	6 hours

Automobile emission – source, control, tests, standards (Indian), Exhaust Gas Recirculation (EGR), Catalytic converter, Alternative fuels – hydrogen – CNG, LPG, Biodiesel.

Module:6	Transducer Principles	6 hours

Transducers classification and basic principles, General Input-output configuration, static characteristics and dynamic characteristics of instruments, Variable resistance transducers, Metal and semiconductor strain gages and their signal conditioning ,Inductive transducers, Electromagnetic sensors, Hall effect sensors, Capacitive transducers, Piezo electric transducers and their signal conditioning, Ultrasonic sensors.

Module:7	Sensors for Transportation	6 hours

Vehicle Body:- Torque sensors/ Force sensors, Sensors Flap air flow sensors, Temperature sensor, Ultrasonic sensors, Ranging radar (ACC) Power Train:- Fuel level sensors, Speed and RPM sensors, Lambda Oxygen sensor, Hotwire air mass meter Chassis:- Steering wheel angle sensor, Vibration and acceleration sensors, Pressure sensors, Speed and RPM sensors.

Module:8	Contemporary Issues	2 hours

	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Fundamentals of Internal Combustion Engines - H.N. Gupta - Second edition (2015) – PHI publisher
2.	Internal Combustion Engines - 2012 -V Ganesan –Tata McGraw Hill
3.	Automotive Sensors (Sensors Technology) –2009 by John Turner & Joe Watson (Author)
Reference Books	
1.	Automotive Sensors, BOSCH. 2002
2.	Fundamentals of Automotive Electronics Book - Sixth Edition-2015 - Alma Hillier

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME502L	Microcontrollers for Vehicular Systems	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Introducing the students to various automotive grade microcontroller for vehicles.
2. Teaching Embedded C programming with 8051 controller and ARM processor.
3. Explaining the architecture and features of ARM processor.

Course Outcome

At the end of the course, the students will able to

1. Understand the architecture of 8051 Microcontroller.
2. Write programs for solving problems using 8051 Microcontroller.
3. Comprehend ARM architecture & its features
4. Describe the architecture of Cortex-M.
5. Perform ARM processor based experiments using Embedded C programming tool.
6. Have an overview of the types of ARM cores in the market and to make a suitable choice for an application.
7. Comprehend various Microcontroller for powertrain and body electronics.

Module:1	**Introduction to 8 bit microcontrollers**	**5 hours**
RISC / CISC and Harvard / Princeton, 8bit Architecture [8051,PIC18], External memory interface, Ports, Timers/counters, Serial Communication, Interrupts.		
Module:2	**8 bit microcontrollers programming for Body, Safety and Temperature**	**7 hours**
Programming in Embedded C [8051, PIC18], Applications on Body, safety and Temperature.		
Module:3	**ARM Architecture**	**7 hours**
ARM Design Philosophy, Overview of ARM architecture, States[ARM, Thumb, Jazelle], Registers, modes, Conditional Execution, Pipelining, Vector Tables, Exception handling.		
Module:4	**ARM Core**	**6 hours**
Architecture of Cortex-M, Memory Addressing, IO ports, Timers/counter, Watch Dog Timer, PWM, ADC/DAC, UART, Interrupts, Displays, C programming.		
Module:5	**ARM core programming**	**6 hours**
Embedded C programming for IO ports, Timers, PWM, ADC and External interfaces.		
Module:6	**Automotive 32-bit MCU**	**6 hours**
Choosing MCU's for Automotive Applications, Atmel – SMART ARM based MCU, ST- SPC5 32-bit Automotive MCU, NXPAutomotive MCU.		
Module:7	**Automotive MCU by Applications**	**6 hours**
Automotive microcontrollers for Powertrain Control, Hybrid and Electric Auxiliaries, Transmission and Body Electronics.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	The 8051 Microcontroller and Embedded Systems Using Assembly and C -3rd Edition - Muhammad Ali Mazidi -2015

Reference Books

1.	8051 Microcontrollers - David Calcutt, Fred Cowan, Hassan Parchizadeh – Newness –
2.	2011 The Definitive Guide to the ARM Cortex M0 - Joseph Yiu –Newness -2015
3.	Automotive Microcontrollers, Volume 2 by Ronald K. Jurgen – SAE publication-2012

Mode of Assessment: Continuous Assessment and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME502P	Microcontrollers for Vehicular Systems Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Introducing the students to various automotive grade microcontrollers for vehicles.
2. Teaching Embedded C programming with 8051 controller and ARM processor.
3. Explaining the architecture and features of ARM processor.

Course Outcome

At the end of the course, the students will able to

1. Understand the architecture of 8051 Microcontroller.
2. Write programs for solving problems using 8051 Microcontroller.
3. Comprehend ARM architecture & its features
4. Describe the architecture of Cortex-M.
5. Perform ARM processor based experiments using Embedded C programming tool.
6. Have an overview of the types of ARM cores in the market and to make a suitable choice for an application.
7. Comprehend various Microcontroller for powertrain and body electronics.

Indicative Experiments

1.	[**8051 Micro controller using Embedded C in Keil and implementation in 8051 Microcontroller] (expt. 1 to 5)** Programming with Arithmetic logic instructions – GPIO programming	2 hours
2.	Programming with timer – using timer for calculating delay	4 hours
3.	Programming with Serial Communication – Serial communication data transfer and receiver	4 hours
4.	Programming with Interrupt – providing external interrupt to activate ISR	4 hours
5.	Programming with LCD – interface LCD to display outputs	2 hours
6.	[**ARM Micro controller using Embedded C using simulator and LPC2148 –ARM microcontroller] (expt. 6 to 10)** Programming with Arithmetic logic instructions – Basic programming like addition, subtraction.	2 hours
7.	Programming with Arithmetic logic instructions - multiply, division, AND , OR etc., logic execution	2 hours
8.	GPIO programming ARM microcontroller - GPIO programming	4 hours
9.	Timers programming ARM Microcontroller– using timer for calculating delay	4 hours
10.	PWM Generation ARM Microcontroller- DC motor control	2 hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment and Final Assessment Test

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME503L	Vehicle Control Systems	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Getting the know-how required for mathematical modeling, performance and stability analysis of feedback vehicle control system.
2. Providing a comprehensive coverage of controller design, state space design methods and digital control system.
3. Acquiring the skills for carrying out typical projects involving vehicle controls using MATLAB and SIMULINK.

Course Outcome

At the end of the course, the student will be able to

1. Understand the modeling aspects involved in the design of the physical system for vehicle applications
2. Identify the steady state and transient response of the different order of the system, analyse its performance and compute error coefficients.
3. Evaluate the stability of the system in frequency domain
4. Design a controller for automotive application using MATLAB/SIMULINK
5. Comprehend the Classical controller design
6. Identify the state space design methods like SISO, etc.
7. Explain the stability test procedure and get introduced to digital controller design.

Module:1	**System Modeling using Transfer function**	**6 hours**

Fundamentals of modeling -transfer function approach. Introduction to block diagrams & signal flow graphs. Introduction to SIMULINK.

Module:2	**Performance of Feedback Control System**	**6 hours**

First order, Second order control system response for step, ramp and impulse inputs. Error Analysis - Type number -characteristic equation -Poles and Zeroes concept -Error Analysis and performance indices.

Module:3	**Stability analysis of feedback control system**	**6 hours**

Frequency response plots -frequency domain specifications -stability analysis- Routh Hurwitz stability criteria –Root Locus – stability in the frequency domain –gain and phase margins – Nyquist stability criterion.

Module:4	**Controller Design**	**6 hours**

Proportional, Integral, Derivative controllers, P, PI, and PID control actions and mathematical models. Using SIMULINK to build 'P','PI', 'PID'controller modules and carry out experiments. Importance and interpretations of results.

Module:5	**Classical controller design**	**6 hours**

Classical design in the frequency domain- lead, lag compensator design.

Module:6	**Modern control theory**	**7 hours**

State space design methods: SISO, MIMO systems, Various forms of representation of the system (Bush form, etc), controllability and observability, state observer.

Module:7	**Introduction to Digital Control System**	**6 hours**

Discrete Time systems, Sampling and aliasing considerations, System time response, characteristics -Jury's stability test -mapping s to z plane -Digital controller design: from analog to digital design.

Module:8	**Contemporary Issues**	**2 hours**

	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Katsuhiko Ogata, —Modern Control Engineeringll, Prentice Hall, (4th Edition), 2015
2.	K. Ogata, —Discrete-Time Control Systems, Prentice-Hall, Inc., 1994
Reference Books	
1.	I.J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited, 4th Edition, 2006
2.	Norman S. Nise," Control Systems Engineering ", 6th Edition December 2015
3.	Uwe Kiencke, Lars Nielsen, —Automotive Control Systems: For Engine, Driveline, and Vehiclell, Springer; 1 edition, March 30, 2000
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test	

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME504L	Automotive Networking and Protocols	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Providing an overview of automotive network systems.
2. Exposing students to the aspects of design, development, application and performance issues associated with automotive network systems.

