**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**

**WORK INTEGRATED LEARNING PROGRAMMES**

**M. Tech. Automotive Electronics**

**First Semester 2019-2020**

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| **Course Title** | Autotronics |
| **Course No(s)** | AEL ZG511 |
| **Credit Units** | 5 |
| **Credit Model** | 1-1-2  (32 Hours of Class-room Instruction + 32 Hours of Case-studies/Tutorials/Laboratories + 64 Hours of Student Preparation) |
| **Instructor In charge** |  |

**Course Objectives**

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| **No** | Objective |
| **CO1** | An introduction to the applications of mechatronics in Automobile systems |
| **CO2** | Introduction to the various mechatronics building blocks like the System modelling, Signal sensing and conditioning, Control system engineering, Electrical and mechanical actuation systems etc. |
| **CO3** | Learning about Sensors and Transducers, Operational Amplifiers, Hydraulic and Pneumatics, Dynamic response of systems, System transfer function, Frequency response, Closed loop controllers. |

**Text Book(s)**

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| --- | --- |
| T1 | Automotive Mechatronics by Konrad Reif , Springer Vieweg Edition |
| T2 | Mechatronics by W. Bolton, 4th Edition, Pearson |

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

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| --- | --- |
| R1 | Understanding Automotive Electronics – 8th Edition, William B.Ribbens |
| R2 | Control Systems by W. Bolton, Newnes |

**Learning Outcomes: Students will be able to**

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| --- | --- |
| LO1 | Apply mechatronics in the field of Automotive systems |
| LO2 | Acquire concepts of signal sensing and conditioning, control and decision making and output actuation. |
| LO3 | Illustrate working of various sensors and transducers, system modelling and dynamic response, open and closed loop controllers, electrical and mechanical actuators. |
| LO4 | Develop hydraulic and pneumatic systems |

**Content Structure:**

**Session 1: Introduction**

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| **Topic No.** | **Topic Title** | **Reference** |
| 1.1 | Introducing Mechatronics, Concepts of signal measurement, control and output actuation | T2- Chapter 1 |
| 1.2 | Application examples |

**Session 2: Electricity and Electronic fundamentals**

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| **Topic No.** | **Topic Title** | **Reference** |
| 2.1 | Resistor, inductor, capacitor, Semiconductor devices | R1- Chapter |
| 2.2 | Diodes, transistors, Field effect transistors , Logic gates |

**Session 3: Sensors**

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| **Topic No.** | **Topic Title** | **Reference** |
| 2.1 | Automotive sensors – Basics and Overview | T1- Pages 144-234 / |
| 2.2 | Sensor measuring principles |

**Session 4: Sensors type**

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| **Topic No.** | **Topic Title** | **Reference** |
| 3.1 | Engine speed, Manifold air pressure, Accelerator pedal, Yaw rate sensors, | T1- Pages 246- 289 / R1- Chapter 5 |
| 3.2 | Temperature, Knock, acceleration, Lambda oxygen sensors |
| 3.3 | Rain/Light , Torque sensors |

**Session 5: Signal conditioning**

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| **Topic No.** | **Topic Title** | **Reference** |
| 4.1 | Operational amplifiers basics | T2- Chapter 3 |
| 4.2 | Summing, difference, integratring, differentiating, logarithmic type |

**Session 6: Signal conditioning - Contd**

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| **Topic No.** | **Topic Title** | **Reference** |
| 5.1 | Wheatstone bridge, Zener diode, Low and High pass filters | T2- Chapter 3 |
| 5.2 | Analog to Digital (ADC) and Digital to Analog(DAC) |

**Session 7: System modelling**

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| **Topic No.** | **Topic Title** | **Reference** |
| 6.1 | Mechanical and Electrical systems | T2- Chapter 10 |
| 6.2 | Hydraulic and Thermal systems |

**Session 7: Dynamic response of systems**

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| **Topic No.** | **Topic Title** | **Reference** |
| 7.1 | First and second order systems, their performance measures | T2- Chapter 12/13 |
| 7.2 | Transfer functions - Basics |

**Session 8: Review Session.**

**Session 9/10 : Feedback / Closed loop controllers**

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| **Topic No.** | **Topic Title** | **Reference** |
| 9.1 | Feedback loops | T2- Chapter 13/15 |
| 9.2 | Open and closed loop |
| 9.3 | Closed loop controllers (PID strategies) |

**Session 11/12: Electronic Engine controls**

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| **Topic No.** | **Topic Title** | **Reference** |
| 9.1 | Engine performance terms | R1- Chapter 4 |
| 9.2 | Electronic fuel control systems |

**Session 13-14: Actuators:**

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| **Topic No.** | **Topic Title** | **Reference** |
| 10.1 | Electric actuators, Electromechanical types | T1- Pages 290-304;  R1- Chapter 247-270 |
| 10.2 | Fuel Injectors, Exhaust gas recirculation |
| 10.3 | Variable valve timing, Electric motor |
| 10.4 | Brushless DC motor, Ignition systems |

**Session 15:** **Hydraulics:**

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| **Topic No.** | **Topic Title** | **Reference** |
| 11.1 | Basics of hydraulics, types of valves | T1- Pages 396-410 |
| 11.2 | Automatic brake functions, Electronic braking force distribution |

**Session 16: Review Session**

**Assignments**

* Each student/ group of students will be given an individual assignment on any of the topics discussed in the class
* Assignments are take-home and deadline-driven (typically of 2 weeks duration) announced post Mid-semester examination
* Students to spend at least 16 hours of work in study, research, discussion and preparation of the report and presentation.
* As part of deliverables, the student is expected to prepare a report and make a short-presentation in the class

**Evaluation Scheme**

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| **Evaluation Component** | **Name** | **Type** | **Weight** | **Duration** | **Schedule** |
| EC - 1 | Assignments | Individual and Take-home | 10% | 2 Weeks | Throughout |
| Lab | Bootcamp / Online | 20% | 1 week |  |
| EC - 2 | Mid-Semester Examination | Closed Book | 30% | 2 Hrs |  |
| EC - 3 | End-Semester Examination | Open Book | 40% | 3 Hrs |  |

**Lab Calendar**

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| **Contact Sessions** | | **Practice (Slot booking and practicing tutorials)** | | |  | **Lab Exam (Remote proctored)** | |
| **No.** | **Date** | **Phases** | **Start Date** | **End Date** | **Type** | **Dates** |
| 1 |  | **Phase1 (30 days)** |  |  | **Regular** |  |
| 2 |  |
| 3 |  |  |  |
| 4 |  | **Makeup** |  |
| Review |  | **Phase2 (16 days)** |  |  |

**Note:**

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.

Evaluation Guidelines:

1. EC-1 consists of Quizzes, assignments, lab
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.
5. Syllabus for Mid-Semester Test (Closed Book): Contact Hours 1 to 8
6. Syllabus for Comprehensive Exam (Open Book): Contact Hours 1 to 16

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 lectures, and take all the prescribed evaluation components such as Quizzes, Assignments, Lab, Mid-Semester Test and Comprehensive Examination according to the evaluation scheme provided in the handout.

**Instructor-in-Charge**

**AEL ZG511**