SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institutions)

SRM Nagar, Kattankulathur- 603 203

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

VI SEMESTER

PEI304 –AUTOMOTIVE INSTRUMENTATION AND CONTROL

Regulation - 2023

Academic Year 2025-2026 (Even)

Prepared By

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DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

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Course Code	: PEI304
Course Name	: **Automotive Instrumentation and Control**
Year / Dept / Sem	: III- EIE / VI sem

UNIT-I AUTOMOBILE FUNDAMENTALS

Introduction, Electronics in automotive and its evolution, Automotive physical configuration, Engine block, Cylinder head, Piton, Crankshaft, Camshaft, Connecting rod, Valve, 4-stroke cycle, Engine control, Ignition system, Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition timing, Drivetrain, Transmission, Drive shaft, Differential, Suspension, Brakes, Steering system.

PART-A

Q.No.	Questions	BT level	COs	Competence
1.	Define the term "drivetrain" in an automobile.	BTL1	**CO1**	Remember
2.	List the four strokes in a 4-stroke engine cycle.	BTL1	**CO1**	Remember
3.	What is the primary function of a crankshaft?	BTL1	**CO1**	Remember
4.	Name any four major components of an engine block.	BTL1	**CO1**	Remember
5.	What is a spark plug?	BTL1	**CO1**	Remember
6.	Define the term "ignition timing."	BTL1	**CO1**	Remember
7.	List two types of automotive suspension systems.	BTL1	**CO1**	Remember
8.	What is the role of a camshaft in an engine?	BTL1	**CO1**	Remember
9.	State the function of a piston in an engine.	BTL1	**CO1**	Remember
10.	What is a cylinder head?	BTL1	**CO1**	Remember
11.	Define valve timing in an engine.	BTL1	**CO1**	Remember
12.	List the main components of a steering system.	BTL1	**CO1**	Remember
13.	Explain the purpose of a cylinder head in an engine.	BTL-2	**CO1**	Understand
14.	Describe how a differential works in an automobile.	BTL-2	**CO1**	Understand
15.	Why is the connecting rod important in engine operation?	BTL-2	**CO1**	Understand
16.	Explain the basic function of a valve in an engine.	BTL-2	**CO1**	Understand
17.	How has electronics evolved in automotive systems?	BTL-2	**CO1**	Understand
18.	Describe the purpose of the high voltage circuit in an ignition system.	BTL-2	**CO1**	Understand
19.	What is the difference between a drive shaft and a crankshaft?	BTL-2	**CO1**	Understand
20.	Explain why ignition timing is critical for engine performance.	BTL-2	**CO1**	Understand
21.	Describe the working principle of a 4-stroke engine cycle.	BTL-2	**CO1**	Understand
22.	Explain how spark pulse generation occurs in an ignition system.	BTL-2	**CO1**	Understand
23.	Discuss the role of transmission in an automobile.	BTL-2	**CO1**	Understand
24.	Explain the importance of suspension in vehicle dynamics.	BTL-2	**CO1**	Understand