Course Outcome

At the end of the course, the student will be able to

1. Illustrate the basics of automotive networking and protocols
2. Comprehend the general protocols and their usage in automotive sector
3. Understand the LIN protocol and implement inconvenience feature applications
4. Design and implement CAN protocol for chassis and power train applications
5. Understand the concepts of time triggered protocols and it‘s usage in automotive field
6. Design and implement in media-oriented system transport protocol applications
7. Understand FlexRay protocol and their usage in safety critical applications

Module:1	**Introduction to Automotive Networking**	**6 hours**
Overview of Data communication and networking –need for In-Vehicle networking –layers of OSI reference model –multiplexing and de-multiplexing concepts –vehicle buses.		
Module:2	**General purpose protocols**	**6 hours**
Overview of general purpose networks and protocols –Ethernet, TCP, UDP, IP		
Module:3	**Protocol for low data rate applications**	**6 hours**
LIN standard overview –workflow concept-applications –LIN protocol specification –signals –Frame transfer –Frame types –Schedule tables –Task behaviour model –Network management – status management.		
Module:4	**Protocol for medium data rate applications**	**7 hours**
Overview of CAN –fundamentals –Message transfer –frame types-Error handling –fault confinement-Bit time requirements		
Module:5	**Time triggered protocol**	**6 hours**
Introduction to CAN open –TTCAN –Device net –SAE J1939		
Module:6	**Protocol for infotainment**	**6 hours**
MOST –Overview of data channels –control channel-synchronous channel –asynchronous channel –Logical device model –functions-methods-properties-protocol basics- Network section-data transport –Blocks –frames –Preamble-boundary descriptor		
Module:7	**Protocols for safety critical applications**	**6 hours**
FlexRay-Introduction –network topology –ECUs and bus interfaces –controller host interface and protocol operation controls –media access control and frame and symbol processing –coding/decoding unit		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. J.Gabrielleen, Automotive in-vehicle networks, John Wiley & Sons, Limited, 2016

Reference Books

1. Robert Bosch, Bosch automotive networking, Bentley publishers,2007

<table>
<tr><td>2.
3.
4.

5.
6.</td><td>Society of automotive engineers, In-vehicle networks ,2015
Ronald K Jurgen, —Automotive Electronics Handbook, McGraw-Hill Inc. 1999.
IndraWidjaja, Alberto Leon-Garcia, —Communication Networks: Fundamental Concepts and Key Architectures, McGraw-Hill College; 1st edition, 2000.
Konrad Etschberger, Controller Area Network, IXXAT Automation, August 22, 2001.
Olaf Pfeiffer, Andrew Ayre, Christian Keydel, —Embedded Networking with CAN and CANopen, Anna books/Rtc Books, 2003</td></tr>
<tr><td colspan="2">Mode of Assessment: Continuous Assessment and Final Assessment Test</td></tr>
<tr><td colspan="2">Recommended by Board of Studies</td><td colspan="2">28-07-2022</td></tr>
<tr><td colspan="2">Approved by Academic Council</td><td>No. 67</td><td>Date</td><td>08-08-2022</td></tr>
</table>

Course Code	Course Title	L	T	P	C
MAME504P	Automotive Networking and Protocols Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Providing an overview of automotive network systems.
2. Exposing students to the aspects of design, development, application and performance issues associated with automotive network systems.

Course Outcome

At the end of the course, the student will be able to

1. Illustrate the basics of automotive networking and protocols
2. Comprehend the general protocols and their usage in automotive sector
3. Understand the LIN protocol and implement inconvenience feature applications
4. Design and implement CAN protocol for chassis and power train applications
5. Understand the concepts of time triggered protocols and it‘s usage in automotive field
6. Design and implement in media-oriented system transport protocol applications
7. Understand FlexRay protocol and their usage in safety critical applications

Indicative Experiments		
1.	LIN node to node communication using HCS512 microcontroller • Data will be sent and received from master and slave node using LIN protocol	8 hours
2.	CAN node to node communication using HCS512 microcontroller • Data will be sent and received from master and slave node using CAN protocol	8 hours
3.	FlexRay communication using EVB9S12XF512E board • Multiple Data bytes sent using FlexRay protocol	6 hours
4.	TCP/IP communication using LabView • Sending data to particular port address using TCP/IP protocol	4 hours
5.	TCP/UDP communication using LabView • Sending data to particular port address using TCP/UDP protocol	4 hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment and Final Assessment Test

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME505L	Electric and Electronic Power Systems for Vehicles	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course to aimed at

1. Developing the skills to understand the circuit and electrical wiring diagram and interpret the same.
2. Providing students with a good understanding of automotive electrical systems with particular emphasize on batteries, charging, ignition, starters and lighting systems.
3. Imparting students the knowledge about the new developments and advancements of automotive electrical technologies.

Course Outcome

At the end of the course, the student will be able to

1. Interpret the electrical wiring, circuit diagram for automotive applications
2. Understand the role of batteries in vehicles
3. Develop a charging system for vehicles
4. Understand the starter and ignition systems in vehicles
5. Demonstrate knowledge on lighting systems for vehicles.
6. Comprehend the passive restraint systems and electrical accessories in vehicles
7. Design and implement various electrical outlet systems for vehicles

Module:1	**Electrical Systems and Circuits**	**6 hours**

System approach –electrical wiring, terminals and switching –multiplexed wiring systems – CAN – circuit diagrams and symbols, Requirements for two wheeler, three wheeler vehicles, Requirements for heavy vehicles- trucks and trailers.

Module:2	**Batteries**	**6 hours**

Vehicle Batteries –Lead-Acid batteries –maintenance and charging –diagnosing Lead acid battery faults –advanced battery technology.

Module:3	**Charging systems**	**7 hours**

Requirements of charging systems —generation of electrical energy in motor vehicle – physical principles – alternators –characteristic curves –charging circuits –diagnosing charging system faults.

Module:4	**Starting system**	**6 hours**

Requirements –starter motors and circuits –types of starter motors –diagnosing starting system faults.

Module:5	**Ignition system**	**6 hours**

Fundamentals –electronic ignition –programmed ignition –distributor less ignition –direct ignition spark plug ignition –diagnosing faults.

Module:6	**Lighting system**	**6 hours**

Insulated and earth return systems, positive and negative earth systems, Concealed headlights Lighting circuit types, glare and preventive methods.

Module:7	**Gauges, Accessories and Passive restraint systems**	**6 hours**

Electrical fuel pump, speedometer, oil and temperature gauges, Horns, Wipers, washers, Blower motors, Defoggers, Power windows, seats, door locks, Air bag systems, Seat belt pretensioners

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Automotive Electricals / Electronics System and Components, Tom Denton, 3rd

	Edition, 2015		
Reference Books			
1.	Judge, A.W., —Modern Electrical Equipment of Automobiles‖, Chapman & Hall London, 1992		
2.	Young, A.P., &Griffiths.L., —Automobile Electrical Equipment‖, English Languages Book Society & New Press, 1990		
3.	Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 4th Edition, 2004		
4.	Automotive Hand Book, Robert Bosch, Bently Publishers, 1997		
5.	Jurgen, R., Automotive Electronics Hand Book, 2015		
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME506L	Automotive Power Electronics and Motor Drives	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Imparting an in-depth knowledge about power electronics devices using MATLAB
2. Acquiring the design capability of converters and inverters for the electric and hybrid vehicles 3. Gaining knowledge on the different motors and their application in electric vehicles

Course Outcome

At the end of the course, the student will be able to

1. Understand the operation of power semiconductor devices
2. Understand the operation of AC-DC converters at different loads
3. Understand the operation of three phase inverters
4. Design different converters: buck, boost and buck-boost converters
5. Understand the concepts of ultracapacitor and its usage in automotive field
6. Describe the different speed control methods of induction motors
7. Give details about the operation and characteristics of different motors

Module:1	**Power Electronics**	**6 hours**
Introduction to power electronics- Structure , operation and characteristics of automotive semiconductor devices -SCR,Power Transistor, Power MOSFET and IGBT- turn on and off circuits – series and parallel operation of SCR –protection Circuits –design of snubber circuits		
Module:2	**Converters**	**6 hours**
Half wave controlled converter with R,RL-RLE load, fully controlled converters with R-RL-RLE load-Three phase half wave controlled converter with R-RL load- Three phase fully controlled converter with R-RL load		
Module:3	**Inverters**	**6 hours**
Voltage source inverter with 120 degree and 180 degree conduction mode-current source inverters – PWM techniques		
Module:4	**Choppers**	**6 hours**
Step up and step down choppers –Different types of coppers – use of choppers		
Module:5	**Ultracapacitors**	**6 hours**
Theory of electronic double layer capacitance-model and cell balancing-sizing criteria-converter interface-ultracapacitors in combination with batteries		
Module:6	**Automotive motor Control**	**6 hours**
Methods of controlling speed – Induction and DC Motor controls		
Module:7	**Automotive drive system**	**7 hours**
BLDC - Motor construction, characteristics and operation -Open loop and close loop control through speed and current sensors-Switched Reluctance Motor -Motor construction, operation and its application.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. P.S. Bimbhra, “Power Electronics:”, Khanna Publishers, 14th edition,2015

Reference Books

1.	Ali Emadi, “Handbook of Automotive power electronics and motor Drives” CRC Press, 2015.
2.	Bimal K Bose, “Power Electronics and Motor Drive: Advances and Trends”, Elsevier, Inc., 2006.

