GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering Syllabus

Subject Code : 3716405

Subject Name : Automotive Embeded System

WEF Academic Year :	2023 - 24
Semester :	1
Category of the Course :	Program Elective II

Prerequisite : Knowledge of basic electronics and vehicle controls.

Rationale : In today's era, use of EV is increasing rapidly. New technologies are coming up for performance and better experience of the user. Embedded systems are used for many tasks in automotive applications like engine control, locking, EMB, power control, battery management and many more. In this context, it is necessary to introduce some concepts of Embedded Systems with reference to automotive applications. This course briefly introduces all these concepts and introduces some automotive embedded system development tools.

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content :

Sr. No.	Content	Total Hrs.
1	**Electronics in Automotive Applications :** ECU for IC engines, Sensors and Actuators for body electronics, power train and chassis systems, - Automotive alarms, Lighting, power steering, ABS, Central locking and electric windows, Climatic Control, Driver information, Parking, etc. Tire pressure monitoring system (TPMS), Electro-mechanical braking (EMB)	4
2	**Electronics in EV :** EV Power train and chassis control, dc-dc converters and different sub systems of EV, ABS, Traction Control, Active Suspension, Adaptive Cruise Control, regenerative breaking of EV, Battery management systems and data communication	4
3	**Automotive Hardware and Software Standards :** International standard for the functional safety of automotive electrical and electronic (E/E) systems- ISO 26262 certification, MISRA C, MISRA C++ and the AUTOSAR C++ coding standards, Functional safety standard ASIL C, ASIL D standards. AEC Q 100, AEC Q 101 etc. for hardware components.	4

4	**Automotive Grade microcontrollers :** TI Automotive C2000 microcontrollers, ST Stellar 32-bit MCU family, Architecture of these microcontrollers, their comparison etc.	4
5	**Automotive C2000** Detailed architecture of TI TMS320C283x, On chip system peripherals like GPIO, ADC, DAC, On chip communication peripherals like CAN, LIN, I2C, FSI, SCI etc., Control peripherals like ePWM, Capture module, CLB etc., Interfacing of C2000 with external hardware, Code Composer Studio IDE, Embedded C programming of C2000 Application study	20
6	**Communication protocols for Automobile Applications :** Various communication protocols for vehicle applications like J1850, CAN, LIN, Time Triggered Protocol (TTP) etc., Their characteristics and comparison	6

Suggested Specification table with Marks (Theory) :

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**20**	**20**	**10**	**-**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books :

(1) Bosch, "Automotive Electrics and Automotive Electronics. System and components, Networking and Hybrid drive", Fifth edition, Springer view 2014
(2) Najamuz Zaman, "Automotive Electronics Design Fundamental" first edition, Springer 2015.
(3) Hillier's, "Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics", Fifth Edition, Nelson Thrones, 2007.
(4) Ronald K Jurgen, "Automotive Electronics Handbook"; McGraw Hill, 2nd edition 1999
(5) Ljubo Vlacic, Michel Parent & Furnio Harshima, "Intelligent Vehicle Technologies: Theory and Applications", Butterworth-Heinemann publications 2001
(6) "Automotive Embedded Systems Handbook", CRC press, Edited by Nicolas Navet and Françoise Simonot-Lion
(7) Hillier's, "Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics", Fifth Edition, Nelson Thrones, 2007.
(8) William B. Ribbens, "Understanding Automotive Electronics" Sixth Edition, Elsevier Newnes, 2002.

Course Outcomes :

Sr. No.	CO statement After studying this subject, the student will be able to	Marks % weightage	Topics Mapped
CO-1	Understand use of electronics in automotive applications.	15	1
CO-2	Explain requirements of electronics in Electric Vehicles.	15	2
CO-3	Explain automotive hardware and software standards.	20	3
CO-4	Select embedded system components and development tools for Electric Vehicle.	25	4,5
CO-5	Design hardware and software interface for automotive applications.	25	5,6

Suggested List of Experiments :

The experiments can be based on the following themes.

- Introduction to CCS IDE for C2000.
- Programming exercise for GPIO, Timers, ADC,DAC, CAN, LIN, LCD TFT displays, capacitive touch screen, ePWM unit.
- Programming Exercise for intermodular data communication

List of Open-Source Software/learning website :

- Web site of Texas Instruments - www.ti.com
- Web Site of ST - https://www.st.com/en/automotive-microcontrollers/stellar-32-bit-automotive-mcus.html#tools-software
- Swayam- https://swayam.gov.in/
- NPTEL- https://onlinecourses.nptel.ac.in/
- Mooc- http://mooc.org/
- Edx - https://www.edx.org/
- Coursera- https://www.coursera.org/
- Udacity - https://in.udacity.com/
  Udemy - https://www.udemy.com/

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