Manipal School of Information Sciences

Manipal Academy of Higher Education, Manipal

Outcome Based Education (OBE) Framework

Two Year full time Postgraduate Program

Master of Engineering - ME (Automotive Embedded Systems)

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NATURE AND EXTENT OF THE PROGRAM

An engineering graduate skillset requirement is changing with invent of the new technologies. In particular the impact of Embedded Systems & Instrumentation provide a high employability in the industry. Master of Engineering - ME (Automotive Embedded Systems), seeks to equip students with the relevant knowledge, professional skills, practical experience and basic management skills, for industry or for research. Students will learn how to design, develop systems and equipment in the aeronautic, space, automobile and electronics sectors. The mandatory internship gives students hands-on experience, in an international setting. Our graduates find job opportunities as developers, project managers, consultants or researchers. The multicultural environment at ESIGELEC allows students to discover new cultures and languages.

Master of Engineering - ME (Automotive Embedded Systems) Program is a comprehensive two-year postgraduate program, which aims to provide hands-on experience to prepare industry-ready ESI professionals. The program Master of Engineering - ME (Automotive Embedded Systems) helps engineering graduates to specialize in the field of electronics, instrumentation and enables them to learn how embedded devices can be programmed, regulating, networked for the data communication and its analysis. Students will also understand the security issues, validation, debugging. This two year masters program will cover various domain like communication, sensors and actuators, cloud, data analytics.

Master of Engineering - ME (Automotive Embedded Systems) postgraduate degree would welcome graduates from any discipline with 50% mark in qualifying exam. Students after successfully completing the program will get career opportunities such as automotive, aerospace and defence, industrial electronics, robotics, chip and circuit board design validation.

PROGRAM EDUCATION OBJECTIVE (PEO)

The overall objectives of the Learning Outcomes-based Curriculum Framework (LOCF) for **Master of Engineering - ME (Automotive Embedded Systems) program are as follows.**

PEO No	Education Objective
PEO 1	Enable to draw upon fundamental and advanced knowledge in order to apply analytical and computational approach to solve technological problems in automotive embedded systems.
PEO 2	Introduce state of art technologies in the area of automotive embedded system and inculcate ethical practices to make industry ready professional.
PEO 3	Promote scientific and societal advancement through research and entrepreneurship.

GRADUATE ATTRIBUTES

S No.	Attribute	Description
1	**Scholarship of Knowledge**	Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyse and synthesise existing and new knowledge, and integration of the same for enhancement of knowledge.
2	**Critical Thinking**	Analyse complex engineering problems critically, apply independent judgement for synthesising information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
3	**Problem Solving**	Think laterally and originally, conceptualise and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
4	**Research Skill**	Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
5	**Usage of modern tools**	Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.
6	**Collaborative and Multidisciplinary work**	Possess knowledge and understanding of group dynamics, recognise opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

7	**Project Management and Finance**	Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.
8	**Communication**	Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
9	**Life-long Learning**	Recognise the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
10	**Ethical Practices and Social Responsibility**	Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
11	**Independent and Reflective Learning**	Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

QUALIFICATIONS DESCRIPTORS

1. Demonstrate

   (i) A systematic, extensive, coherent knowledge and understanding of an academic field of study as a whole, its applications, and links to related disciplinary areas/subjects of study; including a critical understanding of the established theories, concepts, and of a number of advanced and emerging issues in the field of Automotive Embedded Systems;

   (ii) Procedural knowledge that creates different types of professionals related to the Automotive Embedded Systems, including research and development, teaching, government and public service;

   (iii) Professional skills in the domain of embedded systems, automotive domain, communication protocols, sensors and transducers, web-services, Security protocols and architectures, data analytics including a critical understanding of the latest developments, and an ability to use established techniques in the domain of Embedded Systems and Instrumentation.

2. Demonstrate comprehensive knowledge about embedded systems, microcontrollers, Internet of Things, embedded programming including current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to the Embedded Systems techniques and skills required for identifying problems and issues related.

3. Demonstrate skills in identifying information needs, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, analysis and interpretation of data.

4. Methodologies as appropriate to the subject(s) for formulating evidence based solutions and arguments.

5. Use knowledge, understanding and skills for critical assessment of a wide range of ideas, complex problems and issues relating to the chosen field of study.

6. Communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts, constructs and techniques of the automotive embedded systems studies.

7. Address one's own learning needs relating to current and emerging areas of study, making use of research, development and professional materials as appropriate, including those related to new frontiers of knowledge.

8. Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts, to identify, analyse problems, issues, and seek solutions to real-life problems.

PROGRAM OUTCOMES

After successful completion of Master of Engineering - ME (Automotive Embedded Systems) Program, Students will be able to:

PO No	Attribute	Competency
PO 1	**Scholarship of Knowledge**	Acquire in-depth knowledge of AES domain, with an ability to discriminate, evaluate, analyze, synthesize the existing and new knowledge, and integration of the same for enhancement of knowledge.
PO 2	**Critical Thinking**	Analyze complex AES Eco System critically, apply independent judgement for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
PO 3	**Problem Solving**	Think laterally and originally, conceptualize and solve AES problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
PO 4	**Research Skill**	Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
PO 5	**Usage of modern tools**	Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.
PO 6	**Collaborative and**	Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate

	Multidisciplinary work	a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
PO 7	**Project Management and Finance**	Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors
PO 8	**Communication**	Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
PO 9	**Life-long Learning**	Recognize the need for and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
PO 10	**Ethical Practices and Social Responsibility**	Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
PO 11	**Independent and Reflective Learning**	Observe and examine critically the outcomes of one's actions and make corrective measures subsequently and learn from mistakes without depending on external feedback.

COURSE STRUCTURE, COURSEWISE LEARNING OBJECTIVE, AND COURSE OUTCOMES (COS)

FIRST YEAR: ME (Automotive Embedded Systems)

Semester: 1 (Manipal, India) **Semester: 2 (ESIGELEC, France)**

Subject Code	Subject Title	L	T	P	C	Subject Code	Subject Title	L	T	P	C
CSE 602	Real Time Operating Systems	3	-	-	3	AES 610	ADAS and Automotive Electronic Systems	3	-	-	3
ESD 605	Embedded Systems	3	-	-	3	AES 611	Vehicle Comm. Buses	3	-	-	3
AES 601	Sensors and Transducers	3	-	-	3	AES 612	Project Management	3	-	-	3
AES 602	Vehicular Adhoc Networks	3	-	-	3	AES 613	Embedded C Programming	3	-	-	3
	Elective – 1	3	-	-	3	AES 614	Robotics and Localization	3	-	-	3
CSE 602L	Real Time Operating Systems Lab	-	-	3	1	AES 615	Safety Systems and Automotive Constraints	3	-	-	3
ESD 605L	Embedded Systems Lab	-	-	3	1		Elective – 2	2	-	-	3
AES 601L	Sensors and Transducers Lab	-	-	3	1	AES 696	Minor Project - 2	-	3	3	4
AES 602L	Vehicular Adhoc Networks Lab	-	-	3	1	AES 698	Oral Communication	2	-	1	3
	Elective - 1 Lab	-	-	3	1	AES 638	French Language – 2*	3	-	-	3
AES 695	Mini Project - 1	-	-	-	4	AES 640	Bibliographical Studies*	-	1	-	-
AES 697	Seminar - 1	-	-	-	1						
ESI 609	French Language-1 *	5	-	-	-						
Total		**20**	**-**	**15**	**25**	**Total**		**25**	**4**	**3**	**25**

*** Audited and not considered for CGPA calculation**

SECOND YEAR (FINAL YEAR): ME (Automotive Embedded Systems)

III and IV Semester		
ESI 799	Project Work	25
Total Number of Credits to Award Degree		75

List of Electives(Theory)

Manipal, India		ESIGELEC, France	
Elective - 1		Elective - 2	
Code	**Subject**	**Code**	**Subject**
CSE-624	Linux Internals and Programming	AES 616.1	MicroC Real Time Application
IOT-607	Internet of Things	AES 616.2	LabVIEW Programming
ESD-602	Microcontrollers and its Applications	AES 616.3	Deep Learning and Autonomous Vehicle
CSE-620	Linux and Scripting Languages	AES 616.4	Embedded Linux
		AES 616.5	VHDL programming
		AES 616.6	EMC Automotive System
		AES 616.7	Biomedical Imaging and Signal Processing

List of Electives(Lab)

Manipal, India		ESIGELEC, France	
Elective - 1		Elective - 2	
Code	**Subject**	**Code**	**Subject**
CSE-624L	Linux Internals and Programming Lab	AES 616.1L	MicroC Real Time Application Lab
IOT-607L	Internet of Things Lab	AES 616.2L	LabVIEW Programming Lab
ESD-602L	Microcontrollers and its Applications Lab	AES 616.3 L	Deep Learning and Autonomous Vehicle Lab
CSE-620L	Linux and Scripting Languages Lab	AES 616.4 L	Embedded Linux Lab
		AES 616.5 L	VHDL programming Lab
		AES 616.6 L	EMC Automotive System Lab
		AES 616.7 L	Biomedical Imaging and Signal Processing Lab

Note:

- As per MAHE guidelines, credits earned from the partner university / institute is considered for the award of the degree but not for the calculation of GPA / CGPA. Thus, MAHE will issue a certificate for the credits earned from the partner university, but not a Grade Report for those credits.
- Exit policy:

  For the students who are opting out of Study Abroad – Credit Transfer program and continuing II Semester in MSIS:

  1. The exit policy is ME (Vehicular Embedded Systems)
  2. For the subject French Language-I in I Semester
     - This credit will not be considered for the calculation of GPA/ CGPA.
  3. Third & Fourth Semesters - Internship:
     - Number of credits for project work / Internship is 25
     - Minimum duration of internship is 10 months