PART- B

1.	Apply the 4-stroke cycle principle to explain the complete operation of a gasoline engine. Include timing diagrams showing valve opening/closing and piston movement for each stroke.	BTL-3	**CO1**	Apply
2.	Demonstrate how to diagnose and troubleshoot ignition system problems in a modern automobile. Include step-by-step procedures for checking spark plugs, high voltage circuits, and timing.	BTL-3	**CO1**	Apply
3.	Apply the principles of force transmission to explain how power flows from the engine through the drivetrain (transmission, drive shaft, differential) to the wheels. Include calculations for gear ratios.	BTL-3	**CO1**	Apply
4.	Illustrate with diagrams how the piston, connecting rod, and crankshaft mechanism converts reciprocating motion to rotary motion. Apply this to calculate piston speed at different crank angles.	BTL-3	**CO1**	Apply
5.	Use the concept of valve timing to demonstrate how camshaft profiles affect engine performance. Show how different timing affects power output and fuel efficiency with timing diagrams.	BTL-3	**CO1**	Apply
6.	Apply troubleshooting techniques to identify and solve brake system failures. Provide a systematic approach with flowcharts for diagnosing common brake problems.	BTL-3	**CO1**	Apply
7.	Demonstrate how electronic engine control systems regulate ignition timing, fuel injection, and valve timing. Apply this to explain how modern engines optimize performance.	BTL-3	**CO1**	Apply
8.	Apply the principles of automotive suspension to solve vehicle handling problems. Show how suspension geometry affects ride comfort and stability with calculations.	BTL-3	**CO1**	Apply
9.	Implement a maintenance schedule for engine components including cylinder head, pistons, valves, and camshaft. Apply preventive maintenance principles with specific intervals and procedures.	BTL-3	**CO1**	Apply
10.	Analyze the relationship between engine block design, cylinder head configuration, and overall engine performance. Compare different engine configurations (inline, V-type, flat) and their characteristics.	BTL-4	**CO1**	Analyze
11.	Examine the complete ignition system including spark plug selection, high voltage distribution, and timing control. Analyze how each component affects combustion efficiency and engine emissions.	BTL-4	**CO1**	Analyze
12.	Analyze the evolution of electronics in automotive systems from mechanical to electronic control. Discuss the impact on engine management, safety systems, and fuel efficiency.	BTL-4	**CO1**	Analyze
13.	Break down the steering system components and analyze how each element contributes to vehicle control. Compare conventional and power steering systems with their advantages and limitations.	BTL-4	**CO1**	Analyze
14.	Analyze the thermodynamic processes in a 4-stroke cycle with P-V and T-S diagrams. Examine how compression ratio, air-fuel mixture, and ignition timing affect thermal efficiency.	BTL-4	**CO1**	Analyze

15.	Examine the drivetrain configuration in front-wheel drive vs. rear-wheel drive vehicles. Analyze the differences in power transmission, component arrangement, and performance characteristics.	BTL-4	**CO1**	Analyze
16.	Analyze different brake system technologies (drum, disc, anti-lock) and their working principles. Compare their performance characteristics, heat dissipation, and application suitability.	BTL-4	**CO1**	Analyze
17.	Examine the interaction between camshaft design, valve operation, and engine breathing. Analyze how valve lift, duration, and overlap affect engine performance across different RPM ranges.	BTL-4	**CO1**	Analyze

UNIT-II ELECTRONIC ENGINE CONTROL

Motivation, Exhaust emission, Fuel economy, Concept of electronic engine control, Performance parameters and variables, Torque, Power, BSFC, Fuel consumption, Efficiency, Calibration, Engine mapping, Effect of air-fuel ratio, Spark timing, EGR on engine performance, Exhaust Catalytic converter, Oxidizing catalytic and Three-way type, Electronic fuel control, Open and Close Loop, EGO concentration, Intake manifold pressure, Speed density method, EGR, Electronic ignition.