Mode of Assessment: Continuous Assessment and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME506P	Automotive Power Electronics and Motor Drives Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Imparting an in-depth knowledge about power electronics devices using MATLAB
2. Acquiring the design capability of converters and inverters for the electric and hybrid vehicles 3. Gaining knowledge on the different motors and their application in electric vehicles

Course Outcome

At the end of the course, the student will be able to

1. Understand the operation of power semiconductor devices
2. Understand the operation of AC-DC converters at different loads
3. Understand the operation of three phase inverters
4. Design different converters: buck, boost and buck-boost converters
5. Understand the concepts of ultra-capacitor and its usage in automotive field
6. Describe the different speed control methods of induction motors
7. Give details about the operation and characteristics of different motors

Indicative Experiments

1.	Design and study of anode current curve using SCR	2 hours
2.	Design and study of transfer and output characteristics of MOSFET	4 hours
3.	Design and study of transfer and output characteristics of IGBT	4 hours
4.	Single Phase half wave controlled convertor with R load(using SCR), triggering from microcontroller.	4 hours
5.	Three Phase half wave controlled convertor with R, RL, load using MATLAB	4 hours
6.	Three Phase voltage source inverter (VSI) 120 degree mode of conduction using MATLAB	4 hours
7.	Step-up-chopper and step-down chopper using MATLAB	4 hours
8.	Brushless DC (BLDC) motor modeling using MATLAB	4 hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment and Final Assessment Test

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME507L	Alternative Drives, Traction and Controls	3	0	0	3
Pre-requisite	MAME505L	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Acquainting students with the basics of propulsion using IC engines and electric motors
2. Knowing about different energy storage and conversion schemes for Hybrid vehicles
3. Giving details about the different architectures for Hybrid electric vehicles

Course Outcome

At the end of the course, the students will able to

1. Understand automotive electrical systems
2. Suggest an alternate vehicle technology
3. Understand the difference in electric motors and IC engines for propulsion in automobiles
4. Describe the charging systems for different storages devices
5. Understand the types of motors used and control mechanism involved for these types of motors in vehicles
6. Explain the various architectures for Hybrid electric vehicles
7. Understand the need of fuel cells and use them for hybrid vehicles

Module:1	Automotive Electrical Systems	6 hours

Electrical Systems and Circuits - Starting systems - Ignition Systems - Lighting & accessories - Electromagnetic Interference and Compatibility

Module:2	Hybrid Vehicle Technology	6 hours

Background on need for alternate vehicle technologies for propulsion - Emissions from IC engine based transportation and regulating standards - Projections on availability of non-renewable energy sources - Alternate technologies for vehicles for reducing urban pollution and for extending availability of resources - Importance of Hybrid Electric Vehicles technology

Module:3	Basics of Vehicle Propulsion	7 hours

Components comprising traction torque - Vehicle performance Parameters – Speed and Acceleration - Fuel economy in IC engine vehicles - Torque – Speed characteristics of IC engines - Comparison of Electric motors and IC engines as vehicle propulsion power sources - Basics of Electric vehicles - Types of Motors and the speed – Torque characteristics

Module:4	Energy Storage / Energy Conversion	6 hours

Different types of Batteries for Electric vehicles - Lead acid batteries, Nickel Metal Hydride Batteries, Lithium ion batteries - Comparison of different types of batteries - Battery Management systems / Energy Management Systems - Wireless Charging Systems - Fast Charging Systems - Super Capacitors - Fuel Cells - Solar Energy Converters.

Module:5	Motors and Controllers	6 hours

DC motors - Principle and control - Induction motor drives - Methods of speed control of Induction motor - Constant V / f control - Vector control method - Inverter for Vector control - Basic principles of BLDC motors - Performance analysis and control of BLDC Motors - Sensor less technique for driving BLDC motors - Regenerative braking with electric drive - Four quadrant operation - Optimizing energy recovery.

Module:6	Architectures for Hybrid Electric Vehicles	6 hours

Series, parallel and series – parallel hybrids - Different architectures for Hybrid Electric vehicles - Series Hybrid Electric vehicle basics - Sizing of major components - Peak power sourcing - Parallel Hybrid electric vehicle basics - Engine on / off control strategy - Peak

power sourcing - Drive train rating - Parallel Mild hybrid Electric drive system - Series-parallel mild hybrid electric vehicle system.		
Module:7	**Industry examples of Hybrid Electric Vehicle**	**6 hours**
Fuel cell: Basic principles of fuel cells		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Modern Electric, Hybrid Electric and Fuel cell vehicles - by MehrdadEhsani, Yimin Gao, Sebatien Gay and Ali Emadi; Published by CRC press,2015
Reference Books	
1.	Iqbal Husain, Electric & Hybrid Vehicles, CRC Press, 2015
2.	Ronald K Jurgen, Automotive Electronics Handbook, McGraw-Hill Inc. 1999

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME601L	Data Acquisition and Signal Conditioning	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Imparting an in-depth knowledge in sensor signal conditioning, signal conversion, data acquisition, signal processing, transmission and analysis.
2. Providing a comprehensive coverage of data acquisition methods for sensor systems and hardware interface cards available commercially.
3. Enabling the students to do acquire the necessary skills to undertake project work using Multisim and LabView

Course Outcome

At the end of the course, the student will be able to

1. Understand the basics of amplifier for designing circuits
2. Design the circuits using amplifiers for automotive applications
3. Estimate drift in resistors over a period of time and also to learn non-linear signal processing techniques
4. Design different converter like ADC, DAC and voltage to frequency converter
5. Gain knowledge about interference, grounding and its effects the circuitry
6. Understand the data operation of loggers, data acquisition boards and software for acquiring the samples
7. Describe different standards like RS232, GPIB which will be used for interfacing with the DAQ boards

Module:1	**Linear Integrated Circuits**	**6 hours**

Introduction to amplifier–amplifier parameters –operational amplifiers - Differential amplifiersinstrumentation amplifier

Module:2	**Amplifiers**	**6 hours**

carrier amplifiers –Lock-in-Amplifiers –chopper and low drift amplifiers –electrometer and transimpedance amplifiers –charge amplifier –isolation amplifier

Module:3	**Non-linear signal processing techniques**	**6 hours**

Limiting, clipping, logarithmic amplification, multiplication and division –analog linearization – special purpose signal conditioners –Noise in amplifiers –noise and drift in resistors

Module:4	**Signal Conversion**	**7 hours**

Voltage to frequency converter –capacitance to period converter –frequency to code conversion - sampling concepts –pre filtering –Sample and Hold amplifier –Analog-to-Digital converters - multiplexers and De-multiplexers –Digital-to Analog converters

Module:5	**Data transmission**	**6 hours**

Data transmission systems –pulse code format –modulation techniques –telemetry –noise and interference –types and reduction –signal circuit grounding –shield grounding – capacitive, magnetic and optical isolation.

Module:6	**Data Acquisition System**	**6 hours**

DAS boards –interfacing issues with DAS boards, software drivers–data logger –Data acquisition method with time-division channeling and main errors of multi-channel data-acquisition systems, data transmission and error protection

Module:7	**Interfacing**	**6 hours**

Bus standard for communication between instruments - GPIB (IEEE-488bus) - RS-232C-USB -4- to-20mA current loop -serial communication systems

Module:8	**Contemporary Issues**	**2 hours**

	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Pallas Areny. R, Webster. J. G, “Sensors and Signal conditioning”, 2nd ed. John Wiley and Sons, 2015
Reference Books	
1.	Jacob Fraden, “Handbook of Modern Sensors: physics, Designs and Applications”, 3rd ed., Springer, 2015.
2.	Taylor, H. Rosemary, “Data Acquisition for Sensor Systems”, Kluwer Academic Publishers Group, 1997.