Name of the Institution / Department: Manipal School of Information Sciences (MSIS)

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Real Time Operating Systems
Course Code: CSE 602	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic Programming – preferably C

Synopsis:	This Course provides insight on 1. Basics of operating systems and real operating systems. 2. Understanding the concepts of process management, scheduling, synchronization, and deadlocks. 3. This course helps the students to learn thread-based programming. 4. Students learn the concept of memory management. 5. Students learn the salient features of real time operating systems.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Examine the evolution of operating systems and real time operating systems.
CO 2:	Design programs based on threads.
CO 3:	Explain the concepts involved in process management, scheduling, synthetization of processes.
CO 4:	Explain the concepts involved in memory management , detecting, avoiding and recover from dead locks.
CO 5:	Explain the concepts of real time systems and real time operating systems

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*								
CO 2	*	*	*								
CO 3	*		*								
CO 4	*		*								
CO 5		*	*	*							

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction to OS and RTOS	
Essential features of an OS, Single Processor Systems and Multiprocessor Systems, Essential Features of Batch Processing, Time sharing, Multiprogramming, Interactive systems, User mode and Kernel Mode operations, Distinction between function call and system call, Real time operating system and real time embedded systems.	1. Identify the features of OS and RTOS (C2) 2. Distinguish between single processor and multi-processor systems (C2) 3. Identify the features of batch processing, time sharing, multi programming and interactive systems (C2) 4. Distinguish between user and kernel modes (C2) 5. Distinguish between function and system calls (C2)
Unit 2: Process Management	
A process in memory, process state, PCB, Process scheduling, scheduling Queues, Types of schedulers, Process system calls - IPC using Shared Memory, IPC using Sockets.	1. Describe a process, process state, process control block (C2) 2. Illustrate scheduling algorithms, scheduling queues (C3) 3. Examine process related system calls (C1) 4. Illustrate methods for inter process communication through share memory and sockets (C3)
Unit 3: Multithreaded Programming	
Introduction, benefits, multithreading models, Pthreads, Win32 threads, Threading Issues, Thread pools Linux threads.	1. Summarize the benefits of multi-threading (C2) 2. Discover threading issues (C2) 3. Illustrate programs using p threads (C3) 4. Examine the benefits of thread pools (C3)
Unit 4: Process Scheduling	

Introduction, scheduling criteria, scheduling Algorithms – FCFS, SJF, PS, RR, Multilevel Queues, Multilevel feedback Queue Scheduling, Scheduling evaluations.	1. Distinguish between scheduling algorithms (C2) 2. Examine the criteria for scheduling (C3) 3. Explain FCFS, SJF, PS, RR, Multi-level queues, multi-level feedback queues scheduling algorithms (C2) 4. Evaluate the scheduling algorithms (C5)
Unit 5: Synchronization	
Introduction, Critical Section Problem, Petersons Solutions, synchronization hardware, Semaphores, usage, implementations; Deadlocks and starvation, Classical problem of synchronization – Bounded Buffer problem, Reader's Writer's problem, Dining Philosophers problem, sleeping barbers problem; Monitors.	1. Define critical section problem (C1) 2. Demonstrate Software solutions to critical section problems (C3) 3. Demonstrate hardware solution for process synchronization (C3) 4. Describe the usage and implementation of semaphores (C1) 5. Define dead locks and starvation (C1) 6. Illustrate solutions to classical synchanization problems like bounded buffer, readrs writers, dining philosephers and sleeping barbers (C3)
Unit 6: Deadlocks	
Introduction, deadlock, characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, recovery from deadlock.	1. Define dead locks (C2) 2. Examine methods for handling dead locks (C4) 3. Illustrate various dead lock algorithms (C3)
Unit 7: Memory Management	
Memory Management Strategies, Virtual Memory Management.	1. Examine various memory management strategies(C4) 2. Examine the evolution of memory management (C4) 3. Illustrate the benefits of paging and segmentation(C3)

	4. Examine the implementation of demand paging(C4) 5. Examine the various virtual memory concepts (C4)
Unit 8: Real Time Systems	
Overview of Real Time Systems, Real Time clocks and Real Time Scheduling Algorithms	1. Examine the concepts involved in the design of real time systems (C3) 2. Design of real time clocks in various real time languages(C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation				*	*

End Semester Examination	*	*	*	*	*
Feedback Process	• End-Semester Feedback				
Reference Material	• "Operating System principles", Seventh Edition, Abraham Silberschatz, Peter Galvvin, Grag Gagne. John Wiley Publications • "Real – Time Systems and Programming Languages", Allan Burns, Andy Wellings. • "Operating Stems Concepts and Design", Milan Milenkovic • "Design of Unix Operating System", Maurice Bach (IPC) • "The C Programming Language", Kerninghan & Ritchie 5. Kerninghan & Ritchie, "The C Programming Language", Second Edition, Prentice-Hall, 1988.				

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Embedded Systems
Course Code: ESD 605	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Microprocessor architecture, Microcontroller Architecture, Assembly language and Number systems.

Synopsis:	This Course provides insight on 1. This course provides the knowledge of ARM Cortex M3 Processor architecture 2. This course provides the knowledge of Microcontroller based on ARM Processor architecture and its Registers and Instruction sets to write Assembly and Embedded C Programming. 3. This course provides the concept of Interfacing and Programming Sensors and Peripherals to Microcontrollers. 4. This course provides the concept of Communication Protocols required for multi-processor communication. 5. This course provides the concept of Real time operating systems on Microcontrollers. 6. This course provides the concept of Designing Real Time Embedded Systems using ARM Microcontroller.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Employ the knowledge of Microcontrollers to build Embedded systems.
CO 2:	Explain the concept of Programming ARM Microcontrollers using Assembly and Embedded C.
CO 3:	Design a Real time Embedded Systems by interfacing Sensors, Actuators and porting Real time operating systems.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*									
CO 2	*	*	*		*						
CO 3	*	*	*		*						

Course content and outcomes:	
Content	***Competencies***
Unit 1: Introduction to Embedded Systems	
Design Challenges, Processors Technology, Design Technology	At the end of the topic student should be able to: 1. Describe the Design issues in designing the Embedded Systems.(C1) 2. Discuss the design technology associated with Embedded Systems.(C2)
Unit 2: Introduction to ARM Cortex processor	
Variants of Cortex and ARM versions, Comparison of M-series processor, Architecture, Programmers Model, APSR register, Memory Model, Exception, Interrupts, Reset	1. Explain about ARM Processor architecture (C2) 2. Describe ARM Cortex m3 processor data path, Register set, Programming models and memory map (C2) 3. Describe about ARM Cortex M3 Processor Instruction set. (C2) 4. Describe about ARM Processor system bus and Interrupt controller (C2) 5. Describe about interrupt and Exception handling (C2) 6. Describe ARM Microcontroller architecture. (C2)
Unit 3: Instruction Set Architecture	
More on Memory System, Exceptions and Interrupts, NVIC, Memory Protection Unit, Assembly Programming, Embedded C programming, CMSIS, Startup Code	1. Describe ARM Cortex memory system. 2. Describe interrupt and Exception handling (C2) 3. Describe NVIC, Memory Protection Unit. (C2) 4. Discuss CMSIS implementation in ARM Cortex.(C2)
Unit 4: Introduction to LPC13/17xx Microcontroller	
Memory Mapping, Registers involved and programming with GPIO, PWM	1. Discuss Memory Mapping, Registers involved and programming with GPIO, PWM. (C3)

	2. Apply knowledge of ARM Microcontroller architecture to rig up Embedded system circuits(C3)
Unit 5: Data Acquisition System	
ADC, Types of ADC, Choosing the ADC, DAC	1. Identifying various types of ADC. (C1) 2. Review ADC and DAC selection criteria. (C2)
Unit 6: Serial Communication	
UART, I2C, SPI, Interfacing	1. Discussing various types of Serial Communication mechanism. (C2)
Unit 7: USB BUS	
Speed Identification on the bus, States, Packets, Data flow types, Enumeration, Descriptors, USB Interface –C Programs	1. Identify USB types, Firewire devices, ports, cables. 2. Describing Enumeration, Descriptors mechanism in USB.(C2)
Unit 8: CAN BUS	
Introduction, Frames, Bit stuffing, Types of errors, Nominal Bit Timing, A simple application with CAN	1. Describe the nature of CAN and the basic CAN protocol, and the basic structure of a CAN network. (C2) **2.** Prepare a simple application with CAN. (C3)
Unit 9: Introduction to Multitasking in Microcontrollers	
Variants of RTOS, FreeRTOS, UCOS, uCLinux, FreeRTOS on Cortex based Microcontrollers, TASK CREATION, QUEQUES, SEMAPHORE, MUTEX, Application development	1. Describe about Real time operating systems role in building real time systems (C3) 2. Describe about Designing Real Time Embedded systems by interfacing peripherals and actuators (C2) 3. Design a Real time Embedded system by writing applications on top of Real time operating systems (C5)

Unit 10: Designing a Digital Camera	
Introduction, Requirement, Specifications, Implementation, Testing	**1.** Summarize the stages involved in designing a digital camera. (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	
End Semester Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Joseph Yiu, "The definitive guide to the ARM Cortex-M3", Elsevier, 2nd Edition, 2010.

	2. Frank Vahid, Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", Wiley India, ISBN:81-265-0837-X, 2007. 3. Richard Barry, "NXP Semiconductors, LPC13xx/17xx User Manual", 2012. 4. NXP Semiconductors, "LPCzone Examples", 2012. 5. "FreeRTOS Reference Manual", Real Time Engineers Ltd., 2016.