PART-A

Q.No.	Questions	BT level	COs	Competence
1.	Define BSFC (Brake Specific Fuel Consumption).	BTL-1	**CO2**	Remember
2.	What is an exhaust catalytic converter?	BTL-1	**CO2**	Remember
3.	List the two main types of catalytic converters.	BTL-1	**CO2**	Remember
4.	Define EGR (Exhaust Gas Recirculation).	BTL-1	**CO2**	Remember
5.	What is meant by engine mapping?	BTL-1	**CO2**	Remember
6.	State the purpose of electronic engine control.	BTL-1	**CO2**	Remember
7.	What is EGO (Exhaust Gas Oxygen) concentration?	BTL-1	**CO2**	Remember
8.	Define stoichiometric air-fuel ratio.	BTL-1	**CO2**	Remember
9.	What is the speed density method?	BTL-1	**CO2**	Remember
10.	List two performance parameters of an engine.	BTL-1	**CO2**	Remember
11.	What is engine calibration?	BTL-1	**CO2**	Remember
12.	Define open loop control in engine management.	BTL-1	**CO2**	Remember
13.	Explain the motivation behind electronic engine control systems.	BTL-2	**CO2**	Understand
14.	Describe how exhaust emissions affect the environment.	BTL-2	**CO2**	Understand
15.	Explain the difference between open loop and closed loop fuel control.	BTL-2	**CO2**	Understand
16.	How does spark timing affect engine performance?	BTL-2	**CO2**	Understand
17.	Describe the working principle of a three-way catalytic converter.	BTL-2	**CO2**	Understand
18.	Explain the relationship between air-fuel ratio and fuel economy.	BTL-2	**CO2**	Understand
19.	Why is EGR used in modern engines?	BTL-2	**CO2**	Understand
20.	Describe how intake manifold pressure relates to engine load.	BTL-2	**CO2**	Understand
21.	Explain the concept of engine efficiency.	BTL-2	**CO2**	Understand

22.	How does electronic ignition differ from conventional ignition systems?	BTL-2	**CO2**	Understand
23.	Describe the purpose of an oxidizing catalytic converter.	BTL-2	**CO2**	Understand
24.	Explain how EGO sensors help in fuel control.	BTL-2	**CO2**	Understand
PART- B				
1.	Apply the speed density method to calculate the required fuel injection quantity for an engine operating at 3000 RPM with an intake manifold pressure of 80 kPa. Include the step-by-step calculation procedure.	BTL-3	**CO2**	Apply
2.	Demonstrate how to perform engine calibration for optimizing torque and power output. Include the procedure for creating engine maps with varying air-fuel ratios and spark timing.	BTL-3	**CO2**	Apply
3.	Use closed loop control principles to illustrate how an engine management system maintains stoichiometric air-fuel ratio. Show the feedback mechanism with EGO sensor signals and fuel correction.	BTL-3	**CO2**	Apply
4.	Apply the concept of BSFC to compare fuel economy between two engines with different performance characteristics. Calculate and interpret BSFC values at various operating conditions.	BTL-3	**CO2**	Apply
5.	Implement an electronic ignition timing strategy that optimizes engine performance across different load and speed conditions. Provide timing maps and explain adjustment criteria.	BTL-3	**CO2**	Apply
6.	Demonstrate how to troubleshoot an electronic fuel control system showing poor fuel economy. Apply systematic diagnostic procedures including sensor checks and control signal verification.	BTL-3	**CO2**	Apply
7.	Apply EGR control strategies to reduce NOx emissions while maintaining engine performance. Show how EGR rate varies with engine operating conditions using maps and calculations.	BTL-3	**CO2**	Apply
8.	Use engine performance parameters (torque, power, efficiency) to evaluate an engine operating at different air-fuel ratios. Calculate and plot performance curves with interpretations.	BTL-3	**CO2**	Apply
9.	Implement a complete electronic engine control strategy integrating fuel control, ignition timing, and EGR. Show how these systems interact to optimize performance and emissions.	BTL-3	**CO2**	Apply
10.	Analyze the effect of air-fuel ratio variations on engine performance parameters including power, torque, fuel consumption, and exhaust emissions. Compare rich, stoichiometric, and lean mixture operations with graphs.	BTL-4	**CO2**	Analyze
11.	Examine the relationship between spark timing advance and engine performance. Analyze the effects of optimal, advanced, and retarded timing on power output, fuel economy, and knock tendency.	BTL-4	**CO2**	Analyze
12.	Analyze the working mechanism of a three-way catalytic converter in reducing CO, HC, and NOx simultaneously. Examine the operating window and factors affecting conversion efficiency.	BTL-4	**CO2**	Analyze

