SLOT: C2

VIT
Vellore Institute of Technology

Vellore – 632014, Tamil Nadu, India

SCHOOL OF ELECTRONICS ENGINEERING

FALL SEMESTER 2025-2026, CAT-1

Programme: M.Tech	Branch: Embedded Systems	Course code: MAEDS504
Course Name: In Vehicle Networking		Date:
Class Nbr: 5669	Max Marks: 50	Duration: 90 mins
Faculty name(s): Dr. Arun M		

General instruction(s): 1. Answer ALL the Questions

1. For the given CAN message frame,
000010011101000100001010100001001111000000000000000000000000000000000
0000000000000000101110101010100110111111111111

   I) Identify the type of CAN message frame and specify its version (Standard or Extended).
   II) Label and describe all parts of the CAN message frame.
   III) Apply bit-stuffing to the CAN message frame according to the CAN protocol rules. (10 Marks)

2. a)I) In the scenario where a car is parked and locked, describe the role of Terminal 15 and Terminal 30.
   II) In the scenario where a crash occurs while the car is parked, explain how the airbag system is powered, detects the impact, and actuates, highlighting the functions of Terminal 15 and Terminal 30. (5 Marks)

   b) I) Explain the role and purpose of Complex Drivers in the AUTOSAR architecture. II) Compare and discuss the upper-layer dependencies of Complex Drivers with other components in the Basic Software (BSW) module. (5 Marks)

3. Differentiate between the OSI reference model and the TCP/IP model, highlighting key similarities and differences. Discuss the layers from these models that are relevant to the CAN protocol, explaining their specific functions in CAN communication.(10 Marks)

4. Explain the Medium Access Control (MAC) protocol used in Ethernet communication. Discuss the implementation and importance of the back-off mechanism.(10 Marks)

5. I) A total bandwidth of 10 MHz is available for an FDMA system. Each channel requires 25 kHz including guard bands. How many users can be supported simultaneously?

   II) Define Jitter and latency with example. (2+3 Marks)

6. I) Explain the concept and working principle of the Cyclic Redundancy Check (CRC). Discuss the robustness of CRC in detecting single-bit errors, odd-numbered errors, and burst errors

   II) What is the significance of wired AND and 12 ohm resister? (3+2 Marks)

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

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CAT-2

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General instruction(s): 1. Answer ALL questions

1. How do reference messages and time-triggered slots enable deterministic communication? Illustrate with an example where 3 messages are scheduled in a 10 ms basic cycle at 1 ms, 5 ms, and 8 ms. Draw a timeline for a 30 ms observation window. Explain the concept of the Basic Cycle in TTCAN.

2. Using PGN F004h (61444, EEC1) with Source Address = 0x00 (Engine #1), construct the CAN ID. Why does the engine usually have SA = 0x00? Describe the structure of the 29-bit CAN ID in J1939.

3. In LIN, why does the Master node use a 1 kΩ + 2.2 nF resistor-capacitor pair, while a Slave node uses a 30 kΩ + 220 pF pair?

4. How are synchronous, asynchronous, and control channels separated? Give an example of audio playback with volume control, and OBD. Explain the structure of MOST25 frames.

5. Explain how IEEE 802.1AS (time synchronization) and IEEE 802.1Qbv (time-aware scheduling) in TSN ensure deterministic delivery. Use an ADAS camera example.

X/K/TY

Reg. No: 23MEC013

Final Assessment Test – November 2025

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Course: MAED5504 - In Vehicle Networking
Class NBR(s): 5669
Time: Three Hours

Slot: C2+TC2+TCC2
Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Infer the need for data communication, networking, and Automotive Software AUTOSAR in practical in-vehicle communication systems.
CO2	Implement CAN and its higher-layer protocols, including CANopen, DeviceNet, TTCAN, and SAE J1939, in automotive applications.
CO3	Differentiate the functionalities of the LIN, MOST, and FlexRay protocols in various automotive applications.
CO4	Examine the role of automotive Ethernet and TSN technologies in modern vehicle communication systems
CO5	Analyze the effectiveness of wireless communication technologies, general purpose networking protocols -TCP/IP, UDP, and V2X in connected vehicle systems.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

1.	With reference to OSI reference model, Compare the In-vehicle networking protocols CAN and higher layer CAN protocols with examples.	CO1	BL2
2.	Differentiate between *FDMA*, *TDMA*, and *CDMA* in terms of channel allocation, bandwidth usage, and synchronization requirements. Include one advantage and one disadvantage of each technique.	CO1	BL2
3.	An interface for a CAN communication system provides a generic API to access CAN networks, regardless of the number of CAN controllers within an ECU. Explain how network independence is achieved and defined within the AUTOSAR software abstraction layers.	CO1	BL3
4.	Explain how **bit stuffing** works in the CAN protocol. Why is it necessary, and which fields are exempt from bit stuffing?	CO2	BL2
5.	Explain the **communication principle of the LIN protocol**. Describe the roles of **Master** and **Slave nodes**, and the significance of the **header and response frames**.	CO3	BL2

6.	A network experiences jitter and delay in transmitting sensor data over Ethernet. Identify two TSN mechanisms that can minimize these issues, and explain **how they would improve end-to-end latency** in autonomous driving applications.	CO4	BL3
7.	What is **Time-Sensitive Networking (TSN)**? Explain its main objectives in the context of **automotive real-time communication**. List and briefly describe any **four IEEE 802.1 TSN standards**, mentioning their functions.	CO4	BL2
8.	Write short notes on any **two short-range wireless technologies** used in vehicles - choose from **Bluetooth, NFC, Zigbee, UWB** - and explain one automotive use case for each.	CO5	BL2
9.a)	A LIN cluster contains one master and four slave nodes. Design a **schedule table** for a 100 ms frame cycle that includes: • Slave 1: Window lift switch • Slave 2: Door lock actuator • Slave 3: Mirror adjustment • Slave 4: Rain sensor data Explain how synchronization is achieved in this network.	CO3	BL3
	OR		
9.b)	Manufacturer of an infotainment of in-vehicle system has provided the user with 16 bit resolution 4 strerio lines. After the certain life time of the vehicle, User prefers to have an infortainment where 32 bit resolution 3 sterio lines are the requirement. How will in-vehicle networking protocol support in this scenario?	CO3	BL3
10.a)	Differentiate between **Classical CAN (2.0B)** and **TTCAN (ISO 11898-4)** in terms of triggering mechanism, synchronization, determinism, and compatibility.	CO2	BL3
	OR		
10.b)	i) State n: "On Board vehicle Engine ignition is switched off." List the possibilities of communication of on board ECUs through CAN after State n. [5]	CO2	BL3
	ii) Explain the significance of TEC and REC and justify the need of fault confinement. [5]		

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