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Sensors and Transducers
Course Code: AES 601	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basics of Sensors Basics of Data Acquisition and Signal conditioning

Synopsis:	1. This course provides the knowledge of variety of available sensors. 2. Based on need designing an embedded systems using sensors 3. This course provides insight into the sensors used in automobile industry & their working. 4. Provides insight into the actuators used in automotive industry.
Course Outcomes (COs):	On successful completion of this course, students will be able to:
CO 1:	Discuss the working of different types of sensors available.
CO 2:	Design a Data Acquisition System for a specific application using sensors.
CO 3:	Describe the sensors used in Automotive Applications.
CO 4:	Demonstrate the working of sensors in automotive application using simulation as well as building hardware using breadboard.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*									
CO 2		*	*		*						
CO 3	*										
CO 4		*			*	*					

Course content and outcomes:

Content	***Competencies***
Block I	
Introduction:	At the end of the topic student should be able to:

Sensors/ Transducers – Principles – Classification – Parameters – Environmental Parameters – Characterization **Mechanical and Electromechanical Sensors:** Resistive Potentiometer – Strain Gauge – Inductive Sensors – Capacitive Sensors – Force/ Stress Sensors using Quartz Resonators – Ultrasonic Sensors **Thermal Sensors:** Gas Thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Thermometric Sensors – Dielectric Constant and Refractive Index Thermo sensors - Helium Low Temperature Thermometer – Magnetic Thermometer – Resistance Change Type Thermometric Sensors – Thermoemf – Sensors – Junction Semiconductor Types – Thermal Radiation Sensors – Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry – Heat Flux Sensors	1. Discuss the working principles of Sensors/ Transducers (C3). 2. Classify the sensors based on the types (C3). 3. List various characteristics of sensors (C2). 4. Discuss the working principle of Mechanical and Electromechanical sensors (C3) 5. Explain the working principle of Thermal Sensors (C2). 6. Identify the applications of thermal sensors (C3). 7. Discuss different types of thermal sensors (C3)
Block II	
Magnetic Sensors: Sensors and the Principles Behind – Magnetoresistive Sensors – Hall Effect and Sensors – Inductive and Eddy Current Sensors – Angular/ Rotary Movement Sensors – Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors – SQUID Sensors **Electroanalytical Sensors:**	1. Explain the working principles of magnetic sensors (C3) 2. Explain the working principles of Electroanalytical sensors and their properties such as Electrochemical Cell, Cell Potential, Polarisation etc.(C3) 3. Discuss below properties of Smart Sensors (C3)

Electrochemical Cell – Cell Potential – Standard Hydrogen Electrode – Liquid Junction and other potentials – Polarization – Reference Electrodes – Sensor Electrodes – Electroceramics in Gas Media - ChemFET **Smart Sensors:** Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation – Information Coding/ Processing – Data Communication – Automation	
Block III	
Recent Trends in Sensor Technology: Film Sensors – Semiconductor IC Technology – Microelectromechanical Systems (MEMS) - Nano Sensors. **Applications of Sensors:** On-board Automobile Sensors – Flow-rate Sensors – Pressure Sensors – Temperature Sensors – Oxygen Sensors – Torque and Position Sensors.	1. Describe the working principle of Film sensors, – Semiconductor IC Technology, Microelectromechanical Systems (MEMS) - Nano Sensors (C3) 2. Discuss the application of sensors in automobiles (C3)

Learning strategies, contact hours and student learning time

Learning strategy	**Contact hours**	**Student learning time (Hrs)**
Lecture	36	72
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-
Revision	-	-
Assessment	6	-
TOTAL	**78**	**144**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos				
Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2			*	*
Assignment/Presentation		*	*	
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. D Patranabis "Sensors and Transducers", Second Edition, PHI, 2004 2. John G. Webster. Editor-in-chief. "Measurement, Instrumentation, and Sensors Handbook", CRC Press. 1999. 0-8493-2145-X. 3. Pawlak Andrzej M, "Sensors and actuators in Mechatronics", 2007 4. PDF files online available at www.engnetbase.com 5. "Automotive Hand Book", Robert Bosch, Bently Publishers, 2007. 6. John G. Webster, "Modern instrumentation applications and design", 2004

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Vehicular Adhoc Networks
Course Code: AES 602	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic of Computer Communication and Networks.

Synopsis:	1. This course introduces students the basics of Adhoc networking and understanding of various protocols of vehicular adhoc networks (VANETs). 2. Learn the design issues in vehicular networks and about VANET components. 3. The Security Architecture and requirements of VANET. 4. Learn the routing algorithms to route the data packets in VANET. 5. Learn how to perform mobility modelling in VANETs. 6. Learn about the connection establishment and information dissemination in a vehicular network. 7. Learn protocols affiliated to physical and MAC layers of vehicular communication network.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Identify the goals and applications of vehicular networks, able to explain the classification of vehicular networks and reference models.
CO 2:	Explain the functions of On-Board Units (OBUs) and Road-Side Units (RSUs) used in vehicular networks, IP addressing techniques.
CO 3:	Demonstrate routing algorithms and information dissemination mechanisms in vehicular network.
CO 4:	Describe the core components of security requirements and architecture of VANET.
CO 5:	Analyse the performance of the protocols for various topology of vehicular networks.
CO 6:	Design and compare the efficiency of different vehicular network models through simulation.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*	*	*	*						
CO 3	*	*	*		*						
CO 4			*		*						
CO 5	*	*	*								
CO 6	*	*	*								

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction	
Vehicular AdHoc Networks, Basic Concept of VANET, Taxonomy of Vehicular Communication Systems, Challenges and Perspectives, Application for VANETs Basic Principles and Challenges, Past and Ongoing VANET Activities	At the end of the topic student should be able to: 1. Define vehicular adhoc networks. (C1) 2. Describe about any four applications of vehicular adhoc networks. (C2) 3. Write the classifications of Vehicular Networks. (C3) 4. Write an overview of the basic components in VANET. (C3) 5. Explain the challenges faced in the implementation of VANET. (C2) 6. Write notes on VANET perspectives. (C3) 7. Differentiate the IVCs from that of MANETs. (C4)
Unit 2: Cooperative Vehicular Safety Applications	

Motivation, Enabling Technologies, Cooperative System Architecture, Mapping for Safety Applications, VANET-enabled Active Safety Applications.	1. Discuss the enabling technologies for Co-operative driving systems. (C2) 2. Explain the Cooperative system architecture in Cooperative Vehicular safety applications. (C2) 3. Illustrate the working of Infrastructure-to-Vehicle applications in Cooperative Vehicular Safety applications in VANETs. (C4)
Unit 3: Information Dissemination in VANETs	
Obtaining Local Measurements, Information Transport, Protocols for information transport, Improving network connectivity, Geographical Data Aggregation	1. Explain about the basic vehicular network topologies. (C2) 2. Explain the working of position based routing protocols in VANET. (C5) 3. Explain the working of Localization Techniques for VANET. (C6) 4. Illustrate the working of VANET protocols for information transport in Information dissemination. (C2) 5. Write notes on improving network connectivity in information transport with respect to Information dissemination in VANETs. (C3)

	6. Write notes on Cryptographic protection with respect to Secure Position based routing. (C3)
Unit 4: Vehicular Mobility Modelling for VANET	
Random Models, Flow Models, Traffic Models, Behavioural Models, Integration with Network Simulators, A Design Framework for Realistic Vehicular Mobility Models	1. Distinguish different aspects of Vehicular mobility modelling for VANETs. (C2) 2. Illustrate the challenges to modelling vehicular motions. (C4) 3. Describe the popular models available in Vehicular Mobility Modelling. (C6)
Unit 5: Physical Layer Considerations for Vehicular Communications	
Standards Overview, Wireless Propagation Theory, Channel Metrics, Highway environments, Urban environments, Rural LOS environments	1. Write an overview of the DSRC Standard and specific parameters of OFDM architecture. (C3) 2. Summarize small-scale multipath effects. (C6) 3. Explain the impact on OFDM systems. (C2)
Unit 6: MAC Layer and Scalability Aspects of Vehicular Communication Networks	
Introduction: Challenges and Requirements, A Survey on Proposed MAC Approaches for VANETs, Communication Based on IEEE 802.11p, The IEEE 802.11 standard, IEEE 802.11p: towards wireless access in vehicular environments, Performance Evaluation and Modeling, Aspects of Congestion Control.	1. Write notes on the DHCP and Address Resolution Protocol with respect to IP Address Auto configuration in VANETs. (C5) 2. Explain in detail the steps involved in IP passing with the help of a flow chart. (C6)

	3. Illustrate the concept of Pulse Relay used in the Priority-Ensured Medium Access scheme. (C4) 4. Explain the different challenges in Emergency message dissemination with respect to MAC. (C2)
Unit 7: Efficient Application Level Message Coding and Composition	
Introduction to the Application Environment, Message Dispatcher, Example Applications, DataSets, Architecture Analysis.	1. Describe cooperative vehicular safety applications and their communication requirements. (C6) 2. Discuss the goals of system architecture for wireless inter-vehicle safety communication. (C2) 3. Illustrate the basic architectural concept of the Message Dispatcher (MD). (C4)
Unit 8: Data Security in Vehicular Communication Networks	
Introduction and Outline, Challenges of Data Security in Vehicular Networks, Network, Applications, and Adversarial Model, Security Infrastructure, Privacy Protection Mechanisms	1. Describe the attacker's model in VANET with respect to dimensions. (C5) 2. Identify the challenges of Data Security in VANET. (C1) 3. Compare between Academic hacker and Organizational hacker. (C4) 4. Compare between Curious hacker and Malicious hacker. (C4)

	5. Distinguish between IT safety and IT security. (C2) 6. Describe the Network model, Applications model and Adversarial model used for Data Security in VANET. (C6) 7. Explain the security infrastructure used for Data Security in VANET. (C5)
Unit 9: Standards and Regulations	
Layered Architecture for VANETs, DSRC Regulations, DSRC Physical Layer Standard, DSRC Data Link Layer Standard (MAC and LLC), DSRC Middle Layers, DSRC Message Sublayer.	1. Discuss about the layered architecture for VANET. (C2) 2. Discuss about the DSRC regulations. (C2) 3. Examine the various layers of the DSRC protocol stack in detail. (C4) 4. Describe the MAC and LLC of the DSRC Data Link Layer. (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	*	*	*	*		
Sessional Examination 2			*	*	*	*
Assignment/Presentation		*	*	*	*	*
End Semester Examination	*	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Hannes Hartenstein, Kenneth P Laberteaux, "VANET: Vehicular Applications and Inter-Networking Technologies", John Wiley & Sons Ltd, 2010. 2. Hassnaa Moustafa, Yan Zhang, "Vehicular Networks Techniques, Standards and Applications", Auerbach Publications, 2009. 3. IEEE and other Transaction papers.

