Savitribai Phule Pune University

Faculty of Science and Technology

Honors* in major Disciplines Board of Studies (Electronics & Telecommunication)

(Course 2019)

(w.e.f. June 2022)

Savitribai Phule Pune University
Board of Studies (E&TC Engineering)
With effect from June 2022

Honors* in Automotive Electronics

Course Code	Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks						Credit Scheme		
		Theory	Tutorial	Practical	In-Semester	End-Semester	Term work	Practical	Presentation	Total Marks	Theory / Tutorial	Practical	Total Credit
304181HAE	Basics of Automotive Systems	04	--	--	30	70	--	--	--	100	04	--	04
304182HAE	Basics of Automotive Systems Laboratory	--	--	02	--	--	50	--	--	50	--	01	01
	Total	04	-	02	100		50	-	-	150	04	01	05
										Total Credits = 05			
304183HAE	Automotive Software Systems	04	--	--	30	70	--	--	--	100	04	--	04
	Total	04	-	-	100		-	-	-	100	04	-	04
										Total Credits = 04			
404181HAE	Automotive Embedded Systems	04	--	--	30	70	--	--	--	100	04	--	04
404182HAE	Automotive Embedded Systems Laboratory	--	--	02	--	--	50	--	--	50	--	01	01
	Total	04	-	02	100		50	-	-	150	04	01	05
										Total Credits = 05			
404183HAE	Automotive Communication Technologies	04	-	--	30	70	--	--	--	100	04	--	04
	Seminar	--	02	--	--	--	-	--	50	50	02	--	02
	Total	04	-	02	100		-	--	50	150	06	-	06
										Total Credits = 06			
Total Credit for Semester V+VI+VII+VIII = 20													

Savitribai Phule Pune University

Honors* in Automotive Electronics

Third Year of Engineering (Semester V)

304181HAE: Basics of Automotive Systems

Teaching Scheme	Credit	Examination Scheme
Theory: 04 Hours/Week	**04**	**In_Semester (TH): 30 Marks** **End_Semester (TH): 70 Marks**

Companion Course, if any: Basics of Automotive Systems Laboratory

Course Objectives:

The main objective of this course is to introduce the students to basics of Automotive Systems.

- To understand the role of electrical and electronics in automotive systems
- To be acquainted with interfacing of sensors and actuators in automotive systems
- To evaluate the impact of different transportation technologies on environment & energy supply

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Get introduced with fundamental concepts, principles, analysis and design of automobiles

CO2: Understand the need of electronics in automotive systems

CO3: Understand the sensors and their interfacing in automotive systems

CO4: Understand the role of actuators in automotive systems

CO5: Become familiar with the fundamental theory of operation of electronic control systems

CO6: Evaluate the impact of different transportation technologies on environment & energy supply

#Exemplar/Case Studies- Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. Exemplar/Case Studies may be assigned as self-study by students and to be excluded from theory examinations.

Course Contents

Unit I	**Automotive Systems Overview**	**(08 Hours)**

Overview of Automotive Industry, Global challenges, Role of technology in Automotive Electronics and interdisciplinary design. Introduction to Modern Automotive Systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles. Introduction to Electronic systems in Automotive.		
Unit II	**Sensors in Automotive Systems**	**(07 Hours)**
Sensors in powertrain: Throttle position sensor, Manifold absolute pressure sensor, Mass air flow sensor, EGO sensor, engine RPM sensor, Crankshaft position sensor, Coolant temperature sensor **Sensors in body electronics and chassis systems:** Accelerometers, Hall effect sensor, RADAR, LiDAR, Ultrasonic sensor, Infrared sensor		
#Exemplar/Case Studies	Hardware implementation example of automotive systems using Sensors	
Unit III	**Actuators in Automotive Systems**	**(09 Hours)**
Fuel Injection system, EGR, Electronic Fuel Ignition, Actuators in automotive systems like Automotive relays, DC motors, Stepper motors, Servo motors, Piezoelectric actuators, Solenoid valves, Hydraulic actuators		
Unit IV	**Automotive Control Systems**	**(08 Hours)**
Powertrain and transmission domain: Electronic Engine management, Transmission control, Adaptive Cruise Control, etc., Chassis control domain: Antilock braking system, Electronic stability program, Traction Control, Active Suspension, Passive safety		
Unit V	**Automotive Electrical Systems**	**(08 Hours)**
Electrical circuits and wiring in vehicles, Power supply: types, characteristics, selection criteria, Battery types, Battery Parameters, Technical characteristics. Alternators in vehicles, Starter motors, Automotive alarms, Lighting		
Unit VI	**Electric and Hybrid Vehicles**	**(08 Hours)**
Difference between Hybrid Electric Vehicles and Conventional Vehicles, An Overview Hybrid Electric Drive-trains and Electric Drive-trains, Introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, and fuel efficiency analysis, social and environmental importance of hybrid and electric vehicles		
#Exemplar/Case Studies	Impact of modern drive-trains on energy supplies.	
Learning Resources		
Text Books: 1. Bosch, “Automotive Electrics and Automotive Electronics. System and components, Networking and Hybrid drive”, Fifth edition, Springer view 2014 2. William B. Ribbens, “Understanding Automotive Electronics” Sixth Edition, Elsevier Newnes.		