13.	Compare and contrast open loop and closed loop electronic fuel control systems. Analyze their advantages, limitations, operating conditions, and impact on fuel economy and emissions.	BTL-4	**CO2**	Analyze
14.	Examine how electronic engine control improves both exhaust emissions and fuel economy simultaneously. Analyze the trade-offs and optimization strategies used in modern engine management systems.	BTL-4	**CO2**	Analyze
15.	Analyze the speed density method versus mass air flow method for engine load calculation. Compare their accuracy, sensor requirements, computational needs, and suitability for different applications.	BTL-4	**CO2**	Analyze
16.	Examine the effects of EGR on engine performance parameters including power, efficiency, combustion temperature, and emissions. Analyze optimal EGR rates for different operating conditions.	BTL-4	**CO2**	Analyze
17.	Analyze engine mapping strategies for creating optimal calibration tables. Examine how performance variables interact and how multi-dimensional maps are developed for torque, BSFC, and emissions optimization.	BTL-4	**CO2**	Analyze

UNIT-III SENSORS AND ACTUATORS

Automotive variable, Air flow rate sensor, Pressure measurement, Strain gauge MAP sensor, Engine crankshaft angular position sensor, Magnetic reluctance position sensor, Engine angular speed sensor, Timing sensor for ignition and fuel delivery, Hall effect and optical position sensor, Optical crankshaft position sensor, Throttle angle sensor, temperature sensor, coolant sensor, Exhaust gas oxygen (EGO) sensor, Desirable and switching characteristics, Knock sensor, Angular rate sensor, LIDAR, Flex fuel sensor, Acceleration sensor, Fuel injection, Exhaust gas recirculation actuator, Variable valve timing, Electric motor actuator, Ignition system.

PART-A				
Q.No.	**Questions**	**BT level**	**COs**	**Competence**
1.	Define automotive variable in sensor context.	BTL-1	**CO3**	Remember
2.	What is a MAP sensor?	BTL-1	**CO3**	Remember
3.	List two types of crankshaft position sensors.	BTL-1	**CO3**	Remember
4.	What is the function of a knock sensor?	BTL-1	**CO3**	Remember
5.	Define LIDAR in automotive applications.	BTL-1	**CO3**	Remember
6.	What is a throttle angle sensor?	BTL-1	**CO3**	Remember
7.	State the purpose of an EGO sensor.	BTL-1	**CO3**	Remember
8.	What is a Hall effect sensor?	BTL-1	**CO3**	Remember
9.	Define variable valve timing.	BTL-1	**CO3**	Remember
10.	What is a flex fuel sensor?	BTL-1	**CO3**	Remember
11.	List two types of temperature sensors used in automobiles.	BTL-1	**CO3**	Remember
12.	What is an EGR actuator?	BTL-1	**CO3**	Remember
13.	Explain the working principle of a strain gauge MAP sensor.	BTL-2	**CO3**	Understand
14.	Describe how a magnetic reluctance position sensor works.	BTL-2	**CO3**	Understand
15.	Why is crankshaft angular position sensing important for engine control?	BTL-2	**CO3**	Understand