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Internet of Things
Course Code: IOT 607	**Course Instructor:**
Academic Year: 2020 – 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Computer Networks, Programming aspects.

Synopsis:	This Course provides insight on 1. Various elements involved in the development of application for IoT. 2. Understanding of protocols across IoT stack 3. Scripting languages like shell and python. 4. Client Server architecture and Python APIs of Socket programming. 5. Database and Python Database connectivity, Python Web Programming, IoT Framework
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Describe the developmental aspects of the application in IoT.
CO 2:	Demonstrate the usage of networking protocols across IoT stack.
CO 3:	Demonstrate the fundamental concepts in Client Server architecture and database implementation and usage with Python API's.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2	*	*			*						
CO 3	*		*		*						

Course content and outcomes:	
Content	*Competencies*
Unit 1: Internet of Things	
IoT Protocols – Logical Design - Enabling Technologies - Levels – IoT vs M2M – Design Methodology – Domain Specific Applications	At the end of the topic student should be able to: 1. Outline the integration of various elements of IoT ecosystem. (C2)
Unit 2: Introduction to Python	
Datatypes - Constructs – Packages	1. Employ Datatypes, Constructs, Packages in python programming. (C2)

Unit 3: Wireless Sensor Networks	
Protocol Standards – Issues – Routing – Applications	1. Describe Protocol Standards, Routing, Issues in Wireless Sensor Networks. (C2)
Unit 4: Bluetooth	
Introduction – Protocol Stack - RF Classes – Radio Technologies – Service Discovery – Device Discovery – Profiles – Security (Discovering Bluetooth) - Hardware	1. Explain the aspects of Bluetooth technology. (C2)
Unit 5: Zigbee	
- Frequency - Channels – Topology - Zigbee Protocol Stack - PHY - MAC Layer - Working – Frame Structure – Beacon – Non-Beacon Communication - Zigbee PDU – Zigbee Hardware – API Mode and AT mode communication.	1. Describe Protocol Standards, Routing, Issues in Zigbee. (C2)
Unit 6: Internet Protocol	
Introduction to IPv4 and IPv6 – IPv4 Headers – Ipv6 Headers	1. Demonstrate the implementation of IPv4 and IPv6 protocol in TCP/IP protocol stack. (C3)
Unit 7: 6LoWPAN - 6LoWPAN architecture	
simple, extended and ad-hoc networks. Issues in determining IPv6 links in LLNs and illustration of the undetermined link addressing model. IPv6 addressing in 6LoWPAN.	1. Indicate the 6LoWPAN architecture for resource constrained devices. (C2)
Unit 8: Sockets	
Introduction to Sockets – Client Server Architecture –Unix Sockets – PORTS – Python APIs of Sockets – TCP socket programming using Python – UDP – RAW packets python programming.	1. Outline Client Server Architecture. (C1)
Unit 9: Databases & Web Programming	
Introduction to Databases – File System vs RDBMS – ER Diagram – Python Database connectivity (CRUD) - Web Server Concepts - Python Web Programming – IoT Framework.	1. Illustrate the socket communication using python API's for RWA, stream and datagram-oriented use cases. (C3)

Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*

Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation		*	*
End Semester Examination	*	*	*

Feedback Process	• End-Semester Feedback
1. Reference Material	• Arshdeep Bhaga, Vijay Madishetti, “Internet of things:A hands on Approach”, Universities Press, ISBN:978172719547 • Robert Faludi,”Building Wireless Sensor Networks”,Orielly, 2012 • Jean-Philippe Vasseur,Adam Dunkels,"Interconnecting Smart Objects with IP: The Next Internet",Morgan Kaufmann Publishers,2010,ISBN:0123751659 9780123751652 • Marco Schwartz,"Internet of Things with the Arduino Yun",Packt Publishing,2014 • Charalampos Doukas,"Building Internet of Things With the Arduino: Volume 1",CreateSpace Independent Publishing Platform,2012 • Todor Cooklev ,“Wireless communication standards”, IEEE Press • Houda Labiod, Hossam Afifi, Costantino De Santis, “Wi-Fi, Bluetooth, Zigbee and WiMAX”, Springer Publications

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Microcontrollers and its Applications
Course Code: ESD 602	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Microprocessor architecture , Assembly language and Number systems

Synopsis:	This Course provides insight on 1. This course provides the knowledge of Intel 8051 and ARM Microcontrollers. 2. This course provides the knowledge of Microcontroller architecture, Registers and Instruction sets to write Assembly and Embedded C Programming. 3. This course provides the concept of Interfacing and Programming Sensors and Peripherals to Microcontrollers. 4. This course provides the concept of Designing Embedded Systems using Microcontrollers.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Employ the knowledge of Microcontrollers to build Embedded systems.
CO 2:	Explain the concept of Programming Microcontrollers using Assembly and Embedded C.
CO 3:	Design Embedded Systems by interfacing Sensors and Actuators.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2	*	*			*						
CO 3	*		*		*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction to Microprocessor & Microcontrollers	
Comparison – Variants – Types – General – ASIC – PLD – Introduction	1. Explain about the differences of Microprocessor and Microcontrollers(C2)

to Motherboard(Desktop) - Introduction to Embedded Board – Compare and Contrast - Application Types – Single Tasking – Multitasking – Multi-Application	2. Describe Microcontroller Architecture (C2) 3. Explain the Register sets, Programming model and Memory map of Microcontroller(C2) 4. Describe about Microcontroller Instruction set. (C2) 5. Write the Applications using Microcontrollers. (C3)
Unit 2: Introduction to ARM Microcontrollers	
Programming Model – Processor Modes – ARM vs Thumb Introduction to LPCxxxx Microcontrollers – Features – Detailing of Pins - Memory Map Concepts – RAM & ROM - Interrupts Concepts (Internal & External)	1. Describe ARM Microcontroller architecture. (C2) 2. Describe the architecture of ARM Microcontrollers. (C2) 3. Apply knowledge of ARM Microcontroller architecture to rig up Embedded system circuits(C3) 4. Develop a Prototype of Embedded systems using ARM Microcontroller(C5, P3)
Unit 3: Reset Circuitry	
Crystals - Introduction to GPIO – Registers – Input /Output Configuration – Pull Up and Pull Down Resistor Concept – Interfacing with LED – Interfacing Push Buttons – LCD – Stepper Motor – DC Motor	1. Describe Crystal oscillator. (C2) 2. Describe Pull Up and Pull Down Resistor Concept.(C2) 3. Illustrate Interfacing LED, Push Buttons, LCD, Stepper Motor – DC Motor with microcontroller. (C2)
Unit 4: Relays	
Types of Relays – Interfacing	1. Describe Relay and its with interfacing external peripherals to Microcontrollers. (C4)
Unit 5: Timer, Counter Introduction	
Configuration – Programming	1. Describe about timers, counters and its usage with Microcontrollers(C4)
Unit 6: Serial vs Parallel Bus	

Serial vs Parallel Bus - Compare and Contrast – Terminology: Baud Rate – Bit Rate – RS232 – DB9 handshaking concepts - Configuring Registers – Programming for UART modules.	1. Describe about Serial and Parallel communication protocols(C2)
Unit 7: Introduction to SPI and I2C Protocol	
Detailed Discussion – Bit Banging – Interfacing with SPI and I2C Devices – RTC / ADC /DAC.	1. Describe SPI, I2C standards and its Interfacing with SPI and I2C Devices – RTC / ADC /DAC.(C3) 2. Explain about how to establish multi controller communications using communication protocols (C3)
Unit 8: Introduction to ADC and DAC	
Types – Chips - Register Configuration – Interfacing	1. Summarize types of ADC, DAC and its usage with Microcontroller. (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*		*
End Semester Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	• William Hohl, Christopher Hinds,"ARM Assembly Language: Fundamentals and Techniques",2nd Edition, ISBN-13: 978-1482229851, ISBN-10: 1482229854 • Andrew Sloss, Dominic Symes, Chris Wright,"ARM System Developer's Guide: Designing and Optimizing System Software",1st Edition,The Morgan Kaufmann Series in Computer Architecture and Design, ISBN-13: 978-1558608740, ISBN-10: 1558608745 • David Seal, "ARM Architecture Reference Manual", 2nd Edition, Addison-Wesley Professional. • Steve Furber,"ARM System-on-Chip Architecture",2nd Edition,Addison-Wesley Professional, ISBN-13: 078-5342675191,ISBN-10: 0201675196 • Douglas V. Hall,"Microprocessors and Interfacing",Mcgraw Hill Educatin ,ISBN-10 1259006158,ISBN-13 9781259006159,2012. • Websites & Transaction Papers

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Linux and Scripting languages
Course Code: AES 615.1	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:**

Synopsis:	The goal of the course is to 1. Study of scripting languages such as Bash and Perl in Linux environment. 2. The study of usage of scripting languages in VLSI field. 3. To provide the basic knowledge about different tools available to automate the task
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1	Discover shell script programmatically using different features and debugging the code
CO 2	Apply SED & AWK commands to do more complex task in easy way
CO 3	Apply PERL scripts that create and change scalar, array and hash variables