Reference Books:

1. Najamuz Zaman, "Automotive Electronics Design Fundamental'' first edition, Springer.
2. Hillier's, "Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics", Fifth Edition, Nelson Thrones.

Savitribai Phule Pune University

Honors* in Automotive Electronics

Third Year of Engineering (Semester V)

304182HAE: Basics of Automotive Systems Laboratory

Teaching Scheme	Credit	Examination Scheme
Theory: 02 Hours/Week	**01**	**Examination Scheme and Marks** **Term Work: 50 Marks**

Companion Course, if any: Basics of Automotive Systems

Course Objectives:

The main objective of this course is to introduce the students to basics of Automotive Systems through practical approach.

- To be acquainted with interfacing of sensors and actuators in automotive systems
- To understand the role of electrical and electronics in automotive systems

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the sensors and their interfacing in automotive systems

CO2: Understand the role of actuators in automotive systems

CO3: Become familiar with the fundamental theory of operation of electronic control systems

Guidelines for Laboratory Conduction

Lab Assignments: Following is list of suggested laboratory assignments for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the

perspective of the learners. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.

Term Work: Term work is continuous assessment that evaluates a student's progress throughout the semester. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct internal monthly practical examination as part of continuous assessment.

Assessment: Student's work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

Laboratory Journal: Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students' programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Suggested List of Laboratory Experiments/Assignments

Student should perform at least 6 experiments

(Use suitable programming language/Tool for implementation)

Sr. No.	Title of the Experiment
1.	Interface hall effect sensor & accelerometer on simple target like Arduino, Raspberry Pi
2.	Implement a simple data acquisition system for the steering angle.
3.	Perform software transfers, software updates, or flash reprogramming on ECU
4.	Interface Ultrasonic sensor with Arduino and display its reading on 16x2 LCD display
5.	Test and diagnose components of electronically-controlled steering systems using a scan tool and determine necessary action
6.	Write an embedded C program on 32-bit microcontroller for Stepper motor control

7.	Design the battery monitoring system using 32-bit microcontroller
8.	Check for module communication (including CAN/BUS systems) errors using a sca

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Honors* in Automotive Electronics

Third Year of Engineering (Semester VI)

304183HAE: Automotive Software Systems

Teaching Scheme	**Credit**	**Examination Scheme**
Theory: 04 Hours/Week	**04**	**In_Semester (TH): 30 Marks** **End_Semester (TH): 70 Marks**

Companion Course, if any:

Course Objectives:

The main objective of this course is to introduce the students to basics of Automotive Software Systems.

- To equip students with the skills needed to understand, design and assess automotive systems
- To introduce students to MATLAB and Simulink, industry-standard CAD tools
- To understand, design and model various automotive control systems using MBD and Autosar

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Analyse the components of an automotive control systems and its implementation

CO2: Apply different advanced control techniques to automotive control problems

CO3: Design control algorithms for automotive systems using MATLAB and Simulink

CO4: To understand physical modelling applied to vehicles mechatronic systems

CO5: To conceptualize automotive electronic technologies for future

CO6. Interpret the purpose of the ISO26262 functional safety standard and the AUTOSAR standardized automotive software design

#Exemplar/Case Studies- Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. Exemplar/Case Studies may be assigned as self-study by students and to be excluded from theory examinations.

