BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
WORK INTEGRATED LEARNING PROGRAMMES
M. Tech. Automotive Electronics
First Semester 2019-2020

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

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)

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

Reference Book(s) & other resources

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

Learning Outcomes: Students will be able to

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

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

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

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

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

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

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

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

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

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

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

Session 13-14: Actuators:

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:

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

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

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