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

**Work Integrated Learning Programmes Division**

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

|  |  |
| --- | --- |
| **Course Title** | Connected Cars |
| **Course No(s)** | AE ZG443 |
| **Credit Units** | 4 |
| **Credit Model** |  |
| **Instructor-In-Charge** |  |
| **Version Number** | 2.0 |
| **Date** | 25-07-2020 |

**Course Objectives:**

* The students will learn about different types of automotive sensors, their outputs and characteristics
* The students will be exposed to the potential threat entry points in a connected car, the means to secure such vulnerabilities and various security protocols
* The students will learn how a CAN network is implemented, structure of CAN message, priority & arbitration and the control hardware involved in the network
* The students will be able to build a driver behavior model and scoring system based on in-vehicle data.

**Text Book(s):**

|  |  |
| --- | --- |
| **T1** | Connected Vehicles: Intelligent Transportation Systems (Wireless Networks), Radovan Miucic (Author, Editor), Springer, 2018. |
| **T2** | Guide to Automotive Connectivity and Cybersecurity: Trends, Technologies, Innovations and Applications, Möller Dietmar P.F., Haas Roland E., Springer, 2019. |

|  |  |
| --- | --- |
| **LEARNING OUTCOMES** | |
| **LO1** | The students will be able to understand the fundamentals of IOT - Architecture, Sensors, Cloud and the trade-off between polling and storage requirements. |
| **LO2** | The students will be able to understand the structure and implementation of CAN networks, CAN message, priority & arbitration and the control hardware involved in the network |
| **LO3** | The students will be able to perform data analytics by creating a simple data model using OBD tools. |
| **LO4** | The Students will be able to understand the ethical and legal aspects of connected car applications including data theft, privacy and security vulnerablities |
| **LO5** | The students will experience the building of predictive analytic model based on in-vehicle data. |

**Experiential Learning Components:**

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

**Content Structure:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Contact Hour** | **List of Topic Title** | **Sub-Topics** | **Reference** |
| 1-2 | Automotive IoT and Connected cars | * Introduction to IOT & connected cars * IOT as applied to connected cars * Current automotive systems & scope for connected applications | Lecture Slides |
| 3-6 | Automotive Sensors | * Automotive sensor types * Engine and vehicle sensors – attirbutes & characteristics * Environmental sensors - attirbutes & characteristics * Polling time vs storage requirements | Lecture Slides |
| 7-10 | Automotive Communication Networks | * Basics of CAN communication * Different layers in CAN networks * Priority and arbitration * Gateways and controllers * External communication networks | Lecture Slides |
| 11-14 | Data Acquisition and Analytics | * Data acquisition methods * OBD protocols and legal requirements * Diagnositcs data logging equipments * Standalone data logging equipments * Basics of data analytics systems | Lecture Slides |
| 14-20 | Connected Car applications | * Vehicle tracking systems * Telematic systems * Machine fault diagnosis * Usage based insurance * Network optimisation * Vehicle to vehicle communication systems | Lecture Slides |
| 21-22 | Cybersecurity | * Threat matrix in vehicle systems * Vulnerablity analysis of current autonomous systems | Lecture Slides |
| 23-24 | Data Security and piracy | * Data security in connected car systems * Privacy and security aspects in connected car applications * Legal aspects of connected car systems | Lecture Slides |
| 25-32 | Case studies |  | Lecture Slides |

**Project Activity/ Experiential Lab:**

|  |  |  |
| --- | --- | --- |
| **Sr No** | **Lab Details/ Project Details** | **Access** |
| 01 | Virtual lab; MATLAB software tool- 16 hours of Lab Practice | Through Platifi |
| 02 | Remote lab: 8 hours of Lab lectures and 8 hours of assignment |  |

**Evaluation Scheme:**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 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 | Quiz/Assignment | Online | 10% |  |  |
|  | Remote lab/ Bootcamp/ Viva | Online | 20% |  |  |
| EC - 2 | Mid-Semester Test | Closed Book | 30% | 2 hours |  |
| EC - 3 | Comprehensive Exam | Open Book | 40% | 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. 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** (AE ZG443)