ECU SIMULATION AND TESTING 2 WEEKS TRAINING (80 Hrs)

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ECU SIMULATION AND TESTING
Agenda from ANCIT

Delivery Format	:	This Course is offered in Classroom or Online Format
Duration	:	80 Hours (2 Weeks)
Target Group	:	Embedded Engineers working in AUTOMOTIVE and Unit Testers, Manual Testers who wish to switch their carrier into the Automotive System Testing Domain
Prerequisites	:	Freshers or Laterals with Basic C Programming Knowledge
Outcome	:	Basics of Automotive, Intro to Tools for Testing, CAPL Scripting, Testing Process and UDS

Day 1.

1. Introduction to Automotive
   - What and Why?
   - Major systems
   - Electronification of automotive
   - What is ECU?
   - Networking
   - Protocol
2. V model Life cycle
   - Why V model and How it works?
   - Phases in V model
3. Major domains and it's subsystems
   - Chassis and Body control module
   - Engine system
   - The Lubrication system
   - The coolant system
   - Fuel Supply system
   - Transmission system
   - Front and Rear wheel Axles
   - Steering and Suspension system
   - Wheel, Tyre and Brake
   - Electrical or Electronic and Air Conditioning Systems
   - Active and Passive Safety
4. Network communication
   - Why we need networking inside the CAR?
   - How it works?
   - How the communication happens between same or different networks?
   - Available networks – an overview
5. Partner ECU's
   - What is Partner ECU?
   - Why Partner ECU?
   - How do we create the partner ECUs?
6. DBC file
   - How the system knows about the communication signals
   - Necessity of message, Signals, Node, Network
   - Tools to create the database
7. Introduction to Testing
   - Why testing process is required?
   - Importance of testing

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Day 2.

1. Introduction to tools for testing
   - CANoe
   - Why CANoe?
   - Advantage of using CANoe
   - How to use CANoe
2. CAN protocol
   - Why CAN is preferred?
   - What is CAN?
   - How it works?
3. ECU simulation in CAN using CANoe
   - Working with IG block and sending CAN messages in CANoe
   - Overview of different windows in CANoe
   - Sending a CAN message inside DBC
   - Explain a use case
4. DBC creation
   - Using CANdb++ editor
5. Usage of CAPL
   - Message handling
   - Diagnostic handling
   - Test automation
6. Introduction to the CAPL browser
   - Method of accessing CAPL browser
   - Introduction to menus in CAPL browser
   - Programming rules in CAPL browser(Do and Don'ts)
   - Compilation(Runtime errors)
   - Debugging(Enable, disable, enable all, disable all)
   - Import CANoe or CANalyzer environment

Day 3.

1. Network nodes and Test nodes
   - Introduction of Network node
   - Insert network node and link with CAPL file
   - Debugging of network node
   - Edit the existing CAPL file
   - Open node panel(if DBC linked)
   - Open and Configure IL configuration

Day 3.

2. Network nodes and Test nodes contd.,
- Block active, Inactive and Remove
- Introduction to Tester node
- Insert a tester node and link with CAPL
- Compilation and Execution
- Block active, Inactive and Remove(Tester node)
- Introduction to XML test module
- Test Script Linking and Execution

3. Variables, operators, conditions and loops
- Introduction to variables
- Handling variables
- Introduction to operators, conditions and loops in CAPL
- Handling operators, conditions, loops

4. Evaluation for CAPL basics

5. CAPL programming
- Event Message Transmission
- Working with timers
- Periodic Message Transmission
- Conditionally Periodic Message Transmission
- Signal Handling during transmission
- Signal interpretation by logic(eg.,ignition on engine run)
- Signal accessing with and without DBC
- Environmental variable handling
- System variable handling
- Handling on pre start(), on pre stop()
- Handling on start(), on stop Measurement()
- Handling key events
- Handling on message, on *
- Handling on busoff(), on error Active(), on error passive(), on error frame()
- Message analysis with CAPL
- Functions available in CAPL

Day 4.

1. Panel Designing
- Introduction to the Panel Designer
- Creating display and control panels
- Integrating panels in CANoe
- Panels in combination with Signal Generators

2. Use case 1(Seat Belt ECU)
- Network node creation
- Partner ECU simulation
- Designing panel
- Testing through panel

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Day 3.

