**Birla Institute of Technology & Science, Pilani**

**Work Integrated Learning Programmes Division**

## **M.Tech. Automotive Engineering**

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| **Course Title** | Automotive Networking |
| **Course No(s)** | AEL ZG534 |
| **Credit Units** | 4 |
| **Credit Model** | 1-1-2 |
| **Content Authors** |  |
| **Version Number** | 1.0 |
| **Date** | 25-07-2020 |

**Course Objectives:**

To introduce the networked embedded systems in automotive domain; TCP/IP, embedded internet, real time and fault tolerant networks; Intelligent transport systems and IOT applications; Networks, protocols security and routing methods; network models, middleware, V2I and V2V applications; Intra vehicular networks with time triggered and event triggered applications in automotive domains. Emerging trends in automotive networks.

**Text Book(s):**

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| **T1** | Vehicular Networking, Automotive applications and beyond, Mark Emmelmann et al, Wiley publications ISBN 9780470741542 |

**Reference Book(s) & other resources:**

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| --- | --- |
| **R1** | Internet of Things, CRC Press, Qusay Hassan et al, CRC Press, ISBN 978-1-4987-7851-0 |
| **R2** | Embedded ethernet and internet complete, Jan Axelson, Lakeview Research, ISBN 1-931448-01-9 |
| **R3** | The Illustrated Network, How TCP/IP Works in a Modern Network, Walter Goralski, Elsevier publications, ISBN: 978-0-12-811027-0 |
| **R4** | Security of Self organizing Networks, CRC Press, Al-Sakib Khan Pathan, ISBN 978-1-4398-1920-3 |
| **R5** | Automotive Informatics and Communication Systems, Huaqun Guo, Information Science Reference, ISBN 978-1-60566-338-8 |
| **R6** | Bosch Electrics and Automotive Electronics, Springer Vieweg, ISBN 978-3-658-01784-2 |
| **R7** | Embedded Security in cars, Kerstin Lemke et al, Sprinegr-Verlag, ISBN-10 3-540-28384-6 |

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| **LEARNING OUTCOMES** | |
| **LO1** | Introduce the network concepts in automotive domain |
| **LO2** | Introduce the challenges and protocols in designing networks with security and interoperability |
| **LO3** | Develop an understanding of network models for vehicle to vehicle and vehicle to infrastructure |
| **LO4** | Introduction to network routing protocols, middleware and emerging trends in automotive networked systems |

**Experiential Learning Components:**

1. Lab: None
2. Case study: None
3. Work integrated Learning Exercise: None
4. Design work/Field work: None

**Content Structure:**

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| --- | --- | --- | --- |
| **Contact Hour** | **List of Topic Title** | **Sub-Topics** | **Reference** |
| 1-4 | Introduction to Automotive Networks | * Introduction * Overview of TCP/IP Systems * Distributed and Networked Embedded systems * Architectural Model * Intra and Interworking mechanisms, Protocol Layers * TCP/IP Applications * Embedded Internet * Real time networks and Fault tolerant networks * OSI Reference Model * Standards |  |
| 5-8 | Fault Tolerant Networks | * Safety and Flexibility of Network architectures * Flexray and TTP/C – Topologies, Hardware, Node architecture, Protocol * Time triggered message transmission * Event triggered message transmission * Physical interconnection and structure of these networks * Failure scenarios, Cost and complexity |  |
| 9-10 | Internet of Things for Automotive Domain | * Introduction to IOT * Digital transformation – Connected cars * Layered architecture * Security, Privacy, Failure handling * Authentication methods * Software implementation – Certificates and Tokens |  |
| 10-14 | Automotive Network Domains | * Introduction to Automotive Domains * Powertrain * Chassis * Body electronics * Interiors * Telematics * Case studies on Reference Designs * Network Systems * Characteristics and Domain requirements * Bus systems-Data transfer * Standards * Network Management |  |
| 15-16 | Review session | | |
| 17-20 | Wireless self- organizing networks | * Introduction * MANET * VANET * Routing Protocols * Security of networks * Attacks and Solutions * Wave and DSRC standards |  |
| 21-24 | Emerging Automotive Networks | * Aerial Networks * Interconnection in ITS Networks * Case Studies * Inter-vehicle Communications * Technologies for Long range, Medium range and short range |  |
| 25-26 | Network Models | * Publish Subscribe model * Producer Consumer model |  |
| 26-30 | Automotive Middleware | * Autosar and Networked OS * Protocol independent distributed OS * Case studies – Volcano network concept |  |
| 31-32 | Review Session | | |

**Project Activity/ Experiential Lab:**

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| **Sr No** | **Lab Details/ Project Details** | **Access** |
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**Evaluation Scheme:**

**Legend:** EC = Evaluation Component; AN = After Noon Session; FN = Fore Noon Session

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| --- | --- | --- | --- | --- | --- |
| Evaluation Component | Name  (Quiz, Lab, Project, Mid-term exam, End semester exam, etc.) | Type (Open book, Closed book, Online, etc.) | Weight | Duration | Day, Date, Session, Time |
| EC - 1 | Theory- Quiz/Assignment | Online | 15% |  |  |
| EC - 2 | Mid-Semester Test | Closed Book | 35% | 2 hours |  |
| EC - 3 | Comprehensive Exam | Open Book | 50% | 3 hours |  |

Syllabus for Mid-Semester Test (Closed Book): Topics in Contact Hours: 1 to 16

Syllabus for Comprehensive Exam (Open Book): All topics

Important links and information:

Elearn portal: https://elearn.bits-pilani.ac.in

Students are expected to visit the Elearn portal on a regular basis and stay up to date with the latest announcements and deadlines.

Contact sessions: Students should attend the online lectures as per the schedule provided on the Elearn portal.

Evaluation Guidelines:

1. EC-1 consists a Quiz/Assignment/ Project along with Onramp course, Virtual lab and On-site lab. Performing the physical experiments available only in the on-site lab at Hyderabad campus is mandatory. Announcements will be made on the portal, in a timely manner.
2. For Closed Book tests: No books or reference material of any kind will be permitted.
3. For Open Book exams: Use of books and any printed / written reference material (filed or bound) is permitted. However, loose sheets of paper will not be allowed. Use of calculators is permitted in all exams. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.
4. If a student is unable to appear for the Regular Test/Exam due to genuine exigencies, the student should follow the procedure to apply for the Make-Up Test/Exam which will be made available on the Elearn portal. The Make-Up Test/Exam will be conducted only at selected exam centres on the dates to be announced later.

It shall be the responsibility of the individual student to be regular in maintaining the self-study schedule as given in the course handout, attend the online lectures, and take all the prescribed evaluation components such as Assignment, Mid-Semester Test and Comprehensive Exam according to the evaluation scheme provided in the handout.

**Instructor-in-charge**

**(AEL ZG534)**