16.	Explain the switching characteristics of an EGO sensor.	BTL-2	**CO3**	Understand
17.	How does an optical crankshaft position sensor detect engine position?	BTL-2	**CO3**	Understand
18.	Describe the function of a coolant temperature sensor in engine management.	BTL-2	**CO3**	Understand
19.	Explain how a Hall effect position sensor operates.	BTL-2	**CO3**	Understand
20.	Why are timing sensors critical for ignition and fuel delivery?	BTL-2	**CO3**	Understand
21.	Describe the working principle of an air flow rate sensor.	BTL-2	**CO3**	Understand
22.	Explain how an acceleration sensor functions in vehicles.	BTL-2	**CO3**	Understand
23.	How does a flex fuel sensor identify fuel composition?	BTL-2	**CO3**	Understand
24.	Describe the role of electric motor actuators in modern engines.	BTL-2	**CO3**	Understand
PART- B				
1.	Apply the working principle of a magnetic reluctance position sensor to demonstrate how crankshaft angular position is determined. Include signal waveforms and timing calculations for a 4-cylinder engine.	BTL-3	**CO3**	Apply
2.	Demonstrate how to calibrate and test an EGO sensor in a closed-loop fuel control system. Include the procedure for checking switching characteristics and response time.	BTL-3	**CO3**	Apply
3.	Use strain gauge principles to calculate pressure measurements from a MAP sensor. Show how the sensor output voltage relates to intake manifold pressure with circuit diagrams and calculations.	BTL-3	**CO3**	Apply
4.	Apply Hall effect sensor principles to design a timing sensor system for ignition and fuel delivery. Include trigger wheel design, sensor placement, and timing signal generation.	BTL-3	**CO3**	Apply
5.	Implement a complete sensor suite for measuring engine speed, position, temperature, and load. Show how these sensors integrate with the ECU for engine control.	BTL-3	**CO3**	Apply
6.	Demonstrate the troubleshooting procedure for a faulty knock sensor system. Apply diagnostic techniques including signal analysis, sensor testing, and ECU response verification.	BTL-3	**CO3**	Apply
7.	Use temperature sensor characteristics to calculate coolant temperature from sensor resistance values. Apply this to create a temperature calibration curve for engine management.	BTL-3	**CO3**	Apply
8.	Apply variable valve timing control strategies using engine speed and load sensors. Show how actuator commands are generated based on sensor inputs with timing diagrams.	BTL-3	**CO3**	Apply
9.	Implement an optical crankshaft position sensing system with appropriate encoder disc design. Calculate angular resolution and demonstrate signal processing for position determination.	BTL-3	**CO3**	Apply
10.	Analyze different air flow rate sensor technologies (hot wire, vane type, karman vortex) comparing their accuracy, response time, cost, and application suitability. Examine advantages and limitations of each type.	BTL-4	**CO3**	Analyze
11.	Compare and contrast Hall effect sensors versus optical position sensors for crankshaft position detection. Analyze their operating principles, reliability, environmental resistance, and accuracy.	BTL-4	**CO3**	Analyze

		BT level	COs	
12.	Examine the relationship between throttle angle sensor, MAP sensor, and air flow sensor signals in determining engine load. Analyze how these measurements correlate and which method is most accurate.	BTL-4	CO3	Analyze
13.	Analyze the switching characteristics and desirable properties of EGO sensors. Examine factors affecting sensor response time, operating temperature, and signal quality in closed-loop control.	BTL-4	CO3	Analyze
14.	Compare magnetic reluctance and Hall effect angular speed sensors for engine speed measurement. Analyze their signal characteristics, noise immunity, and performance at different RPM ranges.	BTL-4	CO3	Analyze
15.	Examine the complete fuel injection system including sensors (MAP, TPS, coolant temp, EGO) and fuel injector actuators. Analyze how sensor data determines injection timing and duration.	BTL-4	CO3	Analyze
16.	Analyze knock sensor technology and its role in preventing engine damage. Examine sensor placement, frequency response, signal processing, and ignition timing retard strategies.	BTL-4	CO3	Analyze
17.	Examine variable valve timing systems including sensors (cam position, engine speed) and actuators (hydraulic, electric motor). Analyze control strategies for optimizing performance across operating conditions.	BTL-4	CO3	Analyze

UNIT-IV VEHICLE POWER TRAIN AND MOTION CONTROL

Electronic transmission control, adaptive power Steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control.