Mode of Evaluation: Continuous Assessment, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME601P	Data Acquisition and Signal Conditioning Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Imparting an in-depth knowledge in sensor signal conditioning, signal conversion, data acquisition, signal processing, transmission and analysis.
2. Providing a comprehensive coverage of data acquisition methods for sensor systems and hardware interface cards available commercially.
3. Enabling the students to do acquire the necessary skills to undertake project work using Multisim and LabView

Course Outcome

At the end of the course, the student will be able to

1. Understand the basics of amplifier for designing circuits
2. Design the circuits using amplifiers for automotive applications
3. Estimate drift in resistors over a period of time and also to learn non-linear signal processing techniques
4. Design different converter like ADC, DAC and voltage to frequency converter
5. Gain knowledge about interference, grounding and its effects the circuitry
6. Understand the data operation of loggers, data acquisition boards and software for acquiring the samples
7. Describe different standards like RS232, GPIB which will be used for interfacing with the DAQ boards

Indicative Experiments

1.	[Implementation using NI Multisim] (expt. 1 to 5) To study operational amplifier basics and its applications	2 hours
2.	Implementation of wheatstone bridge circuit	2 hours
3.	Implementation of summing amplifier and instrumentation amplifier	4 hours
4.	Implementation of analog to digital conversion (ADC) circuit	4 hours
5.	Implementation of digital to analog conversion (DAC) circuit	4 hours
6.	[Implementation using NI LabVIEW] (expt. 6 to 10) Introduction to LabVIEW, creating, editing and debugging VI	2 hours
7.	Implementation of loops and structure concepts using LabVIEW	4 hours
8.	Implementation of arrays and clusters concepts in LabVIEW	4 hours
9.	Implementation of file handling concepts in LabVIEW	2 hours
10.	Introduction to data acquisition in LabVIEW(Temperature Monitoring)	2 hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment and Final Assessment Test

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME602L	AUTOSAR and ISO Standards for Automotive Systems	2	0	0	2
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Enabling the students to understand AutoSAR standards
2. Introducing to the students the basic knowledge of Communication Stack in AutoSAR
3. Preparing the students to understand the implementation and integration in AutoSAR

Course Outcome

At the end of the course, the student will be able to

1. 1.Apply the knowledge of various AutoSAR standards
2. 2.Analyze AutoSAR codes
3. 3.Apply the AutoSAR – Implementation Integration
4. 4.Analyze the AutoSAR – System Services
5. Implement CAN programming concepts through AutoSAR
6. Analyze the ISO/TS 16949 standards
7. Know the implementation aspects of ISO/TS 16949 standards

Module:1	**AutoSAR Standards**	**3 hours**
General requirement on basic software modules – Functional, Fault operation and error detection.		
Module:2	**AutoSAR Standards – Communication Stack**	**5 hours**
Network Management, TTCAN Interface standards, TTCAN Drivers		
Module:3	**AutoSAR – Implementation Integration**	**3 hours**
Platform Types, Memory Mapping		
Module:4	**AutoSAR – System Services**	**3 hours**
Watchdog Manager, Synchronized Time Base Manager		
Module:5	**ISO/TS 16949**	**5 hours**
Data transmission systems –pulse code format –modulation techniques –telemetry –noise and interference –types and reduction –signal circuit grounding –shield grounding –capacitive, magnetic and optical isolation.		
Module:6	**Introduction to ISO26262 Standard: Basic Concepts**	**3 hours**
Structure of ISO26262 standard and its parts-Vocabulary-Management of functional Safety-Concept Phase		
Module:7	**Introduction to ISO26262 Standard: Implementation Aspects**	**6 hours**
Product Development System level-Product Development Hardware level-Product Development Software level-Production and Operation-Supporting Processes-ASIL Oriented and Safety Oriented Analysis-Guidelines on ISO26262 (Informative)-Case Studies to illustrate concepts, Hazard analysis and Risk assessment-Safety Goals, Preliminary Architecture-Functional Safety Concept		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1. Automotive Quality systems – David Hoyle, Butterworth Heinemann limited, 2015

Reference Books

1.	www. autosar.org		
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME603L	Soft Computing Techniques for Automotive Applications	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Explaining various architectures of Neural Networks and algorithms used in Fuzzy Logic.
2. Imparting knowledge about concepts of neurons, crisp set, fuzzy sets, rough sets and fuzzy inference systems.
3. Providing mathematical foundations of membership functions, fuzzy arithmetic and fuzzy rule base and inference.

Course Outcome

At the end of the course, the student will be able to

1. Identify the essentials components of Soft Computing in automotive applications.
2. Explain working mechanism of Feed forward neural networks.
3. Describe the importance of Radial basis neural network and its applications to solve real life problems.
4. Gain knowledge about working mechanism of convolution neural networks.
5. Explore recent trends in Convolution Neural Network for Automotive applications.
6. Understand the fundamentals of fuzzy sets and operations associated
7. Understand the ability to apply Fuzzy rules for decision making in real-time scenarios, at a basic level.

Module:1	Essentials components of Soft Computing	6 hours

Artificial neural networks – biological neural networks – Applications of neural networks – signal processing – control – Pattern recognition – medicine – speech production – speech recognition – business – Architecture – setting of weights – activation functions – McCulloch Pitt Neuron-application to simulation of fundamental logic gates

Module:2	Simple neural networks for Pattern classification	6 hours

Biases and thresholds – Linear separability – HebbNet – Algorithm – Application – Perceptron – Application – Learning rule convergence theorem – Adaline – Architecture – application – Madaline-automatic identification of number plates, milestones

Module:3	Pattern Association	7 hours

Hebb and Delta rule for pattern Association – Heteroassociative memory neural network – Associative Net – Storage capacity – Iterative Autoassociative Net – Discrete Hopfield Net – Bidirectional Associative memory – algorithm – application-classification of vehicles

Module:4	Neural network based on Competition	6 hours

Fixed weight competitive nets – Maxnet – Mexican Hat – Hamming Net – Kohonen Self Organizing Maps – Learning Vector Organization – Full Counterpropagation – Forward only counter propagation-application-sign board recognition-lane departure warning

Module:5	Adaptive Resonance theory and backpropagation neural net	6 hours

ART1 – ART2 – Standard back propagation – Alternative weight update procedures – alternative activation functions-application-pedestrian detection

Module:6	Fuzzy logic – Introduction	6 hours

Classical sets – operations on classical sets – properties of classical sets - Fuzzy set operations – Properties of fuzzy sets – Classical relations – Operations and properties of Crisp relations – Fuzzy relations – operations and properties – Tolerance and equivalence relations –applications-identification of automatic right gear engagement

Module:7	Properties of Membership functions,	6 hours

	Fuzzification and Defuzzification	
Features of membership functions – various forms – fuzzification – defuzzification to crisp sets – lambda cuts for fuzzy relations – defuzzification to scalars – Membership value assignments – Intution – Inference – Rank ordering – Neural networks – Genetic algorithms – Inductive reasoning-application-automatic electronic fuel injection system design		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Fundamentals of Neural Networks – Architectures, Algorithms and Applications, LaureneFausett, Pearson Education, New Delhi, 2015
Reference Books	
1.	Fuzzy Logic with Engineering Applications, Timothy J. Ross, Third Edition, Wiley India Edition, New Delhi, 2015
2.	Fuzzy Image Processing and Applications with MATLAB, TamalikaChaira, Ajoy Kumar Ray, CRC Press, New York, 2010.

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME604L	Automotive EMI and EMC Standards	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Teaching the students about the concepts of noise, filter and shield related to EMI and EMC
2. Acquainting the students with skills used to build systems compliant with EMC standards
3. Providing the students with the knowledge of testing the products for emissions and ESD

Course Outcome

At the end of the course, the student will be able to

1. Comprehend the concepts of power, signal and ground
2. Develop and understand ` the concepts of antennas and transmission lines in EMC
3. Understand the concepts of electric, magnetic and electromagnetic fields
4. Reproduce the testing methods adopted for conducted and radiated emissions
5. Understand the effects of cable and harnessing in EMI and EMC
6. Explain about the vehicle generated noise
7. Understand the issues of EMC in vehicles and various test methods for ESD