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*								
CO 2	*	*		*							
CO 3		*	*	*							

Course content and outcomes:

Content	***Competencies***
Unit 1: Essentials	
Structure of a Linux Based Operating System, Hardware, Kernel, files & file system; Processes; networking; version control.	1. Summarize the Structure of a Linux Based Operating System 2. Discuss Hardware, Kernel (C2) 3. Explain files & file system, Processes; networking; version control(C2)

Unit 2: Introduction to Scripting: Shell, Tcl/tk, perl, python	
Getting started with Shell Programming: Writing shell scripts, Variables in shell, User defined variables (UDV), Rules for Naming variable name (Both UDV and System Variable), Printing or accessing values of UDV (User defined variables), echo Command, Shell Arithmetic, More about Quotes, Exit Status, The read Statement, Wild cards (Filename Shorthand or meta Characters), More commands on one command line, Command Line Processing, Requirements for Command Line arguments, Redirection of Standard output/input i.e. Input - Output redirection, Pipes, Filter, What is Processes, Why Process required, Linux Command(s) Related with Process Shells (bash) structured Language Constructs: Decision making in shell script, test command or [expr], if...else...fi, Nested ifs, Multilevel ifthen-else, Loops in Shell Scripts, for loop, Nested for loop, while loop, The case Statement, Debugging the shell script. Advanced Shell Scripting Commands: /dev/null - to send unwanted output of program, Local and Global Shell variable (export command) Conditional execution i.e. && and ||, I/O Redirection and file descriptors,	1. Explain Variables, User defined variables (UDV) (C2) 2. Examine the Rules for Naming variable name (C3) 3. Write basic shell script using echo Command, Shell Arithmetic, Quotes, Exit Status, Wild cards, Command Line arguments; Redirection, Pipes, constructs. (C3)

Functions, User Interface and dialog utility-Part I, User Interface and dialog utility-Part II, Message Box (msgbox) using dialog utility, Confirmation Box (yesno box) using dialog utility, Input (inputbox) using dialog utility, User Interface using dialog Utility - Putting it all together, trap command, The shift Command, getopts command.	
Unit 3: Awk utility	
Getting Starting with awk, Predefined variables of awk, Doing arithmetic with awk, User Defined, variables in awk, Use of printf statement, Use of Format Specification Code, if condition in awk, Loops in awk, Real life examples in awk, awk miscellaneous, sed - Quick Introduction, Redirecting the output of sed command, Writing sed scripts.	1. Illustrate Data manipulation using awk utility(C3) 2. Experiment Regular expression using awk utility (C4) 3. Experiment script using conditional statement using awk (C4)
Unit 4:	
Scalar Variables: What is Scalar? , Defining Scalar Variables, Literal Representation, Scalar Operators. Arrays: What is a List or Array? , Defining Array variables, Literal Representation, Array Operators. Hash Arrays: What is a Hash Array?, Hash Key and its value, Defining Array variables, Literal Representation, Accessing Hash Array values, Hash Array Operators, How a Scalar Operator determines, Strings, Numbers.	1. Illustrate scalar variables, arrays, and hash arrays (C3)
Unit 5: Perl	

Introduction to perl: What is PERL?, The structure of a Perl CGI script, Informing the Server software where Perl, CGI scripts are stored, Concept of granting permissions for everyone, to be able to use the Perl scripts. The perl programming environment: Creating a Perl CGI script, Invoking a Perl CGI script, Executing a Perl CGI script, Placing comments in a Perl script. Perl functions and procedures: Scalar Functions, Scalar Procedures, Array Functions, Array Procedures, Hash Array Functions, Hash Array Procedures.	1. Experiment Perl program using Perl constructs (C4)
Unit 6: Pattern Matching Subroutines	
Stdin/Stdout: Input from STDIN (Server Default Port 80), Output to STDOUT (Server Default Port 80), Makefile – create a makefiles, shortcuts	1. Illustrate stdin/stdout and makefile (C3)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:			
Formative:			**Summative:**
Internal practical Test			Sessional examination
Theory Assignments			End semester examination
Lab Assignment & Viva			Viva
Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation			*
End Semester Examination	*	*	*

Feedback Process	• Mid-Semester feedback • End-Semester Feedback
Reference Material	1. "Introduction to Linux – A Beginner's Guide", Machtelt Garrels 2. "Unix shell programming", Stephen G. Kochan, Patrick H. Wood 3. "Sed & awk ",Dale Dougherty, Arnold Robbins 4. "Programming Perl", Larry Wall, Tom Christiansen, Jon Orwant

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Real Time Operating Systems Lab
Course Code: CSE 602	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 1	Prerequisites: Knowledge on C programming, Operating System concepts

Synopsis:	This Course provides insight on 1. Basics of operating systems and real operating systems. 2. Understand the concepts of process management, scheduling, synthetization and dead lock. 3. Learn thread-based programming. 4. Learn the concept of memory management. 5. Learn the salient features of real time operating systems
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Experiment process creation, process hierarchies and multi-thread concepts.
CO 2:	Apply process-scheduling algorithms and process synchronization concepts on various scenarios.
CO 3:	Apply memory management techniques on various scenarios

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*		*						
CO 2	*	*	*		*						
CO 3	*	*	*		*						

Course content and outcomes:

Content	*Competencies*

Unit 1:	
Basics of C programming: String manipulation, file handling.	Practice basic C programming concepts (C3)
Unit 2:	
Process creation, fork, exec, wait, multi thread concepts.	Experiment process creation, process hierarchies and multi-thread concepts. (C4)
Unit 3:	
Process scheduling algorithms	Apply process-scheduling algorithms on various scenarios. (C3)
Unit 4:	
Process synchronization concepts.	Experiment process synchronization concepts (C4)
Unit 5:	
Memory management techniques	Apply memory management techniques on various scenarios (C3)

Learning strategies, contact hours and student learning time

Learning strategy	Contact hours	Student learning time (Hrs)
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	Summative:

Continuous practical Test			Sessional examination
			End semester examination
Lab Assignment & Viva			Viva
Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Assignment/Presentation			*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	[1] Text mining handbook: advanced approaches in analyzing unstructured data Feldman, Ronen and James Sanger, 9780521836579, CUP, 2008 [2] Linked Lexical Knowledge Bases Iryna Gurevych, Judith Eckle-Kohler, Michael Matuschek,9781627059749, Morgan & Claypool, 2016 [3] Introduction to information retrieval Manning, Christopher D. and Prabhakar Raghavan and Hinrich Schutze, 9780521865715, Cambridge University Press,2008 [4] Text mining: classification, clustering and applications Srivastava, Ashok and Mehran Sahami (eds.)., 9781420059403, Chapman & Hall,2009 [5] Weiss, S. M., Indurkhya, N., Zhang, T. (2010). Fundamentals of Predictive Text [6] Mining. Springer: New York. ISBN: 978-1849962254 [7] Pustejovsky, J. and Stubbs, A. (2012). Natural Language Annotation for Machine [8] Learning. O'Reilly. [9] Foundations and Trends in Information Retrieval, 2(1-2): 1–135. Available online at: http://www.cs.cornell.edu/home/llee/opinion-mining-sentiment-analysis-survey.html.

	[10] Manning, C. D., Raghavan, P., and Schutze, H. (2008). Introduction to Information Retrieval, Chapters 6 and 13-18, Cambridge University Press. Available online at: http://nlp.stanford.edu/IR-book/ [11] Articles: https://www.healthcatalyst.com

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Embedded Systems Lab
Course Code: ESD 605L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Microprocessor architecture , Microcontroller Architecture , Assembly language and Number systems

Synopsis:	This Course provides insight on 1. This course provides the knowledge of ARM Cortex M3 Processor architecture. 2. This course provides the knowledge of Microcontroller based on ARM Processor architecture and its Registers and Instruction sets to write Assembly and Embedded C Programming. 3. This course provides the concept of Interfacing and Programming Sensors and Peripherals to Microcontrollers. 4. his course provides the concept of Real time operating systems on Microcontrollers.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Illustrate the features of embedded systems, architecture of ARM7, Instruction set and development tools of ARM.
CO 2:	Experiment the architectural features of LPC13/17XX microcontrollers, interfacing peripheral devices to LPC2148.
CO 3:	Design a Real time Embedded Systems by interfacing Sensors and Actuators and porting Real time operating systems.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*		*						
CO 2	*	*			*						
CO 3	*	*	*		*						

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction to LPC13/17xx Microcontroller	
Introduction to LPC13/17xx Microcontroller - Hardware, SW.	At the end of the topic student should be able to: 1. Summarise LPC13/17xx Microcontroller architecture and development tools of ARM. (C2)
Unit 2: Interfacing LPC13/17xx Microcontroller	
Interfacing With LED, LCD Seven Segment Display, UART, HEX Keypad.	Experiment interfacing LPC13/17xx Microcontroller with I/O devices. (C2)
Unit 3:	
Introduction to Free RTOS, FreeRTOS API Calls, Task Creation, Queques, semaphore, mutex, RTOS application development.	1. Summarise FreeRTOS architecture. (C2) 2. Practise different API call in FreeRTOS. (C2) 3. Design a Real time Embedded system by writing applications on top of Real time operating systems (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-

TOTAL	**48**	**-**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	*
Assignment		*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Joseph Yiu, "The definitive guide to the ARM Cortex-M3", Elsevier, 2nd Edition, 2010. 2. Frank Vahid, Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", Wiley India, ISBN:81-265-0837-X, 2007. 3. Richard Barry, "NXP Semiconductors, LPC13xx/17xx User Manual", 2012. 4. NXP Semiconductors, "LPCzone Examples", 2012. 5. "FreeRTOS Reference Manual", Real Time Engineers Ltd., 2016.