PART-A

Q.No.	Questions	BT level	COs	Competence
1.	Define electronic transmission control.	BTL-1	CO4	Remember
2.	What is adaptive cruise control?	BTL-1	CO4	Remember
3.	List two safety systems in modern vehicles.	BTL-1	CO4	Remember
4.	What is ABS (Anti-lock Braking System)?	BTL-1	CO4	Remember
5.	Define traction control system.	BTL-1	CO4	Remember
6.	What is electronic stability control?	BTL-1	CO4	Remember
7.	State the purpose of active suspension control.	BTL-1	CO4	Remember
8.	What is adaptive power steering?	BTL-1	CO4	Remember
9.	List two comfort systems in automobiles.	BTL-1	CO4	Remember
10.	Define wheel slip in the context of traction control.	BTL-1	CO4	Remember
11.	What is meant by vehicle yaw control?	BTL-1	CO4	Remember
12.	State the function of electronic transmission control unit.	BTL-1	CO4	Remember
13.	Explain how electronic transmission control improves vehicle performance.	BTL-2	CO4	Understand
14.	Describe the working principle of adaptive power steering.	BTL-2	CO4	Understand
15.	How does adaptive cruise control maintain vehicle speed and distance?	BTL-2	CO4	Understand
16.	Explain the purpose of anti-lock braking systems in vehicle safety.	BTL-2	CO4	Understand

17.	Why is traction control important in vehicle motion control?	BTL-2	**CO4**	Understand
18.	Describe how electronic stability control prevents vehicle skidding.	BTL-2	**CO4**	Understand
19.	Explain the basic operation of active suspension control.	BTL-2	**CO4**	Understand
20.	How do safety systems enhance vehicle and occupant protection?	BTL-2	**CO4**	Understand
21.	Describe the difference between ABS and traction control.	BTL-2	**CO4**	Understand
22.	Explain how comfort systems improve driving experience.	BTL-2	**CO4**	Understand
23.	Why is electronic stability control critical during cornering?	BTL-2	**CO4**	Understand
24.	Describe the benefits of adaptive power steering over conventional systems.	BTL-2	**CO4**	Understand
PART- B				
1.	Apply ABS control logic to demonstrate how wheel lock-up is prevented during emergency braking. Include pressure modulation cycles, wheel speed sensor signals, and braking force calculations with timing diagrams.	BTL-3	**CO4**	Apply
2.	Demonstrate how electronic transmission control determines optimal gear shift points based on throttle position, vehicle speed, and engine load. Provide shift maps and calculation procedures for automatic transmission control.	BTL-3	**CO4**	Apply
3.	Use traction control principles to show how excessive wheel slip is prevented during acceleration. Include wheel speed comparisons, torque reduction strategies, and control algorithm implementation with flowcharts.	BTL-3	**CO4**	Apply
4.	Implement an adaptive cruise control system showing how vehicle speed and following distance are maintained. Include sensor inputs (radar/LIDAR), throttle/brake actuation, and control logic with block diagrams.	BTL-3	**CO4**	Apply
5.	Apply electronic stability control strategies to correct vehicle understeer and oversteer conditions. Show how individual wheel braking and engine torque reduction restore vehicle stability with force diagrams.	BTL-3	**CO4**	Apply
6.	Demonstrate active suspension control operation for improving ride comfort and handling. Include sensor inputs (acceleration, body position), actuator control, and damping force calculations at different road conditions.	BTL-3	**CO4**	Apply
7.	Use adaptive power steering control to show how steering assist varies with vehicle speed. Calculate steering torque requirements at different speeds and demonstrate the control strategy with graphs.	BTL-3	**CO4**	Apply
8.	Implement an integrated safety system combining ABS, traction control, and electronic stability control. Show how these systems coordinate during various driving scenarios with control flow diagrams.	BTL-3	**CO4**	Apply
9.	Apply electronic transmission control for hill start assist and downhill descent control. Demonstrate clutch/brake pressure modulation and gear selection strategies with operational sequences.	BTL-3	**CO4**	Apply