Module:1	**EMC**	**7 hours**
EMC an introduction, System level issues- component and system, significance of EMC, Power and signal return- current path, safety grounding, single point ground		
Module:2	**Basic concepts used in EMC**	**7 hours**
Antennas, Omni Directional Antennas, Transmission lines, shields, Fourier series, Capacitor, inductor and actual properties, filtering overview, enclosure shielding, shield discontinuities		
Module:3	**Electromagnetic Fields**	**7 hours**
Introduction, Characteristics of EM environment, comparison of circuit theory and EM field theory, Maxwells equation, Regions around the source, Polarization		
Module:4	**EMC testing**	**6 hours**
EMC disciplines, Radiated Emission Diagnostics, Switching transients, test methods		
Module:5	**Effects of cable and harnessing**	**6 hours**
Conducted emission and immunity, Automotive EMC approaches, Filter placement, coupling between wires, Grounding and PCB layout, Ferrites, High frequency emissions		
Module:6	**Automobile Electrical and Electronics Systems**	**5 hours**
Vehicle generated radiated emissions, Broadband noise, Narrowband noise, Signal characteristics, Vehicle radiated emission tests		
Module:7	**EMC issues**	**5 hours**
Vehicle ABS, Flight controls, Blimp problems, Fuel systems, Aircraft, Runway wheel chairs, Ignitions sytems, Inexpensive Shielding methods, EMC design for immunity, Automotive industry practices		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Automotive Electromagnetic compatibility – Terence Rybak, Mark steffka – KluverAcademic Publishers, 2015

Reference Books

1.	Balcells- J.; González- D.; Gago- J. Curso "EMC design in industrial systems". 2015
2.	Weston- D.A. Electromagnetic compatibility: principles and applications. 2nd ed.- rev. and exp. NeYork [etc.]:Marcel Dekker- 2001. ISBN 0824788893

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME605L	Vehicular Information and Communication Systems	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Teaching the students concepts of data processing, instrumentation and ECU recording equipment.
2. Providing students, a good understanding about automotive sound system and navigation for vehicular systems
3. Providing details about the positioning and guidance systems.

Course Outcome

At the end of the course, the student will be able to

1. Understand the data processing in motor vehicles.
2. Comprehend the networking in automotive.
3. Gain knowledge about the information & communication
4. Understand the ECU recording equipment and Parking systems
5. Explore the sound system for automotive
6. Understand the Positioning and Map Matching for vehicles
7. Understand the Route Planning and Route Guidance techniques for automotive

Module:1	**Data processing in motor vehicles**	**5 hours**
Requirements, Electronic control unit (ECU), Architecture, CARTRONIC.		
Module:2	**Automotive networking**	**6 hours**
Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, Coupling of networks, Example.		
Module:3	**Instrumentation**	**6 hours**
Information and communication areas, Driver information systems, Instrument clusters, Display types		
Module:4	**ECU recording equipment and Parking systems**	**6 hours**
Legal requirements, Design variations, parking aid with ultrasonic sensors, Further development		
Module:5	**Automotive sound systems**	**7 hours**
Radio tuners, Conventional tuners, Digital receivers, Reception quality, Reception improvement, Auxiliary equipment, Vehicle antennas.		
Module:6	**Positioning and Map Matching**	**7 hours**
Dead Reckoning, Global Positioning System , Sensor fusion. Conventional map matching, Fuzzy logic Based Map matching, Map aided Sensor calibration.		
Module:7	**Route Planning and Route Guidance**	**6 hours**
Shortest Path , Heuristic Search, Bidirectional Search , Hierarchical search **,**Guidance while En Route , Guidance while off Route , Guidance with dynamic information		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Bosch, “Automotive Handbook”, 8th Edition, SAE publication, 2015

Reference Books

1. Intelligent Vehicle Technologies Theory and Appications– L Vlacic, M Parent,FHarashima - Butterworth Heinemann, 2015
2. Vehicle location and Navigation Systems – Yilin Zhao – Artech House Inc., 2016
3. Sussman, Joseph. Perspectives on Intelligent Transportation Systems (ITS). NewYork,

3.	14. NY: Springer, 2010
4.	Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME606L	Parallel Programming using Multi cores and Graphical Programming Units	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Imparting the knowledge about implementation of multi-threading on single core versus multi-core platforms
2. Providing the basic concept of threads error diffusion and parallel error diffusion.
3. Elaborating the details of Deadlock and Semaphores and implementation of dependent threading features.

Course Outcome

At the end of the course, the student will be able to

1. Understand the basic concepts of multi-core architecture
2. Demonstrate knowledge of the core architectural aspects of Parallel Computing
3. Develop efficient parallel algorithms and apply a suite of techniques that can be applied across a wide range of applications
4. Apply the concept of threading for large scale systems
5. Apply methods to support and manage virtualization
6. Develop and implement the various Parallel Programming Concepts in Linux Platform
7. Analyze the gblockIdx and threadIdx

Module:1	**Multi-core Architecture**	**6 hours**

Overview of Single core processor Architecture and its limitations, Architectural Innovations, Need for Multi-core Processor and its Limitations, Classification Multicores, Multicore system software stack.

Module:2	**Overview of Threading**	**6 hours**

Defining threads – threads inside the OS – threads inside the hardware – Application programming models and threading – virtual environment – Run time virtualization – System virtualization

Module:3	**Fundamental concepts of parallel programming**	**6 hours**

Thread Level Parallelism(TLP), Instruction Level Parallelism(ILP), Comparisons, Cache Hierarchy and Memory-level Parallelism, Cache Coherence, Parallel programming models, Shared Memory and Message Passing, Vectorization

Module:4	**Parallel programming constructs**	**6 hours**

Synchronization – Critical sections – Deadlock – Semaphores – Locks – Condition variables – Messages – Fence – Barrier – Implementation dependent threading features

Module:5	**OpenMP : Portable solution for threading**	**7 hours**

Loop carried dependence – Data-race conditions – Managing shared and private Data – Loop Scheduling and Partitioning – Effective use of reductions – work-sharing sections – Using barrier and Nowait – Interleaving single thread and multi-thread execution – Data copy-in and copy-out – Protecting updates of shared variables – OpenMP Library functions – OpenMP environmental variables – multithreading debugging techniques

Module:6	**CUDA Programming**	**6 hours**

GPUs as Parallel computers – architecture of a modern GPU – Data Parallelism – CUDA program structure – Matrix – Matrix multiplication example – Device memories and data transfer – Kernel functions and threading – predefined variables – Runtime API

Module:7	**CUDA threads and Memories**	**6 hours**

CUDA thread organization – Using block and thread – synchronization and Transparent Scalability – Thread Assignment – Thread scheduling – CUDA device memory types – strategy for reducing global memory traffic

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Multi-Core Programming, Increasing Performance through Software Multi-threading, Shameem Akhter and Jason Roberts, Intel Press, BPB Publications, New Delhi, 2015
Reference Books	
1.	Programming Massively Parallel Processors, A hands-on approach, David B. Kirk and Wen-mei W. Hwu, Elesevier, New Delhi, 2015

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME607L	Digital Signal Processing and its Applications	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Introducing the concepts of sampling, digital filter, adaptive digital system
2. Providing the concepts of information theory and source coding different applications
3. Teaching methods and algorithms which would enable communication to happen as close to the maximum information transfer rate as possible

Course Outcome

At the end of the course, the student will be able to

1. Gain insight into digital models and algorithms to process the signals, after due conversion of signals from analog to digital
2. Determine the techniques to perform analog to digital and digital to analog conversion process
3. Design adaptive filters based on the signal processing and communication concepts
4. Analyse the signal spectrum from the received signal and modulation scheme suitable for information transmission
5. Determine the statistical properties of the signal
6. Find different ways of minimizing the number of bits, needed to represent a given amount of information
7. Find methods to minimize the probability of communication errors, without affecting the rate of communication process

Module:1	Basics	5 hours

The history of digital signal processing : Measurements and analysis , Telecommunications, Audio and television, Household appliances and toys, Automotive, Digital signal processing basics: Continuous and discrete signals, Sampling and reconstruction, Quantization, Processing models for discrete-time series, Common filters may be added digital filters: Filter architectures, Filter synthesis, Digital control systems :Proportional-integral-derivate controllers , Advanced controllers

Module:2	Analog Digital interface	7 hours

System considerations : Encoding and modulation, Number representation and companding systems, Digital-to-analog conversion: Multiplying digital-to-analog converters , Integrating digital-to-analog converters, Bitstream digital-to-analog converters , Sample-and-hold and reconstruction filters , Analog-to-digital conversion : Anti-aliasing filters and sample-and-hold , Flash analog-to-digital converters , Successive approximation analog-to-digital converters , Counting analog-to-digital converters , Integrating analog-to-digital converters , Dither , Sigma–delta analog-to-digital converters

Module:3	Adaptive digital systems	6 hours

Introduction: System structure The processor and the performance function: The adaptive linear combiner, The performance function , Adaptation algorithms : The method of steepest descent , Newton's method, The least mean square algorithm , Applications: Adaptive interference channel, Equalizers, Adaptive beam forming

Module:4	Spectral analysis and modulation	7 hours

Discrete Fourier transform and fast Fourier transform: Spectral analysis , Discrete Fourier transform and fast Fourier, transform approaches , "Z" transforms Using the auto-correlation function, Periodogram averaging, Parametric spectrum analysis, Modulation : Amplitude shift keying (ASK), Frequency shift keying (FSK), Phase shift keying (PSK), Complex modulation , The Hilbert transformer