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Sensors and Transducers Lab
Course Code: AES 601L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Basics of Sensors Basics of Data Acquisition and Signal conditioning

Synopsis:	This course provides the knowledge of variety of available sensors. 1. Based on need designing an embedded systems using sensors 2. This course provides insight into the sensors used in automobile industry & their working. 3. Provides insight into the actuators used in automotive industry.
Course Outcomes (COs):	On successful completion of this course, students will be able to:
CO 1:	Discuss the working of different types of sensors available
CO 2:	Design a Data Acquisition System for a specific application using sensors
CO 3:	Describe the sensors used in Automotive Applications
CO 4:	Demonstrate the working of sensors in automotive application using simulation as well as building hardware using breadboard

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*									*
CO 2		*	*		*				*		*
CO 3	*										*
CO 4		*			*	*	*	*			*

Course content and outcomes:

Content	***Competencies***
Block I	
Introduction:	At the end of the course student should be able to:

Sensors/ Transducers – Principles – Classification – Parameters – Environmental Parameters – Characterization **Mechanical and Electromechanical Sensors:** Resistive Potentiometer – Strain Gauge – Inductive Sensors – Capacitive Sensors – Force/ Stress Sensors using Quartz Resonators – Ultrasonic Sensors **Thermal Sensors:** Gas Thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Thermometric Sensors – Dielectric Constant and Refractive Index Thermo sensors - Helium Low Temperature Thermometer – Magnetic Thermometer – Resistance Change Type Thermometric Sensors – Thermoemf – Sensors – Junction Semiconductor Types – Thermal Radiation Sensors – Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry – Heat Flux Sensors	1. Demonstrate the working of below sensors in Proteus Simulation Software using Arduino / ARM microcontroller (C4): • Humidity sensor • Light sensor • Temperature sensor • Load Cell • RTD • Flex sensor • Force Sensitive Resistor • Motion Sensor / Passive Infrared Sensor • Hall effect sensor
Block II	
Magnetic Sensors: Sensors and the Principles Behind – Magnetoresistive Sensors – Hall Effect and Sensors – Inductive and Eddy Current Sensors – Angular/ Rotary Movement Sensors – Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors – SQUID Sensors **Electroanalytical Sensors:**	1. Design & Demonstrate sensor project in automobile with suitable sensors to measure below parameters using Arduino / ARM microcontroller (C5) • Distance of the obstacle • Engine Temperature • Accelerator • Human movement near the car

Electrochemical Cell – Cell Potential – Standard Hydrogen Electrode – Liquid Junction and other potentials – Polarization – Reference Electrodes – Sensor Electrodes – Electroceramics in Gas Media - ChemFET	• Speed measurement
Block III	
Applications of Sensors: On-board Automobile Sensors – Flow-rate Sensors – Pressure Sensors – Temperature Sensors – Oxygen Sensors – Torque and Position Sensors.	1. Demonstrate the working of the sensor application in automobile using Simulation Software as well as in hardware using breadboard (C4).

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination

Lab Assignment & Viva				Viva
Mapping of assessment with Cos				
Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2			*	*
Assignment/Presentation		*	*	
Laboratory examination		*		*
Feedback Process	• End-Semester Feedback			
Reference Material	1. D Patranabis "Sensors and Transducers", Second Edition, PHI, 2004 2. John G. Webster. Editor-in-chief. "Measurement, Instrumentation, and Sensors Handbook", CRC Press. 1999. 0-8493-2145-X. 3. Pawlak Andrzej M, "Sensors and actuators in Mechatronics", 2007 4. PDF files online available at www.engnetbase.com 5. "Automotive Hand Book", Robert Bosch, Bently Publishers, 2007. 6. John G. Webster, "Modern instrumentation applications and design", 2004			

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Vehicular Adhoc Networks Lab
Course Code: AES 602L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Basic of Computer Communication and Networks.

Synopsis:	This Course provides insight on 1. Basics of Adhoc networking and understanding of various protocols of vehicular adhoc networks (VANETs). 2. Learn the Routing algorithms to route the data packets in VANETs. 3. Learn how to perform Mobility Modelling in VANETs. 4. Learn about the connection establishment and information dissemination in a vehicular network.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Demonstrate routing algorithms and information dissemination mechanisms in vehicular network.
CO 2:	Analyse the performance of the protocols for various topology of vehicular networks.
CO 3:	Design and compare the efficiency of different vehicular network models through simulation.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*	*	*					*	
CO 2	*		*	*	*					*	
CO 3	*		*	*	*					*	

Course content and outcomes:

Content	***Competencies***
Unit 1: Installation and usage of SUMO tool	

Installation of **S**imulation of **U**rban **MO**bility (SUMO) tool, configuring path variables, Node and Edge creation	At the end of the topic student should be able to: 1. Demonstrate the usage of SUMO tool. (C3)
Unit 2: Network Building	
Network generation, importing networks with Netconvert, importing non-SUMO networks, importing SUMO networks, creating and modifying networks,.	2. Practice creation and modification of network files (C3)
Unit 3: Demand Modelling and Simulation	
Introduction to demand modelling, definition of vehicles, vehicle types and routes, Simulation of Public transport, shortest or optimal path routing. Generation of route file, generation of additional files, generation of configuration file, running a sample scenario,	3. Practice simulation of public transport. (C3) 4. Practice routing in the simulation. (C3) 5. Experiment various VANET Scenarios. (C4)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	*
End Semester Examination			
Laboratory examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. https://www.eclipse.org/sumo/ 2. https://sumo.dlr.de/docs/index.html 3. https://www.tetcos.com/downloads/v12/VANETs.pdf 4. https://www.openstreetmap.org/ 5. http://www.nsnam.org/

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Internet of Things Lab
Course Code: IOT 607L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Computer Networks, Programming aspects.

Synopsis:	This Course provides insight on 1. Various elements involved in the development of application for IoT. 2. Understanding of protocols across IoT stack. 3. Scripting languages like shell and python. 4. Client Server architecture and Python APIs of Socket programming. 1. Database and Python Database connectivity, Python Web Programming, IoT Framework.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Explain basic principles of Python programming language. (C2)
CO 2:	Demonstrate the usage of networking protocols across IoT stack using Raspberry Pi and Cloud. (C3)
CO 3:	Demonstrate the fundamental concepts in Client Server architecture, database implementation and web programming with Python API's. (C3)

Mapping of COs to POs											
COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2	*	*		*	*						
CO 3	*		*		*						

Course content and outcomes:	
Content	***Competencies***
Unit 1: Python	
Introduction to Python datatypes, constructors, functions, Python Class, Modules, exception Handling, Python Packages	At the end of the topic student should be able to: Employ Datatypes, Constructs, Packages in python programming. (C2)
Unit 2: Raspberry PI IoT Board	

Introduction to RPI, Raspberry Pi - Installation, first boot configuration, Raspberry Pi - Sensor Interfacing, Sending data to Cloud.	Demonstrate the usage of RPI in IoT Application Scenario. (C3)
Unit 3: Things Board Cloud	
Installation of things board Platform, Device, assets & dashboard Creation, population of data.	Illustrate the usage of things board Platform. (C4)
Unit 4: Socket Programming	
Unix Socket Programming - Client Server Architecture, Python Socket Programming - Client Server Architecture, RAW packets python programming	Illustrate the socket communication using python API's for RWA, stream and datagram-oriented use cases. (C3)
Unit 5: Databases	
Python Database connectivity (CRUD) - Web Server Concepts - Python Web Programming – IoT Framework.	Demonstrate the usage of databases, web programming using Python API . (C3)

Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	*
Assignment/Presentation		*	*
Lab Semester Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	• Arshdeep Bhaga, Vijay Madishetti, “Internet of things:A hands on Approach”, Universities Press, ISBN:978172719547 • Robert Faludi,”Building Wireless Sensor Networks”,Orielly, 2012 • Jean-Philippe Vasseur,Adam Dunkels,"Interconnecting Smart Objects with IP: The Next Internet",Morgan Kaufmann Publishers,2010,ISBN:0123751659 9780123751652 • Marco Schwartz,"Internet of Things with the Arduino Yun",Packt Publishing,2014 • Charalampos Doukas,"Building Internet of Things With the Arduino: Volume 1",CreateSpace Independent Publishing Platform,2012 • Todor Cooklev ,“Wireless communication standards”, IEEE Press • Houda Labiod, Hossam Afifi, Costantino De Santis, “Wi-Fi, Bluetooth, Zigbee and WiMAX”, Springer Publications • Madhushree Ganguli , “Getting started with Bluetooth”, Premier Press, 2002, ISBN 1931841837, 9781931841832.