Q.No.	Questions	BT level	COs	Competence
10.	Analyze the interaction between ABS, traction control, and electronic stability control systems. Examine how these systems share sensors and actuators, their priority hierarchy, and coordination strategies during combined slip conditions.	BTL-4	CO4	Analyze
11.	Compare and contrast conventional hydraulic ABS versus electronic brake force distribution (EBD) systems. Analyze their control algorithms, response times, braking performance, and effectiveness on different road surfaces.	BTL-4	CO4	Analyze
12.	Examine electronic transmission control strategies for different driving modes (economy, sport, manual). Analyze shift point optimization, torque converter lockup control, and their effects on fuel economy and performance.	BTL-4	CO4	Analyze
13.	Analyze adaptive cruise control systems using radar versus LIDAR sensing technologies. Compare detection range, accuracy, weather resistance, cost, and suitability for different vehicle applications.	BTL-4	CO4	Analyze
14.	Examine the relationship between active suspension control and vehicle dynamics. Analyze how suspension stiffness adjustment affects body roll, pitch, ride comfort, and cornering performance with mathematical models.	BTL-4	CO4	Analyze
15.	Compare passive, semi-active, and fully active suspension systems. Analyze their control mechanisms, energy requirements, performance characteristics, cost implications, and application suitability.	BTL-4	CO4	Analyze
16.	Analyze electronic stability control intervention strategies during different loss-of-control scenarios (understeer, oversteer, spinning). Examine sensor inputs, control decisions, and actuator commands with vehicle dynamic analysis.	BTL-4	CO4	Analyze
17.	Examine integrated vehicle motion control systems that coordinate power train, braking, and steering. Analyze how these systems work together for optimal safety, comfort, and performance under various driving conditions.	BTL-4	CO4	Analyze

UNIT-V ACTIVE AND PASSIVE SAFETY SYSTEM

Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program, air bags. Automotive standards and protocols: Automotive standards like CAN protocol, LIN protocol, FLEX RAY, Head-Up Display (HUD), OBD-II, CAN FD, automotive Ethernet etc. Automotive standards like MISRA, functional safety standards (ISO 26262).

PART-A

Q.No.	Questions	BT level	COs	Competence
1.	Define body electronics in automotive systems.	BTL-1	CO5	Remember
2.	What is CAN protocol?	BTL-1	CO5	Remember
3.	List two functions of electronic instrument clusters.	BTL-1	CO5	Remember
4.	What is an immobilizer system?	BTL-1	CO5	Remember
5.	Define electromagnetic interference (EMI).	BTL-1	CO5	Remember

6.	What is OBD-II?	BTL-1	**CO5**	Remember
7.	State the purpose of airbags in vehicles.	BTL-1	**CO5**	Remember
8.	What is LIN protocol?	BTL-1	**CO5**	Remember
9.	Define Head-Up Display (HUD).	BTL-1	**CO5**	Remember
10.	What is ISO 26262 standard?	BTL-1	**CO5**	Remember
11.	List two passive safety systems in automobiles.	BTL-1	**CO5**	Remember
12.	What is FlexRay protocol?	BTL-1	**CO5**	Remember
13.	Explain the working principle of remote keyless entry systems.	BTL-2	**CO5**	Understand
14.	Describe how lighting control systems operate in modern vehicles.	BTL-2	**CO5**	Understand
15.	Why is electromagnetic compatibility important in automotive design?	BTL-2	**CO5**	Understand
16.	Explain the function of dashboard electronics.	BTL-2	**CO5**	Understand
17.	How does an ESP (Electronic Stability Program) enhance vehicle safety?	BTL-2	**CO5**	Understand
18.	Describe the difference between active and passive safety systems.	BTL-2	**CO5**	Understand
19.	Explain the purpose of MISRA standards in automotive software.	BTL-2	**CO5**	Understand
20.	How does CAN FD improve upon standard CAN protocol?	BTL-2	**CO5**	Understand
21.	Describe the advantages of automotive Ethernet over traditional protocols.	BTL-2	**CO5**	Understand
22.	Why is functional safety critical in automotive systems?	BTL-2	**CO5**	Understand
23.	Explain how airbag deployment is triggered during a collision.	BTL-2	**CO5**	Understand
24.	Describe the role of OBD-II in vehicle diagnostics.	BTL-2	**CO5**	Understand
PART- B				
1.	Apply CAN protocol specifications to design a communication network for connecting engine control, transmission control, and ABS modules. Include message frame structure, arbitration mechanism, and bit timing calculations with network topology diagram.	BTL-3	**CO5**	Apply
2.	Demonstrate the implementation of an airbag deployment system including crash sensors, control unit logic, and deployment actuators. Show signal processing, decision algorithms, and timing requirements with circuit and timing diagrams.	BTL-3	**CO5**	Apply
3.	Use EMI suppression techniques to design automotive electronic circuits that meet electromagnetic compatibility standards. Include filtering, shielding, grounding strategies, and PCB layout guidelines with practical examples.	BTL-3	**CO5**	Apply
4.	Implement a remote keyless entry system showing RF communication, encryption, authentication, and door lock actuation. Include signal flow diagrams, security protocols, and control logic implementation.	BTL-3	**CO5**	Apply
5.	Apply OBD-II diagnostic protocols to troubleshoot vehicle faults. Demonstrate how to read diagnostic trouble codes (DTCs), interpret freeze frame data, and perform readiness tests with practical diagnostic procedures.	BTL-3	**CO5**	Apply