Module:5	Kalman filters	4 hours

An intuitive approach : Recursive least square estimation , The pseudo-inverse , The Kalman filter : The signal model , The filter, Kalman filter properties , Applications.		
Module:6	**Data compression**	**7 hours**
An information theory primer: Information and entropy ,Source coding : Huffman algorithm, Delta modulation, adaptive delta modulation and continuously variable slope delta modulation, DPCM adaptive DPCM techniques, Speech coding, adaptive predictive coding and sub-band coding, Vocoders and linear predictive coding , JPEG, MPEG, MP3, The Lempel–Ziv algorithm, Recognition techniques: Speech recognition, Image recognition		
Module:7	**Error-correcting codes**	**7 hours**
Channel coding: The channel model , The channel capacity , Error-correcting codes : Hamming distance and error correction , Linear block codes , Cyclic codes, Convolution codes, Viterbi decoding , Interleaving , Concatenated codes and turbo codes		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Digital signal processing and applications, Dag Stranneby and William Walker, Second Edition, Elsevier, New York, 2015
Reference Books	
1.	Advanced digital signal processing noise reduction, SaeedV.Vasaghi, Fourth edition, Wiley, New Delhi, 2015
2.	Digital Signal Processing: Fundamentals and Applications, by Li Tan, First edition 2007

Mode of Evaluation: Continuous Assessment, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME607P	Digital Signal Processing and its Applications Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Introducing the concepts of sampling, digital filter, adaptive digital system
2. Providing the concepts of information theory and source coding different applications
3. Teaching methods and algorithms which would enable communication to happen as close to the maximum information transfer rate as possible

Course Outcome

At the end of the course, the student will be able to

1. Gain insight into digital models and algorithms to process the signals, after due conversion of signals from analog to digital
2. Determine the techniques to perform analog to digital and digital to analog conversion process
3. Design adaptive filters based on the signal processing and communication concepts
4. Analyse the signal spectrum from the received signal and modulation scheme suitable for information transmission
5. Determine the statistical properties of the signal
6. Find different ways of minimizing the number of bits, needed to represent a given amount of information
7. Find methods to minimize the probability of communication errors, without affecting the rate of communication process

Indicative Experiments

1.	Auto correlation • To implement auto-correlation using Matlab	2 hours
2.	LMS algorithm • To implement the algorithm using Matlab	4 hours
3.	RLS algorithm • To implement the algorithm using Matlab	4 hours
4.	ASK, FSK, PSK • To implement digital modulation techniques using Matlab	4 hours
5.	Complex modulation • To implement complex modulation techniques using Matlab	4 hours
6.	Reed-Solomon encoding and decoding • To perform reed-Solomon encoding and decoding	4 hours
7.	CRC encoding and decoding • To perform cyclic redundancy check	4 hours
8.	Polynomial division and linear feedback shift registers • To perform division using LFSR	4 hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment and Final Assessment Test

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME608L	Open Source Hardware and Software System Design	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Introducing to the students the foundation of open source programming.
2. Understand client-server architectural model for web applications.
3. Teaching the students the basis of Automation using Raspberry Pi.

Course Outcome

At the end of the course, the student will be able to

1. Understand the importance of Open Source programming
2. Identify and apply appropriate server side programming for web based applications
3. Understand various database operations
4. Comprehend the operation of different type of Socket programming
5. Understand the details of Raspberry Pi fundamentals and exploring GPIO Interface
6. Develop and implement the various Raspberry Pi project
7. Explore GPIO Interface

Module:1	**Basics**	**5 hours**
Variable types – basic operators – decision making – loops – strings- Lists – Tuples – Dictionary – Date and Time – Functions – Modules – Files – Exceptions – Classes and Objects		
Module:2	**GUI and Web programming**	**7 hours**
Tkinter Programming – Tkinter Widgets - CGI – Web server support – Environmental variables – GET and POST methods – Passing information using POST method		
Module:3	**Data base access**	**6 hours**
MySQLdb – database connection – Creating database table – INSERT – READ – UPDATE – DELETE – COMMIT – ROLEBACK		
Module:4	**Network Programming**	**7 hours**
Sockets – Server socket – Client Socket – General Socket methods – Sending an HTTP e-mail – Sending an attachment as an email		
Module:5	**Raspberry Pi fundamentals**	**6 hours**
Architecture – setting up the Raspberry Pi – Interacting with Raspberry command line – Setting up I2C, serial port – Connect Pi to network		
Module:6	**Raspberry Basic Projects**	**7 hours**
Controlling the brightness of LED – Buzzing sound – Switch high power DC source using transistor and relays – controlling high voltage AC device – Using PWM pulses for control – Pi to run different types of motors – servo motor – DC motor – Stepper motor - Displaying HD images – Playing music		
Module:7	**Advanced Raspberry projects**	**5 hours**
Exploring GPIO Interface – Controlling GPIO output – Detecting GPIO input – Work with switches – keypads – Interfacing various sensors – measuring light – detecting methane – measuring acceleration – measuring temperature – measuring distance – logging into a USB flash drive		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Python programming for Raspberry Pi in 24 hours, Richard Blum and Christine Bresnahan, Sams Teach Yourself, Indiana, 2015

Reference Books

1.	Raspberry Pi Cookbook, Simon Monk, O'Reilly, California, 2015		
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME609L	Machine Vision System for Automotive	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Providing the basic concepts of Digital Image Processing & their algorithm implementation
2. Introducing the concepts of shape descriptors and their applications in automotive systems.
3. Elaborating on automation and automotive components testing.

Course Outcome

At the end of the course, the student will be able to

1. Understand the principle, advantages, limitation and possible application of image processing in Automotive
2. Identify and apply the appropriate image processing techniques to image segmentation, shape analysis and decision making
3. Understand the various operational behavior of Components in Automation
4. Comprehend the operation of different type of Cylinder blocks, detecting missing balls and behaviours
5. Comprehend the concepts of shape description
6. Develop and implement vision / manipulator interface
7. Detail out automotive component testing techniques

Module:1	Elements of Computer Vision	8 hours

Artificial intelligence – image processing – industrial machine vision – image understanding – System Architecture – Illumination – Sensors - Elementary optics - Camera sensor – Camera interfaces and video standards- Sampling and quantization – inter pixel distances – adjacency conventions – Image acquisition hardware – speed considerations.

Module:2	Fundamentals of digital Image processing	8 hours

Point operation – Contrast stretching – thresholding – noise suppression – background subtraction – Neibourhood operations – Convolution – Thinning – Erosion – dilation – Geometrical operation – Warping – grey level interpolation – registration – morphology – structuring elements – opening and closing – grey scale morphology

Module:3	Segmentation Problem	7 hours

Region and boundary based approach – Global, local and dynamic thresholding – Gradient and difference based edge detectors – template matching – region growing - quadtree – boundary detection – graph theoretic techniques – contour following – dynamic programming

Module:4	Image Analysis	5 hours

Inspection, location and identification – local template matching – simple feature extraction – classification using Bayes' rule – Hough transform – Generalized Hough transform – Histogram analysis

Module:5	Shape description	5 hours

Taxonomy of shape descriptors – external descriptors – features of the boundary – internal descriptors – features of the region – boundary chain code

Module:6	Automation considerations	5 hours

Design of conveyor belts – Choice of various light sources – Design of separators – Grippers – Control of motors – vision / manipulator interface

Module:7	Automotive component Testing applications	5 hours

Differentiating types of cylinder blocks – detecting holes in a camshaft – detecting missing balls in bearings – checking faulty components in a car stereo – differentiating gear types –

detecting a lack of sealing compound – detecting improper assembly of a fuse box – Checking an LCD panel				
Module:8	**Contemporary Issues**			**2 hours**
	Total Lecture hours:			**45 hours**
Text Book(s)				
1.	Computer and machine vision : Theory, Algorithm and Practicalities, E.R. Davies, Fourth Edition (Kindle Edition), 2015			
Reference Books				
1.	Intelligent Vision systems for Industry, Bruce G. Batchelor and Paul F. Whelan, Springer, London, 2015			
Mode of Evaluation: Continuous Assessment, Digital Assignment, Quiz and Final Assessment Test				
Recommended by Board of Studies		28-07-2022		
Approved by Academic Council		No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME609P	Machine Vision System for Automotive Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Providing the basic concepts of Digital Image Processing & their algorithm implementation
2. Introducing the concepts of shape descriptors and their applications in automotive systems.
3. Elaborating on automation and automotive components testing.