Course Contents		
Unit I	**Automotive control systems**	**(08 Hours)**
Basic Control System Theory: Development of control algorithms for different automotive subsystems, Control systems in powertrain, need of maps, Procedure to generate maps, Fuel-maps / tables, Ignition maps / tables, Engine calibration, Torque table, Dynamometer testing.		
Unit II	**Model based development**	**(07 Hours)**
Software Development demands in Automotive Industry, Automotive Control System & Model Based Development, Introduction to Model based Development in MATLAB Environment, Requirement's analysis, Exploring the system response using different control methods, Tuning the system, Exploring system limitations		
Unit III	**MBD Validation Techniques**	**(09 Hours)**
MATLAB Automotive Advisory Board Process Overview, Simulation & Code Generation, Model in Loop Testing & Validation, Software in Loop Testing & Validation, Hardware in Loop Testing & Validation		
Unit IV	**Autosar Architecture**	**(08 Hours)**
Autosar Basics, System-level architectures & examples, Autosar Software Components & Application Layer, Autosar architecture, Autosar basic Software Layer, Autosar MCAL Layer, Autosar Services Layer, Autosar Diagnostics, Autosar Memstack, Autosar RTE		
Unit V	**Modelling Autosar compliant systems**	**(08 Hours)**
Autosar Complex Drivers, Autosar OS & C Rules, Modelling Autosar SWCs in MATLAB, Embedded Coder vs Autosar Coder, Autosar Editor – Code Mapping		
#Exemplar/Case Studies	Design & development of AUTOSAR complaint microcontroller abstraction layer for Freescale PowerPC controller	
Unit VI	**Functional safety**	**(08 Hours)**
Automotive functional safety, Overview of ISO26262, Different safety standards & levels, SW Architectural descriptions for functional safety, Hazard & Risk Analysis and determination of ASILs, Futuristic trends in automotive electronics		
#Exemplar/Case Studies	Modelling, simulation and implementation of Automotive systems (Cruise control of car, Artificial Intelligence based ADAS system, and Engine management system)	
Learning Resources		
Text Books:		

1. G. Meyer, J. Valldorf and W. Gessner: "Advanced Microsystems for Automotive Applications", Springer.
2. Allan Bonnick: "Automotive Computer Controlled Systems, Diagnostic Tools and Techniques", Elsevier Science.
3. AUTOSAR Documentation [on line]. Available on: www.autosar.org

Reference Books:

1. Tao Zhang, Luca Delgrossi, "Vehicle Safety Communications: Protocols, Security and Privacy", Wiley Publication.
2. Uwe Kieneke and Lars Nielsen: "Automotive Control Systems: Engine, Driveline and Vehicle", 2nd Edition, Springer Verlag.
3. Miroslaw Staron, "Automotive Software Architectures: An Introduction", Springer

Savitribai Phule Pune University

Honors* in Automotive Electronics

Fourth Year of Engineering (Semester VII)

404181HAE: Automotive Embedded Systems

Teaching Scheme	**Credit**	**Examination Scheme**
Theory: 04 Hours/Week	**04**	**In_Semester (TH): 30 Marks** **End_Semester (TH): 70 Marks**

Companion Course, if any: Automotive Embedded Systems Laboratory

Course Objectives:

Within the context of modern automotive control system, the aim of this course is to critically evaluate the different technologies and methods required for the efficient vehicle implementation, validation and verification of the automotive embedded system.

- To learn and understand the basics of Automotive Embedded systems
- To conduct a review of modern automotive control hardware requirements and architectures
- To design embedded systems for automotive applications

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Develop, simulate and integrate control algorithms for ECUs with hardware

CO2: Understand techniques essential to the design and implementation of automotive embedded systems using suitable hardware and software tools

CO3: Interface devices and build a complete automotive control system

CO4: To evaluate safety standards, advances in towards autonomous vehicles, vehicle on board and off board diagnostics in today's automotive industry

CO5: Get strong familiarity with Serial & Automotive Protocols and its debugging skills

CO6: Identify the problems in vehicle by reading DTC using OBD Tools & Equipment

#Exemplar/Case Studies- Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. Exemplar/Case Studies may be assigned as self-study by students and to be excluded from theory examinations.

Course Contents

Unit I	**Basics of Automotive Embedded Systems**	**(08 Hours)**

Automotive Embedded systems, Introduction to functional building blocks of automotive embedded systems, Criteria to choose the right microcontroller/processor for various automotive applications, Overview of ECU operation, ECU Design Cycle: V-Model development cycle, Components of ECU, Examples of ECU on chassis, and in body electronics, infotainment and clusters.

Unit II	**Automotive Microcontrollers**	**(07 Hours)**

Overview of automotive grade processors, understanding various architectural attributes relevant to automotive applications, understanding various architectural attributes relevant to automotive applications, Study of Automotive grade processors viz. Renesas, Quorivva, ARM and Infineon, Understanding and working on tool-chains for different processors.