2. Network nodes and Test nodes contd.,
- Block active, Inactive and Remove
- Introduction to Tester node
- Insert a tester node and link with CAPL
- Compilation and Execution
- Block active, Inactive and Remove(Tester node)
- Introduction to XML test module
- Test Script Linking and Execution

3. Variables, operators, conditions and loops
- Introduction to variables
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Day 4.

1. Panel Designing
- Introduction to the Panel Designer
- Creating display and control panels
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2. Use case 1(Seat Belt ECU)
- Network node creation
- Partner ECU simulation
- Designing panel
- Testing through panel

Day 5.

1. Use case 2(Tyre Pressure Monitoring System)
   - Network node creation
   - Partner ECU simulation
   - Designing panel
   - Testing through panel
2. Use case 3(Air bag system)
   - Network node creation
   - Partner ECU simulation
   - Designing panel
   - Testing through panel

Day 6.

1. Use case 4(Automated Emergency Braking)
   - Network node creation
   - Partner ECU simulation
   - Designing panel
   - Testing through panel
2. Use case 5(Door Control Module) (Evaluation)
   - Network node creation
   - Partner ECU simulation
   - Designing panel
   - Testing through panel

Day 7.

1. Testing process
   - Why testing process is required?
   - V model and waterfall model, Agile process, Fish bone model
   - Advantage of V model in Automotive Domain
2. Master test plan preparation
   - Master test plan needs?
   - Template preparation
   - Project estimation technique[Project complexity and duration]
   - Man power selection guide
3. Testing methodology
   - Static code and dynamic code analysis
   - Unit testing
   - SW Integration Test
   - Hardware Test
   - SW & HW integration test
   - Smoke test
   - Regression test
   - System testing

Day 7.

4. Testing technique
- Error guessing
- Boundary testing
- Range Test
- Positive & negative Test
- White-Box Test
- Blackbox test
- Gray-Box test

5. Testing Domain Selection
- Model in loop testing
- Software in loop testing
- Bench Test {CANoe}
- Hardware in Loop testing
- Driver in Loop testing
- Vehicle in loop testing
- Acceptance testing on Vehicle

6. Test setup preparation
- Power Supply[Normal, Arbitrary Supply, Pulse Generator]
- CAN communication device [CANCASE,VN1630,PCAN]
- Break-In-Break-Out[BIBO] box
- Harness [ECU to BIBO box, Power Supply to BIBO, BIBO to CANCASE]
- Termination resistor[High speed communication]

7. Test specification preparation
- Prepare the Testcase skeleton [Precondition, Action, Expectation]
- Write the test step for each requirement
- Linking the requirement with Testcase and assign unique number[Testcase ID] for the testcase
- Traceability of the customer requirement to Testcase
- Call for Testcase review

8. Test execution methodology selection
- Test execution selection guide preparation based on the Test domain availability
- Test execution selection : Manual or automation
- Test script development and linking the Testcase ID with ID
- Test script robustness checks

Day 8.

1. Test report preparation
   - Based on the test execution method, report updating in requirement management tool
   - Test result analysis and find the reasonable results
   - Update the results in requirement management system [including bug ID for failed testcase]
   - Generating the Test report with final traceability which can be shared with Customer
2. Software bug reporting
   - Analysis the failed testcase and find the Root cause
   - write the bug report with short & long description which understandable by Developer
   - Linking the testcase ID with bug ID for traceability
3. Working with test node in CAPL
   - Test script writing for use case 1 &2
   - Report generation
4. Test node
   - Test script writing for use case 1, 2 & 3
   - Report generation
5. Evaluation of Test Scripting

Day 9.

1. CAPL for UDS
   - Stored Data Transmission Services
   - Diagnostics P-Code and Fault Codes
   - Remote Activation of Routines
   - IO Controls services
   - Upload and Download Services
   - Software Update
   - Functional and Non-functional diagnostics introduction
   - Functional and Non-functional diagnostics in detail
   - Automation of diagnostics
2. Hands on for UDS
   - Diagnostic session control(0x10)

Day 10.

1. Hands on for UDS for the majorly used Services
   - Tester Present(0x3E)
   - Security Access(0x27)
   - Read Data by identifier(0x22)
   - Write Data by identifier(0x2E)
2. Evaluation of UDS
3. Traceability
4. Working with JIRA & DOORS tool
5. ASPICE
6. 8D principles
7. ADAS
8. Cyber security basics
9. Test Automation basics

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