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Microcontroller and its Applications Lab
Course Code: ESD 602L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Microprocessor architecture , Assembly language and Number systems

Synopsis:	This Course provides insight on
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Employ the knowledge of Microcontrollers to build Embedded systems.
CO 2:	Explain the concept of Programming Microcontrollers using Assembly and Embedded C.
CO 3:	Design Embedded Systems by interfacing Sensors and Actuators.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*		*						
CO 2	*	*			*						
CO 3	*	*	*		*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction to Microprocessor & Microcontrollers	
Comparison – Variants – Types – General – ASIC – PLD – Introduction to Motherboard(Desktop) - Introduction to Embedded Board – Compare and Contrast - Application Types – Single Tasking – Multitasking – Multi-Application	1. List different IDE's to program Microcontrollers (C1) 2. Design a Environment with tools required to build Embedded systems using Microcontrollers (C3)
Unit 2: Introduction to ARM Microcontrollers	

Programming Model – Processor Modes – ARM vs Thumb Introduction to LPCxxxx Microcontrollers – Features – Detailing of Pins - Memory Map Concepts – RAM & ROM - Interrupts Concepts (Internal & External)	1. Demonstrate ARM Processor architecture specification using LPC 2148 Microcontroller Board (C3) 2. Demonstrate a peripherals of ARM Microcontroller using LPC 2148 Microcontroller Board (C3)
Unit 3: Reset Circuitry	
Crystals - Introduction to GPIO – Registers – Input /Output Configuration – Pull Up and Pull Down Resistor Concept – Interfacing with LED – Interfacing Push Buttons – LCD – Stepper Motor – DC Motor	1. Design an Digital notice board using LPC 2148 Microcontroller board to understand Peripherals on board (C3) 2. Design an Automated Fan / AC / Temperature control system using on chip sensors and peripherals of LPC 2148 Microcontroller board (C3)
Unit 4: Relays	
Types of Relays – Interfacing	1. Demonstrate working of Relay by controlling High voltage devices like DC Motor interfacing to ARM Microcontroller (C4)
Unit 5: Timer, Counter Introduction	
Configuration – Programming	1. Design a Digital clock using ARM Microcontroller using on chip Timer and Counter (C3)
Unit 6: Serial vs Parallel Bus	
Serial vs Parallel Bus - Compare and Contrast – Terminology: Baud Rate – Bit Rate – RS232 – DB9 handshaking concepts - Configuring Registers – Programming for UART modules.	1. Design a Master and Slave architecture using Microcontrollers and establish communication using on chip serial UART (c4)
Unit 7: **Introduction to SPI and I2C Protocol**	

Detailed Discussion – Bit Banging – Interfacing with SPI and I2C Devices – RTC / ADC /DAC.	1. Design a Serial wired communication among multiple Microcontrollers and sensors using I2C (c4) 2. Design a Serial wired communication among Microcontroller and multiple sensors in Master and Slave Architecture using SPI (c4)
Unit 8: Introduction to ADC and DAC	
Types – Chips - Register Configuration – Interfacing	1. Design a Data Acquisition system ARM Microcontroller (C4)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	• William Hohl, Christopher Hinds,"ARM Assembly Language: Fundamentals and Techniques",2nd Edition, ISBN-13: 978-1482229851, ISBN-10: 1482229854 • Andrew Sloss, Dominic Symes, Chris Wright,"ARM System Developer's Guide: Designing and Optimizing System Software",1st Edition,The Morgan Kaufmann Series in Computer Architecture and Design, ISBN-13: 978-1558608740, ISBN-10: 1558608745 • David Seal, "ARM Architecture Reference Manual", 2nd Edition, Addison-Wesley Professional. • Steve Furber,"ARM System-on-Chip Architecture",2nd Edition,Addison-Wesley Professional, ISBN-13: 078-5342675191,ISBN-10: 0201675196 • Douglas V. Hall,"Microprocessors and Interfacing",Mcgraw Hill Educatin ,ISBN-10 1259006158,ISBN-13 9781259006159,2012. • Websites & Transaction Papers

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Linux and Scripting languages Lab
Course Code: CSE-620L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:**
No of Credits: 1	**Prerequisites:** Problem solving, basic programming

Synopsis:	This Course provides insight on 1. Study of scripting languages such as Bash and Perl in Linux environment. 2. The study of usage of scripting languages.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Experiment shell script programmatically using different features and debugging the code
CO 2:	Operate SED & AWK commands to do more complex task in easy way
CO 3:	Experiment PERL scripts that create and change scalar, array and hash variables

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2			*								
CO 3	*				*						

Course content and outcomes:

Content	***Competencies***
Unit 1:	
Essentials	1. Understand the basic concepts of shell, kernel, operating system (C2). 2. Able to create user account (c3)

Unit 2:	
Introduction to Scripting: Shell, Tcl/tk, perl, python	1. Able to write shell script and debug the script (C3) 2. Understand the importance of shell script in real wold. (C2)
Unit 3:	
Awk utility	1. Generate report using awk script (C3)
Unit 4:	
Sed & Make	1. Perform file handling function using sed script (C4) 2. Appraise the importance of MAKE file (C3)
Unit 5:	
Perl	1. Create pattern matching , report generation and perform file handling function using Perl Script (C3)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	36	-
Revision	-	-

Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	
Laboratory examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	5. "Introduction to Linux – A Beginner's Guide", Machtelt Garrels 6. "Unix shell programming", Stephen G. Kochan, Patrick H. Wood 7. "Sed & awk ",Dale Dougherty, Arnold Robbins "Programming Perl", Larry Wall, Tom Christiansen, Jon Orwant

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Mini Project - 1
Course Code: AES 695	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 4	**Prerequisites:** Any programming language and circuit basics

Synopsis:	Students are expected to select a problem in the area of their interest and the area of their specialization that would require an implementation in hardware / software or both in a semester
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Apply the objectives of the project work and provide an adequate background with a detailed literature survey
CO 2:	Breakdown the project into sub blocks with sufficient details to allow the work to be reproduced by an independent researcher
CO 3:	Compose hardware/software design, algorithms, flowchart, methodology, and block diagram
CO 4:	Evaluate the results
CO 5:	Summarize the work carried out

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1				*							
CO 2					*			*			
CO 3							*			*	
CO 4						*					*
CO5:							*				

Course content and outcomes:

Content	***Competencies***
Phase 1	
Problem identification, synopsis submission, status submission, mid evaluation.	At the end of the topic student should be able to: 1. Identify the problem/specification (C1) 2. Discuss the project (C2)

	3. Prepare the outline (C3) 4. Describe the status of the project (C2) 5. Prepare a mid-term project presentation report (C3) 6. Prepare and present mid-term project presentation slides (C3, C5) 7. Develop project implementation in hardware/software or both in chosen platform (C5)
Phase 2	
Status submission, final evaluation.	1. Prepare the progress report (C3) 2. Prepare the final project presentation report (C3) 3. Prepare and present final project presentation slides (C3, C5) 4. Modify and Develop implementation in hardware/software or both in chosen platform (C3, C5) 5. Justify the methods used and obtained results (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	48	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-

Assessment	03	-
TOTAL	**51**	**09**

Assessment Methods:	
Formative:	**Summative:**
Project Problem Selection	Mid-Term Presentation
Synopsys review	Second status review
First status review	Demo & Final Presentation

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Mid Presentation	*	*			
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen project

Name of the Program:	Master of Engineering - ME (Automotive Embedded Systems)
Course Title:	Seminar - 1
Course Code: AES 697	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Communication Skill

Synopsis:	1. To select, search and learn technical literature. 2. To Identify a current and relevant research topic. 3. To prepare a topic and deliver a presentation. 4. To develop the skill to write a technical report. 5. Develop ability to work in groups to review and modify technical content.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Show competence in identifying relevant information, defining and explaining topics under discussion.
CO 2:	Show competence in working with a methodology, structuring their oral work, and synthesizing information.
CO 3:	Use appropriate registers and vocabulary, and will demonstrate command of voice modulation, voice projection, and pacing.
CO 4:	Demonstrate that they have paid close attention to what others say and can respond constructively.
CO 5:	Develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*							*	*		*
CO 2	*							*	*		*
CO 3	*							*	*		*
CO 4	*							*	*		*
CO5:	*							*	*		*

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	14	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	-	-
TOTAL	**14**	**-**

Assessment Methods:	
Formative:	**Summative:**
Seminar Topic Selection	
Synopsys review	
PPT Review	

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen Seminar

PROGRAM OUTCOMES (POS) AND COURSE OUTCMES (COS) MAPPING

Sl.No.	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1	CSE 602	Real Time Operating Systems	3	*	*	*	*							
2	ESD 605	Embedded Systems	3	*	*	*		*						
3	AES 601	Sensors and Transducers	3	*	*	*		*	*					
4	AES 602	Vehicular Adhoc Networks	3	*	*	*	*	*						
5	ESD-602	Microcontrollers and its Applications	3	*	*	*	*	*						
6	CSE-620	Linux and Scripting Languages	3	*	*	*	*							
7	CSE 602L	Real Time Operating Systems Lab	1	*	*	*		*						
8	ESD 605L	Embedded Systems Lab	1	*	*	*		*						
9	AES 601L	Sensors and Transducers Lab	1	*	*	*		*	*	*	*	*		*
10	AES 602L	Vehicular Adhoc Networks Lab	1	*		*	*	*					*	
11	ESD-602L	Microcontrollers and its Applications Lab	1	*	*	*		*						
12	CSE-620L	Linux and Scripting Languages Lab	1	*		*		*						
11	AES 695	Mini Project - 1	4				*	*	*	*	*		*	*
12	AES 697	Seminar - 1	1								*	*		*

Semester 2: ESIGELEC, FRANCE

Communication Buses

Module code: MSCAES01 Duration: 30h

Objectives: At the end of this module, students will be able to:

- Use the most widely used communication busses in the field of embedded processors
- Understand technical specifications
- Design and implement bus-based communication architectures
- Understand and implement different bus systems like CAN, I2C, SPI, LIN, etc.
- Design communication programming for different board and protocol

List of topics:

- RS-485
- I2C BUS, SPI BUS
- CAN BUS
- ARINC bus

ADAS and Automotive Electronic Systems

Module Code: MSCAES02 Duration: 46h

Objectives: At the end of this module, students will be:

- Able to design ADAS automotive system architecture
- Familiar with Driver Assistance System for Autonomous Vehicle
- Able to describe the EMC as a generic immunity and emission mechanisms of an electric/electronic vehicle
- Familiar with interaction traffic, vehicles and infrastructures

List of topics:

- ADAS Autonomous and Connected Driving:
  - Road safety
  - ADAS functions, Intellectual property and TRIZZ low
  - Lateral and longitudinal control
  - Autonomous driving, and Car2X
- ADAS Automotive Systems-based EMC:
  - Standards and regulations
  - EMC design, Mitigation techniques, Numerical simulation
  - Equipment validation, Vehicle validation, Future challenges
- Introduction to Highway Engineering and Traffic Analysis:
  - Vehicles and road infrastructures
  - Highway design
  - Introduction to traffic theory
  - Road transport system technologies
- Autonomous Vehicle:
  - Autonomous vehicle issues and how it works
  - Autonomous Driver (AD)
  - Sensors

Robotics and Localization

Module Code: MSCAES03 Duration: 30h

Objectives: At the end of this module, students will be:

- Familiar with mobile robotic architecture
- Able to control a mobile robot like Wifibot
- Able to design and implement navigation algorithm on a mobile robot
- Able to design and implement a localization algorithm based on odometry
- Able to implement localisation of a robot in a known and / or unknown environment

List of topics:

- Introduction to mobile and autonomous robotics
- Control software architectures:
  - Case study: the ESIGELEC VIKINGS robot (TOTAL ARGOS challenge)
- Location based odometry:
  - Project: Implementation of a Wifibot robot based on odometry
- Development of different projects using Wifibot and which has as application:
  - Mobile robot
  - Environment perception and navigation
  - Localization
  - Autonomous navigation

Embedded C Programming

Module Code: MSCAES04 Duration: 30h

Objectives: At the end of this module, students will be:

- Familiar with C coding practices for embedded systems
- Familiar with the parts and tools for embedded software validation
- Able to develop, write and test a C language program (as per design specifications) to be used with a microprocessor, in keeping with good practices like MISRA-C rules
- Able to analyse and enumerate the various phases of development for a software project: the V cycle
- Able to programme a microcontroller and develop embedded applications. These applications will deal with digital inputs/ outputs, analog signals and will create delays and time events by means of a hardware timer
- Able to apply techniques and rules to ensure software quality and best coding practices (A sizeable part of the course is devoted to programming the microcontroller)

List of topics:

- Specificities of C Language for embedded systems (variables, memory organization, physical address access, etc.)
- Introduction to embedded system and programming methods
- Software analysis and validation tools and principles for embedded systems
- C language for embedded systems
- Best coding practices
- Programming the MSP430 microcontroller

LabVIEW Programming

Module Code: MSCAES11 Duration: 30h

Objectives: At the end of this module, students will be able to:

- Use LabVIEW to create applications
- Understand front panels, block diagrams, and icons and connector panes
- Use built-in LabVIEW functions
- Create and save programs in LabVIEW so students can use them as subroutines
- Create applications that use plug-in DAQ devices. The application must respect standard LabVIEW practices (taken from the Certified LabVIEW Developer (CLD) test) and use a modular and evolving architecture
- Design a program with LabVIEW for an electrocardiogram that monitors real and "noisy" data. This program must:
    - Respect design standards
    - Use standard programming and signal processing tools seen in the 2nd year

List of topics:

- Fundamental programming notions in LabVIEW
- LabVIEW programming
- Creating an interface
- Learning good LabVIEW practices for form and structure in programming

VHDL Programming

Module Code: MSCAES12 Duration: 30h

Objectives: At the end of this module, students will be able to:

- Program logic devices (PLD) and develop programs using VHDL language
- Design Finite State Machines (FSMs) in VHDL.
- Use the Xilinx ISIM simulator
- Synthesize a VHDL design and program the resulting bitstream in a FPGA
- Understand the different design flows for the design, verification and test of logic designs using VHDL as the design language and a FPGA as the final target device

List of topics:

- Review of combinatory and sequential logic
- The different families of programmable logic devices
- Practice with synthesis tools (Xilinx or Altera targets, Quartus or ISE tools, Modelsim)

Embedded Linux

Module Code: MSCAES07 Duration: 30h

Objectives: At the end of this module, students will:

- Be familiar with the uses of the Linux kernel for an embedded IT project
- Be familiar with principle software tools used in the Linux/Unix world and how to use them to develop
- Be able to write a device driver for specific Linux run material
- Be able to combine tools to create advanced functions with a minimum of programming

List of topics:

- Introduction to Linux
- How an OS fits in an embedded system
- History of Linux and Unix systems
- Linux compared to other embedded operating systems
- Fundamental tools: command lines, shell scripts
- Linux development tools
- C programming with embedded systems
- Linux drivers
- Web connections and Remote Administration Tools (RATs)

Biomedical Imaging & Biomedical Signal Processing

Module Code: MSCAES05 Duration: 30h

Objectives: At the end of this module, students will be:

- Familiar with medical images used in clinics and hospitals, including a description of physical phenomena

List of topics:

- Image processing and signal analysis
- Introduction of Fourier transforms features of medical images within Matlab introduction
- Ultrasound images basic theory of acoustic waves reflection and transmission, ultrasonic arrays, formation of images in B mode, other techniques of ultrasonic imaging:
  - Doppler
  - Agents of contrast
  - Elastography
- X-ray images, radiography images and computed tomography
- Magnetic resonance images

EMC Automotive System

Module Code: MSCAES06 Duration: 30h

Objectives: At the end of this module, students will:

- Be familiar with EMC System architecture
- Be familiar with Integrity signal and how to calculate it
- Be familiar with EMC of components and how to protect electronic system
- Be familiar with near field and interactions with the environment

List of topics:

- EMC Integration
- Integrity Signal (IS)
- EMC of Components
- EMC Measurement tools:
    - Test facilities
    - Instrumentation
- EMC Tests on an Automotive equipment in reverberation chamber
- Near-field
- European requirements and associated tests

Project

Module Code: MSCAESPRJ Duration: 100h

Objectives: At the end of this module, students will be able to:

- Design, develop and realize an embedded system in mobile robotics and automotive systems
- Develop technical solutions - hardware and software
- Test the platform developed
- Develop and carry out an embedded system platform successfully and learn how to manage a technical project

List of topics:

- Project Management:
  - Benchmarking study
  - Technical and Functional specifications
  - Architecture Design and Risk analysis
  - Test protocol
- Technical Development:
  - Image processing and computer vision systems
  - Image segmentation
  - Pattern recognition
  - Object detection and tracking
  - Artificial Intelligence and Deep Learning Applications for mobile robotics and automotive
  - Dataset collection
  - Mobile robotics and autonomous navigation
  - IoT and sensors
  - Smart mobility

Project Management

Module Code: MSCAESPRMG Duration: 26h

Objectives: At the end of this module, students will:

- Be familiar with the importance of project management, including formal methods, as a recognized discipline. They will also understand the complexities of different types of computing projects and methods to manage them
- Appreciate the need to break up complex projects
- Appreciate the need for effective planning, monitoring & control mechanisms
- Appreciate the need for formal project management organizational structures
- Appreciate the importance & management of stakeholders in an international project
- Be able to apply some of the skills and knowledge acquired, in any future project and, in particular, documentation for development project
- Appreciate the complexity of a technical project and the need for formal methods

List of topics:

- What is a project? The need for Project Management, formal methods
- Managing large, complex, international projects
- Un peu de franglais (Project Management culture and language in English and in French)
- Management of projects, project life cycle, roles of the project manager and stakeholders
- Stakeholder management, scope, creep
- Work planning, project breakdown structures and estimating
- Resource planning, estimating, management ◌ Risk identification, analysis, management
- PERT and Gantt charts, their use and shortcomings
- Project Management planning tools (including practical sessions with MS Project)
- Change control, documentation, configuration management
- Project control, quality, documentation, delivery management
- Project closure; maintenance projects

- Types of computing projects and risks; computing Project Management methods
- Cost-benefit analysis and project accounting may be touched upon, but are not in the scope of this course

Automotive Safety Systems

Module Code: MSCAES08 Duration: 25h

Objectives: At the end of this module, students will:

- Be familiar with the role EMC phenomena play in the field of embedded systems, by studying automotive examples
- Be able to design and develop automotive embedded systems
- Be able to verify mechatronics and electromagnetic compatibility constraints in the development
- Be able to design a functional safety system

List of topics:

- EMC (Electromagnetic Compatibility) issues for electronics
- Cause and effect
- Prevention and solutions
- The automotive field: an overview

Bibliographical Studies

Module Code: MSCAES09 Duration: 15h

Objectives: At the end of this module, students will be familiar with:

- State of the art technologies relate to the autonomous vehicle:
  - Mobile robotics, sensors, deep learning applications
  - Mobile robot localization
- Issues related to testing and validation of autonomous vehicles
- How to conduct a presentation on a technical subject, given at the beginning of the semester
- How to acquire basic skills and methods about information searching and final presentations
- Information searching and final presentation

List of topics:

- Team working
- Information searching
- Final presentation

Oral Communication

Module Code: MSCAES10 Duration: 14h

Objectives: At the end of this module, students will:

- Have a clear model of what constitutes successful and unsuccessful presentations
- Have practiced giving formal presentations in English
- Be more aware of their own shortcomings when presenting
- Practice and perfect final presentation skills
- Learn the importance of structure and how formal prepared speech differs from everyday social interactions
- Work with their presenting strengths and weaknesses via several short practice presentations and a final (individual and/or group) presentation

List of topics:

- Methods for creating a final presentation
- Practice

French Language 2

Module Code: MSCAESLANG Duration: 64h

Objectives: At the end of this module, students will be able to:

- Understand standard French used in everyday situations at work, school, etc. (Oral comprehension)
- Understand texts written in standard French used in everyday situations such at work, school, etc. (Written comprehension)
- Participate in a regular day-to-day conversation on familiar topics (Oral expression)
- Ask and exchange information (Oral expression)
- Prepare and give a short formal presentation (Oral expression)
- Write short, clear and coherent texts on familiar/everyday situations with basic grammar and vocabulary (Written expression)

List of topics:

- Revision of grammar and vocabulary
- Preparation for the Test of French Language (TCF or TEF)