Unit III	**Tools and Technologies in Automotive Embedded Systems**	**(09 Hours)**

Introduction to Development Tools and Environment: Programmers, Debuggers, Emulators, Simulators, Development Board, Understanding Automotive Product Design Cycle, Introduction to Software Development Life Cycle, Types of Software Development Life Cycle, Overview of MISRA C and ISO 26262 industry standard.

Unit IV	**Vehicle Diagnostics**	**(08 Hours)**

Electronic transmission checks and Diagnosis, Diagnostic procedures and sequences, Fault Codes, Vehicle Systems On- and Off- Board Diagnostics, OBD-I, OBD-II, Diagnostic tools, Engine Analysers, Diagnostics Protocols & Standards

#Exemplar/Case Studies	Implementing Application Prototype: Power windows and automotive lighting system, A Case Study of On-Board Diagnostic for Engine Management System, Illustration of how OBD Functions in the Catalyst Monitoring system	
Unit V	**Advanced Driver Assistance Systems**	**(08 Hours)**
Basic ADAS System Operation, Sensor Technology for Advanced Driver Assistance Systems, Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems		
Unit VI	**Intelligent Transportation Systems**	**(08 Hours)**
Vehicle-to-X (V2X) Communication for Intelligent Transportation Systems (ITS), Safety and non-safety applications, Use cases, Network service requirements of different applications, V2X communication regimes, Standards and Technologies		
#Exemplar/Case Studies	Collision avoidance systems using V2X communication, Vehicle to Pedestrian communication system, Social acceptance of autonomous vehicles, Use of deep learning for obstacle avoidance	

Learning Resources

Text Books:

1. William B. Ribbens, “Understanding Automotive Electronics- An Engineering Perspective”, Seventh edition, Butterworth-Heinemann Publications.
2. Ronald K. Jurgen, “Automotive Electronics Handbook”, Mc-Graw Hill.
3. James D. Halderman: “Automotive Electricity and Electronics", PHI Publication.

Reference Books:

1. Kiencke, Uwe, Nielsen & Lars, “Automotive Control Systems for Engine, Driveline and Vehicle”, Second edition, Springer Publication.
2. Tao Zhang, Luca Delgrossi, “Vehicle Safety Communications: Protocols, Security and Privacy”, Wiley Publication.
3. Allan Bonnick: “Automotive Computer Controlled Systems, Diagnostic Tools and Techniques”, Elsevier Science.
4. Robert Bosch,” Automotive Hand Book”, Fifth edition, SAE Publications.

Fourth Year of Engineering (Semester VII)

404182HAE: Automotive Embedded Systems Laboratory

Teaching Scheme	Credit	Examination Scheme
Theory: 02 Hours/Week	**01**	**Examination Scheme and Marks** **Term Work: 50 Marks**

Companion Course, if any: Automotive Embedded Systems

Course Objectives:

The main objective of this course is to introduce the students to automotive embedded systems through practical approach.

- To learn and understand the basics of Automotive Embedded systems
- To learn and understand the various application of electronics systems and ECU in automotive
- To analyse various embedded products used in automotive industry
- To understand, design and model various automotive control systems using Model based development techniqu

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Develop, simulate and integrate control algorithms for ECUs with hardware

CO2: Understand the networking of various modules in automotive systems and communication protocols of interfacing different electronics components, systems and functional counterparts.

CO3: To interface devices and build a complete automotive control system

Guidelines for Laboratory Conduction

Lab Assignments: Following is list of suggested laboratory assignments for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.

Term Work: Term work is continuous assessment that evaluates a student's progress throughout the semester. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct internal monthly practical examination as part of continuous assessment.

Assessment: Student's work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

Laboratory Journal: Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students' programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Suggested List of Laboratory Experiments/Assignments

Student should perform at least 6 experiments

(Use suitable programming language/Tool for implementation)

Sr. No.	Title of the Experiment
1.	Study of 32-bit automotive grade controller board. Writing code in IDE. Flashing code & testing.
2.	Build a model of an Engine Management System in Simulink and SimDriveline.
3.	Implement an ADAS system for detecting driver drowsiness using computer vision
4.	Implement any one application prototype from below: Adaptive cruise control, Power windows and automotive lighting system, etc. in Simulink
5.	Write a program in embedded C for Sensing Engine Speed, Load and Temperature.
6.	Develop the Simulink model for servo motor control and download on target like Arduino, raspberry Pi, etc.
7.	Develop a Transistorized Ignition Driver model using MATLAB script

8.	Develop the data acquisition system for capturing LiDAR sensor data

Savitribai Phule Pune University

Honors* in Automotive Electronics

Fourth Year of Engineering (Semester VIII)

404183HAE: Automotive Communication Technologies

Teaching Scheme	**Credit**	**Examination Scheme**
Theory: 04 Hours/Week	**04**	**In_Semester (TH): 30 Marks** **End_Semester (TH): 70 Marks**

Companion Course, if any:

Course Objectives:

The main objective of this course is to introduce the students to basics of Automotive Communication Technologies.