Course Outcome

At the end of the course, the student will be able to

1. Understand the principle, advantages, limitation and possible application of image processing in Automotive
2. Identify and apply the appropriate image processing techniques to image segmentation, shape analysis and decision making
3. Understand the various operational behavior of Components in Automation
4. Comprehend the operation of different type of Cylinder blocks, detecting missing balls and behaviours
5. Comprehend the concepts of shape description
6. Develop and implement vision / manipulator interface
7. Detail out automotive component testing techniques

Indicative Experiments

1.	To Implement Histogram Equalization on grayscale images	2 Hours
2.	To Perform Edge detection using various operators	2 Hours
3.	To carry out Conversion between colour spaces	2 Hours
4.	To Perform Image segmentation using watershed transform	3 Hours
5.	To Understand Filtering in Frequency domain	2 Hours
6.	To Perform Various transformations like image translation, rotation, scaling	2 Hours
7.	To Implement Image classification using deep learning	3 Hours
8.	To Perform Hough transformation of an image	3 Hours
9.	To Implement Design of object classification system for conveyor belts	3 Hours
10.	To Perform Morphological operations on image such as erosion, dilation, opening, closing	3 Hours
11.	To Apply Feature extraction using Texture operators	3 Hours
12.	To Perform Template matching using basic shapes	2 Hours
	Total Laboratory Hours	**30 hours**

Mode of Assessment: Continuous Assessment and Final Assessment Test

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME610L	Automotive Fault Diagnostics	3	1	0	4
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Familiarising students with the basic concepts of automotive fault diagnostics
2. Teaching students about the fault sensors output waveforms
3. Elaborating the operation of Automotive Oscilloscopes, OBD II and Fault code readers

Course Outcome

At the end of the course, the student will be able to

1. Understand the basic concepts of fault diagnosis in automotive field.
2. Comprehend MIL for various automotive faults.
3. Have a brief idea of various sensors and assess ECU failures with the help of oscilloscope
4. Comprehend the operation of fault-finding systems (OBD)
5. Identify and rectify the faults of automotive sensors and fuel injection systems.
6. Analyze the various failure modes in Electronic control unit of chassis and body units
7. Understand the concepts of Electrical systems fault diagnostics

Module:1	**Diagnostic**	**6 hours**
Diagnostic Techniques - diagnostic process - diagnostics on paper - mechanical diagnostic techniques - electrical diagnostic techniques - fault codes - on and off-board diagnostics - Data sources		
Module:2	**Tools and Equipment**	**6 hours**
Basic equipment - Oscilloscopes - Scanners - Fault code readers - Engine Analysers		
Module:3	**Oscilloscope diagnostics**	**4 hours**
Sensors - Actuators - Ignition System - Other components		
Module:4	**On-board diagnostics**	**6 hours**
A first perspective - Petrol / Gasoline on-board diagnostics monitors - a second perspective		
Module:5	**Engine Systems**	**7 hours**
Diagnostics of Engine operation - Fuel system - Ignition - Emission - Fuel Injection - Diesel injection - Engine management - Fault finding information - air supply and exhaust systems - cooling - lubrication - batteries - starting system - charging system		
Module:6	**Chassis System**	**7 hours**
Diagnostics of brakes - anti-lock brakes diagnostics - traction control diagnostics - steering and types diagnostics - suspension diagnostics		
Module:7	**Electrical System**	**7 hours**
Electronic components and circuits diagnosis - multiplexing - lighting - diagnosing auxiliary system faults - in car entertainment security and communication - body electrical system faults - diagnosing instruments system faults - HVAC diagnostics - Cruise control diagnostics - Air bags and belt tensions diagnostics		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Automotive Technician Training, Tom Denton, Taylor and Francis, New York, 2015

Reference Books

1. Automobile Electrical and Electronic Systems : Automotive Technology - Vehicle Maintenance and Repair, Tom Denton, Fourth Edition, Elsevier, New York, 2015
2. Advanced Automotive Fault Diagnosis: Automotive Technology - Vehicle Maintenance and Repair, Tom Denton, Third Edition, Elsevier, New York, 2012.

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME611L	Emission Control and Diagnosis	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Preparing the students to analyze automotive pollution control techniques
2. Introducing the concepts of formation and control techniques of pollutants like sulphur, CO, NOx and particulate matter
3. Preparing the students to analyze smoke for both SI and CI engines

Course Outcome

At the end of the course, the student will be able to

1. Get details of the emission from automobiles
2. Analyze emission from Spark Ignition Engine
3. Analyze emission from Compression Ignition Engine
4. Explain about the exhaust emissions
5. Comprehend the Emission Control Legislation - I
6. Comprehend the Emission Control Legislation – II
7. Understand about the Exhaust gas measuring techniques

Module:1	Emission From Automobiles	6 hours

8 Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment 11 devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

Module:2	Emission From Spark Ignition Engine And Its Control	7 hours

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, CCS, Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion

Module:3	Emission From Compression Ignition Engine And Its Control	6 hours

Formation of White, Blue, and Black Smokes, NOx, soot, sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, HCCI, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

Module:4	Exhaust Emissions	6 hours

Combustion products, Properties of exhaust gas components

Module:5	Emission control legislation - I	6 hours

Overview, CARB legislation, EPA legislation, EU legislation, Japanese legislation

Module:6	Emission control legislation - II	6 hours

US test cycles for passenger cars and light duty trucks, European test cycles for passenger cars and light duty trucks, Japanese test cycles for passenger cars and light duty trucks, test cycles for heavy commercial vehicles

Module:7	Exhaust gas measuring techniques – I	6 hours

Exhaust gas test on chassis dynamometers, Exhaust gas measuring devices, Diesel smoke emission test, Evaporative emission test

Module:8	Contemporary Issues	2 hours

	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.
2.	D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication, 1985.
3.	Autmotive Handbook – 9th Edition – 2015, BOSCH
Reference Books	
1.	V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
2.	Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company.,Newyork
3.	1993. Charles K. Alexander, Matthew N. O. Sadiku, "Fundamentals of Electric Circuits," 2015, 5th Edition, Tata McGraw Hill Education Private Limited, New Delhi, India.

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME612L	Vehicle Safety Systems	2	0	0	2
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Have a better understanding of good design practices which will enable product improvement that manifests significantly less risk to humans, machines and the environment
2. Gain the ability to design and demonstrate the vehicle safety critical systems to reduce the system errors and faults
3. Introducing the students to do design safety systems using MATLAB simulation

Course Outcome

At the end of the course, the student will be able to

1. Understand the basic concept of vehicle safety
2. Understand the operation of braking system design and its operation
3. Understand the braking system for passenger vehicles
4. Know the working principle of ABS and traction control systems
5. Understand the concepts of braking systems for commercial vehicles
6. Understand the vehicle stabilization for commercial vehicles
7. Understand about the airbag system for passenger safety

Module:1	**Basic concepts of vehicle safety**	**4 hours**
Underlying principles-cause and effect –safety factors-design for uncertainty-identifying component safety factor-Digital models and man testing -compliance		
Module:2	**Braking systems**	**4 hours**
Definitions-principles-design and components of braking system-brake-circuit configurations-braking system design		
Module:3	**Braking system for passenger cars and light utility vehicles**	**4 hours**
Brake booster-brake master cylinder-braking force limiters-disk brakes-drum brakes		
Module:4	**Vehicle stabilization systems for passenger cars**	**4 hours**
Anti-Lock braking system(ABS)-traction control system(TCS)-Electronic stability program(ESP)-Electrohydraulic brakes		
Module:5	**Braking system for commercial vehicles**	**4 hours**
System and configuration-air supply and processing-Transmission device-wheel brakes-parking brake system-retarder braking system		
Module:6	**Vehicle stabilization system for commercial vehicles**	**4 hours**
Electronic stability program(ESP) for commercial vehicles-Electronically controlled braking(ELB)-function-system design-components-electro pneumatic braking		
Module:7	**Occupant injury prevention and distracted driver**	**4 hours**
Introduction-proper use of head restraints-Airbags-distractors and risk reduction-information processing		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1. George A. Peters, Barbara J. Peters, ”Automotive vehicle safety”, Taylor and Francis,3rd

	edition, 2015		
Reference Books			
1.	Robert Bosch, ”Automotive handbook”,9th edition,2015		
2.	Bimal K Bose, “Power Electronics and Motor Drive: Advances and Trends”, Elsevier, Inc., 2006		
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME613L	Vehicle Bodies	2	0	0	2
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Giving insight into the vehicle construction
2. Design and construction of vehicular bodies for passenger car and commercial vehicles
3. Providing an overview of lighting in vehicles

Course Outcome

At the end of the course, the student will be able to

1. Understand Road-vehicle systematics
2. Understand Vehicle bodies for passenger cars
3. Comprehend and analyze commercial vehicles bodies
4. Classify External lighting technologies
5. Classify Internal lighting technologies
6. Brief about Automotive windshield and window glass
7. Comprehend the windshield and rear-window cleaning systems