		BTL	CO	
6.	Design an electronic instrument cluster interface using appropriate communication protocols (CAN/LIN). Show sensor data acquisition, processing, display rendering, and warning indicators with system architecture diagrams.	BTL-3	**CO5**	Apply
7.	Implement lighting control systems with automatic headlamp adjustment, daytime running lights, and adaptive lighting. Show sensor inputs, control algorithms, and actuator commands with state machine diagrams.	BTL-3	**CO5**	Apply
8.	Apply ISO 26262 functional safety principles to develop a safety-critical automotive system. Include hazard analysis (HARA), safety goals, ASIL determination, and safety requirements with documentation examples.	BTL-3	**CO5**	Apply
9.	Use FlexRay protocol to design a high-speed, fault-tolerant communication network for X-by-wire applications. Include time-triggered scheduling, redundancy mechanisms, and bandwidth allocation with configuration examples.	BTL-3	**CO5**	Apply
10.	Compare and contrast CAN, LIN, FlexRay, and automotive Ethernet protocols. Analyze their data rates, topology, cost, complexity, fault tolerance, and application suitability for different automotive subsystems.	BTL-4	**CO5**	Analyze
11.	Analyze the integration of active safety systems (ABS, ESP) with passive safety systems (airbags, seatbelt pretensioners). Examine how these systems coordinate during collision scenarios and their combined effectiveness in injury reduction.	BTL-4	**CO5**	Analyze
12.	Examine electromagnetic interference sources in automotive systems and analyze their impact on electronic control units. Evaluate EMI suppression techniques and their effectiveness in ensuring electromagnetic compatibility.	BTL-4	**CO5**	Analyze
13.	Analyze dashboard electronics architecture including electronic instrument clusters, infotainment systems, and Head-Up Display. Compare traditional analog versus digital displays in terms of functionality, flexibility, cost, and user experience.	BTL-4	**CO5**	Analyze
14.	Compare OBD-II with CAN FD for vehicle diagnostics and data logging. Analyze diagnostic capabilities, data throughput, standardization, and future trends in automotive diagnostics and telemetry.	BTL-4	**CO5**	Analyze
15.	Examine body electronics systems including lighting control, remote keyless entry, and immobilizers. Analyze their network architecture, security vulnerabilities, power management, and integration challenges with central body control modules.	BTL-4	**CO5**	Analyze
16.	Analyze MISRA C coding standards and ISO 26262 functional safety requirements for automotive software development. Examine how these standards improve code quality, safety, and reliability with specific rule examples and their rationale.	BTL-4	**CO5**	Analyze
17.	Compare different airbag system architectures (driver, passenger, side, curtain, knee airbags). Analyze sensor placement strategies, deployment thresholds, inflation timing, and coordination logic for multi-stage deployment systems.	BTL-4	**CO5**	Analyze