- To learn the basics of Automotive communication
- To understand various topologies of automotive communication system
- To evaluate the impact of intelligent vehicles on transportation

Course Outcomes:

On completion of the course, learner will be able to–

CO1: To understand the need of automotive communication protocols

CO2: Understand the interface of ECUs with the vehicle data bus networks and sensors

CO3: Identify the type of sensor technology needed to implement remote sensing

CO4: Understand the fundamentals of sensor data fusion as it relates to ADAS

CO5: Become familiar with modern vehicle display/cluster technology

CO6: Understand the connected vehicle concept and its role in ADAS and Autonomous vehicles

#Exemplar/Case Studies- Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. Exemplar/Case Studies may be assigned as self-study by students and to be excluded from theory examinations.

Course Contents

Unit I	**Introduction to Vehicle Networking**	**(08 Hours)**

Need of automotive communication protocols, Overview of automotive communication protocols: CAN, LIN, FlexRay, MOST, Ethernet, D2B and DSI. Communication interface with ECUs		
Unit II	**Testing and Calibration Tools**	**(07 Hours)**
Test, Calibration and Diagnostics tools for networking of electronic systems like ECU Software and Testing Tools, ECU Calibration Tools, Vehicle Network Simulation, Troubleshooting and Maintenance of Advanced Driver Assistance		
Unit III	**Remote Sensing Technology**	**(09 Hours)**
Environment Perception, Collision warning and avoidance, Radar & Sonar, Lidar – Multiple Beam, Cameras & Night Vision, Model Creation & Sensor Data Fusion, Standards of remote sensing		
Unit IV	**Telematics and Infotainment Systems**	**(08 Hours)**
Application of telematics in automotive domain, Global positioning systems (GPS) and General packet radio service (GPRS), Applications of Infotainment Systems, Realizing bus interfaces for diagnostics, dashboard display, multimedia electronics		
Unit V	**Wireless Networks**	**(08 Hours)**
Basic Networking Concepts: Wireless Networking Fundamentals, Relevance of Protocols such as TCP/IP for automotive applications, Wireless LAN standards for automotive applications, IEEE 802.1x, and Cellular communication, Protocols and IP Addressing, Connection of On-Board Networks to Off-Board, Review of On-Board Networks		
#Exemplar/Case Studies	International standards of wireless networking in vehicles, Use of off-board networks, IoT for automotive navigation safety, Study of Fleet management systems	
Unit VI	**V2V communications and Connected Cars**	**(08 Hours)**
Connectivity Fundamentals: Navigation and Other Applications, Vehicle-to-Vehicle (V2V), Vehicle-to-Roadside (V2R), Vehicle-to-Infrastructure (V2I), Wireless Security Issues		
#Exemplar/Case Studies	Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues and Security Issues in autonomous vehicles, E-Mobility Business Models	
Learning Resources		
Text Books: 1. Ronald K. Jurgen, "Automotive Electronics Handbook", Mc-Graw Hill. 2. Tao Zhang, Luca Delgrossi, "Vehicle Safety Communications: Protocols, Security and Privacy", Wiley Publication.		
Reference Books:		

1. Terence Rybak, Mark Stefika: “Automotive Electromagnetic Compatibility (EMC)”, Springer.
2. L.Vlacic, M.Parent, F.Harahima, “Intelligent Vehicle Technologies”, SAE International.
3. John. P. Haryes, “Computer Architecture and Organisation”, Tata McGraw Hill
4. William Stallings, “Data and Computer Communication”, PHI

Savitribai Phule Pune University

Honors* in Automotive Electronics

Fourth Year of Engineering (Semester VIII)

Seminar

Teaching Scheme	**Credit**	**Examination Scheme**
Tutorial: 02 Hours/Week	**02**	**Examination Scheme and Marks** **Presentation: 50 Marks**

Companion Course, if any:

Course Objectives:

The main objective of this course is to make students learn and understand automotive technology through technical presentations and reports in course lab projects.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Demonstrate effective communication and teamwork skills through technical presentations and reports in course lab projects

Student shall prepare a brief seminar report and presentation on the assigned topic. Hardcopy of seminar report along with similarity report shall be submitted after successful presentation and viva .