Module:1	**Road-vehicle systematics**	**2 hours**
Classification according to ECE, Classification according to USA		
Module:2	**Vehicle bodies- passenger cars**	**4 hours**
Main dimensions, Body design, Aerodynamics, Aeroacoustics, body structure, Body materials, Body surface, Body finishing components, Safety		
Module:3	**Vehicle bodies-commercial vehicles**	**4 hours**
Commercial vehicles, Light utility vans, Medium and heavy-duty trucks and tractor vehicles, Buses, Passive safety in commercial vehicles		
Module:4	**Lighting technology-I**	**5 hours**
Functions, Regulations and equipment, Definitions and terms, Main headlamps, European system, Main headlamps, European regulations, Head lamps, USA, Headlamps, US regulations, Headlamp leveling, Europe, Headlamp cleaning systems, Fog lamps, Auxiliary driving lamps		
Module:5	**Lighting technology-II**	**5 hours**
Lights and lamps, Hazard-warning and turn-signal flashers, Side-marker, clearance, and tail lamps, Parking lamps, License-plate lamps, Stop lamps, Rear fog warning lamps, Reversing lamps, Daytime running lamps, Reversing lamps, Daytime running lamps, other lighting devices, Motor-vehicle bulbs.		
Module:6	**Automotive windshield and window glass**	**4 hours**
The material properties of glass, Automotive glazing, Functional design glazing		
Module:7	**Windshield and rear-window cleaning systems**	**4 hours**
Windshield wiper systems, Rear-window wiper systems, Headlamp cleaning systems, Wiper motors, Washing systems		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1. Powloski.. J., “Vehicle Body Engineering”, Business books limited, London,1970

Reference Books

1. Robert Bosch, ”Automotive handbook”, 9th edition, SAE publication 2015

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME614L	Engine Peripherals	2	0	0	2
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Preparing the students to understand engine peripherals connections and operation theory
2. Introducing the basics of engine cooling and lubrication
3. Preparing to study and analyze emission reduction techniques

Course Outcome

At the end of the course, the student will be able to

1. Get an overview of Engine
2. Comprehend the techniques for Engine Cooling
3. Understand about Engine lubrication
4. Demonstrate knowledge on Air filtration
5. Comprehend the concepts of engine peripherals
6. Understand turbochargers and superchargers for IC engines
7. Understand emission reduction systems and exhaust gas systems

Module:1	**Overview of Engine**	**3 hours**
Engine operation, Engine components, Engine types		
Module:2	**Engine Cooling**	**4 hours**
Water cooling, Air cooling, Intercooling, Oil and fuel cooling, cooling module technology, Intelligent thermal management, Exhaust gas cooling		
Module:3	**Engine lubrication**	**3 hours**
Overview, Force feed lubrication system, lubrication components		
Module:4	**Air filtration**	**2 hours**
Air pollution, Air filters		
Module:5	**Other engine peripherals**	**5 hours**
HVAC, alternator, vacuum pump, steering pump, air intake system, exhaust system		
Module:6	**Turbochargers and superchargers for IC engines**	**5 hours**
Superchargers (mechanical driven), Pressure wave, Exhaust gas and multistage superchargers, Acceleration aids		
Module:7	**Emission reduction systems and exhaust gas systems**	**6 hours**
Exhaust gas recirculation systems, secondary air injection, Evaporative emission control system, crankcase ventilation, Manifold, Catalytic converters, particulate converters, muffers connecting elements		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1. Automotive Handbook – BOSCH – 9th Edition -2015

Reference Books

1. T. Kenneth Garrett, Kenneth Newton and William Steeds, “The Motor Vehicle” 13th Edition, Butterworth-Heinemann Limited, London, 2015
2. Heinz Heisler, “Advanced Vehicle Technology”, second edition, Butterworth – Heinemann, New York, 2002

Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME615L	Vehicle Security and Comfort Systems	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

The course is aimed at:

1. Teaching the students about locking systems and theft-deterrent systems
2. Providing the technical knowhow of acoustic signalling devices and occupant-protection systems
3. Discussing about the Power-window drives, comfort and safety functions in the passenger compartment and driver assistance systems

Course Outcome

At the end of the course, the student will be able to

1. Understand about locking systems
2. Understand the concept of theft-deterrent systems
3. Understand about the acoustic signalling devices
4. Demonstrate the knowledge about occupant-protection systems
5. Brief about power-window drives
6. Identify the technique for comfort and safety functions in the passenger compartment
7. Understand about driver-assistance systems
8. Design and implement vehicle security and comfort systems

Module:1	**Locking systems**	**6 hours**
Function, structure, operating principle, Open by wire, Electrical locking system, Central locking system, Electronic vehicle immobilizer, functional description Comfort Entry/Go system		
Module:2	**Theft-deterrent systems**	**6 hours**
Regulations, Permissible alarm signals. System design, alarm detectors, Alarm system control unit, Alarm siren, Tilt sensor, Interior monitoring		
Module:3	**Acoustic signaling devices**	**6 hours**
Acoustic signaling devices applications, Horn, Fanfare horns		
Module:4	**Occupant-protection systems**	**6 hours**
Seat belts and seat-belt pretensioners, Front airbag, Side airbag, Components, Rollover protection systems		
Module:5	**Power-window drives**	**6 hours**
Power-window motors, Power-window control, Power sunroof drives		
Module:6	**Comfort and safety functions in the passenger compartment**	**6 hours**
Electrical seat adjustment, Electrical steering-column adjustment, Multi purpose actuator		
Module:7	**Driver-assistance systems**	**7 hours**
Critical driving situations, Causes of accidents and possible action, Applications, Convenience and safety functions, Sensors for all round electronic visibility, Sensor-data fusion.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Automotive Handbook – BOSCH – 9th Edition -2015

Reference Books

1.	Bosch, "Safety, Comfort & Convenience Systems" 7th Edition - 2016		
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME696J	**Study Oriented Project**				**02**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. The student will be able to analyse and interpret published literature for information pertaining to niche areas.
2. Scrutinize technical literature and arrive at conclusions.
3. Use insight and creativity for a better understanding of the domain of interest.

Course Outcome:

1. Retrieve, analyse, and interpret published literature/books providing information related to niche areas/focused domains.
2. Examine technical literature, resolve ambiguity, and develop conclusions.
3. Synthesize knowledge and use insight and creativity to better understand the domain of interest.
4. Publish the findings in the peer reviewed journals / National / International Conferences.

Module Content	**(Project duration: One semester)**

This is oriented towards reading published literature or books related to niche areas or focussed domains under the guidance of a faculty.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Report to be submitted, presentation and project reviews – Presentation in the National / International Conference on Science, Engineering Technology.

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME697J	**Design Project**				**02**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

1. Students will be able to design a prototype or process or experiments.
2. Describe and demonstrate the techniques and skills necessary for the project.
3. Acquire knowledge and better understanding of design systems.

Course Outcome:

1. Develop new skills and demonstrate the ability to upgrade a prototype to a design prototype or working model or process or experiments.
2. Utilize the techniques, skills, and modern tools necessary for the project.
3. Synthesize knowledge and use insight and creativity to better understand and improve design systems.
4. Publish the findings in the peer reviewed journals / National / International Conferences.

Module Content	**(Project duration: One semester)**

Students are expected to develop new skills and demonstrate the ability to develop prototypes to design prototype or working models related to an engineering product or a process.

Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Report to be submitted, presentation and project reviews – Presentation in the National / International Conference on Science, Engineering Technology.

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME698J	**Internship I/ Dissertation I**				**10**
Pre-requisite	**NIL**	**Syllabus version**			
		1.0			

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field and also to give research orientation.

Course Outcome:

1. Considerably more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.
2. The capability to use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.
3. A consciousness of the ethical aspects of research and development work.
4. Publications in the peer reviewed journals / International Conferences will be an added advantage.

Module Content	**(Project duration: one semester)**

1. Dissertation may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Dissertation should be individual work.
3. Carried out inside or outside the university, in any relevant industry or research institution.
4. Publications in the peer reviewed journals / International Conferences will be an added advantage.

Mode of Evaluation: Assessment on the project - Dissertation report to be submitted, presentation, project reviews and Final Oral Viva Examination.

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course Code	Course Title	L	T	P	C
MAME699J	Internship II/ Dissertation II				12
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

Upon successful completion of this course students will be able to

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing.
5. Synthesize the results and arrive at scientific conclusions / products / solution.
6. Document the results in the form of technical report / presentation.

Module Content **(Project duration: one semester)**

1. Dissertation may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Dissertation should be individual work.
3. Carried out inside or outside the university, in any relevant industry or research institution.
4. Publications in the peer reviewed journals / International Conferences will be an added advantage.

Mode of Evaluation: Assessment on the project - Dissertation report to be submitted, presentation, project reviews and Final Oral Viva Examination.

Recommended by Board of Studies	28-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022