

**SOFTWARE-DEFINED VEHICLES
(IOT3131)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Which protocol is most commonly used in traditional in-vehicle networking for real-time communication?
(a) HTTP (b) Bluetooth (c) CAN (d) FTP
- (ii) What is the primary role of a hypervisor in Software-Defined Vehicles?
(a) Manage over-the-air updates
(b) Schedule real-time tasks for safety systems
(c) Allow multiple OS environments to run securely on shared hardware
(d) Enable infotainment and multimedia streaming
- (iii) What is the primary function of the Anti-lock Braking System?
(a) Reduce brake pad wear
(b) Prevent engine overheating
(c) Prevent wheel lock-up during hard braking
(d) Improve fuel efficiency
- (iv) Which system in SDVs adjusts damping and ride height based on road conditions?
(a) ESP (b) TCU (c) Adaptive Suspension System (d) ABS
- (v) How do modern ESP systems predict and adapt to road conditions?
(a) Using fixed braking thresholds (b) By measuring battery voltage
(c) Through AI models and cloud data (d) Via Bluetooth sensors
- (vi) Which of the following is an example of high-level path planning?
(a) MPC (b) Obstacle avoidance
(c) Google Maps-style routing (d) Trajectory generation
- (vii) In the decision-making module, what is commonly used to model discrete driving behaviors?
(a) Decision Trees (b) RNN
(c) CNN (d) None of these

- (viii) Which charging solution is most suitable for fully autonomous vehicles to charge without human intervention?
- (a) Level 1 AC Charging (b) Wireless Charging
(c) Plug-in Charging (d) Manual Battery Swapping
- (ix) What is the main limitation of using Dynamic Programming in hybrid energy management?
- (a) It doesn't support real-time processing
(b) It requires fuzzy logic for operation
(c) It needs wireless communication
(d) It cannot optimize fuel consumption
- (x) What is a primary function of the Vehicle Control Unit in EV architecture?
- (a) Route planning using GPS
(b) Monitoring inverter phase voltage
(c) Coordinating powertrain operations and logging faults
(d) Heating and cooling the cabin

Fill in the blanks with the correct word

- (xi) The _____ protocol is commonly used for low-speed applications like seat adjusters and window controls.
- (xii) _____ braking applies pulsating brake pressure to prevent wheel lock during emergency braking.
- (xiii) _____ Control System prevents wheel spin by adjusting engine torque during acceleration.
- (xiv) The _____ controller coordinates all motion systems such as brakes, suspension, steering, and powertrain.
- (xv) The technique where AVs form tightly spaced groups to reduce congestion and improve fuel efficiency is called _____.

Group - B

2. (a) Explain the concept and benefits of Software-Defined Vehicles (SDVs). [[CO1](Understand/LOCQ)]
- (b) Discuss the role of software in vehicles. [[CO1](Understand/LOCQ)]
- (c) Mention one advantage and one limitation of CAN protocol. [[CO2](Remember/LOCQ)]
- 5 + 5 + 2 = 12**
3. (a) Compare any three vehicle network protocols. [[CO2](Analyse/IOCQ)]
- (b) Explain the roles of cloud computing and edge computing in the SDV ecosystem. [[CO2](Understand/LOCQ)]
- (c) What is hypervisor in SDVs? [[CO1](Understand/LOCQ)]
- 5 + 5 + 2 = 12**

Group - C

4. (a) Discuss how AI and predictive algorithms are enhancing braking systems in Software-Defined Vehicles. [[CO3](Understand/IOCQ)]
 (b) Describe the functionalities of ECU Software in SDVs. [[CO1/CO3](Understand/LOCQ)]
 (c) Name two software tools used for simulation or model-based design in vehicle control systems. [[CO3](Remember/LOCQ)]
5 + 5 + 2 = 12
5. (a) Explain the core functions of vehicle dynamics and stability control systems. [[CO3](Understand/LOCQ)]
 (b) Analyze the application of the coordinated vehicle dynamics control in SDV with an example. [[CO3](Analyse/HOCQ)]
 (c) Why is RTOS crucial for automotive applications? [[CO3](Understand/LOCQ)]
5 + 5 + 2 = 12

Group - D

6. (a) How does sensor fusion work? [[CO4](Understand/LOCQ)]
 (b) Analyze the industrial reconstruction caused by SDVs. [[CO5](Analyse/HOCQ)]
 (c) What is decision-making in SDVs? [[CO4](Remember/LOCQ)]
5 + 5 + 2 = 12
7. (a) Discuss an algorithm used in global path planning. [[CO4](Understand/LOCQ)]
 (b) Consider the scenario of smart traffic management system and analyze the application of intelligent intersection service in that traffic system. [[CO5](Analyse/HOCQ)]
 (c) Mention two techniques for congestion management in AV Systems. [[CO5](Remember/LOCQ)]
5 + 5 + 2 = 12

Group - E

8. (a) Analyze the methodologies which can be applied to overcome the challenges in the realization of SDVs. Give an example. [[CO6](Analyse/HOCQ)]
 (b) Discuss charging management software in AV ecosystems. [[CO1/CO6](Remember/LOCQ)]
 (c) Why does optimization matter in hybrid vehicles? [[CO6](Understand/LOCQ)]
5 + 5 + 2 = 12
9. (a) Describe charging infrastructure in AV ecosystems. [[CO6](Understand/LOCQ)]
 (b) Compare rule-based and optimization-based energy management strategies used in hybrid vehicles. [[CO6](Analyse/IOCQ)]
 (c) Mention two performance metrics used for optimization. [[CO6](Remember/LOCQ)]
5 + 5 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	63.54	15.63	20.83

