Module Descriptions Engineering Projects

Faculty of Engineering

Contents

Engineering Laboratories, Campus Friedrichshafen

(Study Projects, Self-Directed Projects, Bachelor Thesis, Master Thesis)

The Department of Engineering offers opportunities for the following study modules:

- Student Research Project (**3 months fulltime** or **6 months parttime**) with 10 credits
- Bachelor Thesis (**4 months fulltime**) with 12 credits
- Master Thesis (**6 months fulltime**) with 25 credits

The projects can be carried out at any time in the period from October to June. The respective subjects (project contents) can be selected from current topics, see below. **Prior detailed agreement with the supervisor is necessary! Please contact your supervisor.**

Electrical Engineering

High-Frequency Technology and/or Electro Magnetic Compatibility	
Projectduration and ECTS Points	Flexible (150 hours of workload correspond to 5 ECTS; can be scaled depending on required ECTS)
Prerequisites for participation	Open for all students with basic knowledge of electromagnetic fields and waves
Course description	Projects are possible in the field of Radio Wave Technology (High Frequency) and Electromagnetic Compatibility. Besides topics with focus on theory and simulation (e.g. simulating the propagation of electromagnetic waves), practical work is possible as well in dedicated labs: Both the communications engineering laboratory („Nachrichtentechnisches Labor“) and the Electromagnetic compatibility (EMC) laboratory offer the opportunity to work on hardware-related projects. • In the communications engineering laboratory, new lab experiments are to be designed that will be included in future teaching. For example, evaluation boards, oscilloscopes and spectrum analysers are available and tob e used. The work has a theoretical part as well as a part related to measurements. • In the EMC laboratory at DHBW Ravensburg, electrical or electronic devices and systems can be tested for their electromagnetic compatibility. The aim is to ensure that the devices do not interfere with each other. The test objects are either tested for interference resistance with interference effects as they occur in reality. In addition, their own radiation can also be examined. An electrical or electronic device can only be classified as electromagnetically compatible after all the legally prescribed checks have been carried out. In the frame of a student projects, existing lab experiments shall be expanded and optimised. Furthermore, some experiments require documentation including a theoretical and a practical part. Internal staff will give an introduction to the lab.
Contact	Prof. Dr. Jens Timmermann timmermann@dhbw-ravensburg.de

Racing Car Development (GFR Team)	
Projectduration and ECTS Points	Currently available
Prerequisites for participation	The project ist open to all engineering and bussiness administration students.
Course description	Global Formula Racing is an international cooperation between students from Duale Hochschule Baden-Württemberg-Ravensburg (DHBW), Germany, and the from Oregon State University (OSU), USA. GFR began the global venture in 2009, sharing physical and intellectual resources by using advanced communication technology to create two highly competitive vehicles with electrical drives an autonomous functions. Design, manufacturing, and testing occur simultaneously at both schools, over nine time zones and 8770 kilometers apart. The supply chain management is unique in Formula Student, and it adds an extra dimension to the team. The English language, the team language, is key for cross-border communication. Each student on the team specializes in its own tasks, e.g. on electrical, mechanical, or bussiness issues. In addition to their regular university schedule, students learn and gain experience with their time on the team. Find more information on the website: https://www.global-formula-racing.com/en/
Contact	Prof. Dr. Thomas Kibler kibler@dhbw-ravensburg.de

Autonomous/Connected Vehicles	
Projectduration and ECTS Points	
Prerequisites for participation	Knowing a programming language
Course description	As part of the ZF-DHBW Innovation Lab, a test platform for functions and components of assisted and autonomous driving (ADAS) has been under development since 2017 based on a small fleet of model trucks. These model vehicles are being equipped with the necessary on-board computers, sensors, electronics and intelligent algorithms as part of student work. This platform will then be used for research, development and validation of algorithms, subsystems and products (e.g. real vehicle sensors from ZF) in the ADAS environment. A powerful simulation environment using IPG Truck Maker is also part of the project. Since the 2017/2018 academic year, around 15-35 students from various courses of study have been working on this project each year. In the meantime, 15 trucks and a simulation and test environment have become available. ROS (Robot Operating

	System) has been used since the academic year 2019/2020. In the new academic year 2023/2024, a main focus is on modularizing the software architecture for autonomous functions and on increasing the degree of function reuse. In the previous studies that implemented autonomous driving functions, only raw sensor data was used (esp. the raw data for the central 2D-Lidar). This is now changing: several modules for raw sensor data processing are expected to be created, which perform sensor abstraction and provide e.g. edges, surfaces and objects. The modules for autonomous vehicle guidance (e.g., platooning, maneuvering, etc.) then use this processed data. This will allow a higher degree of specialization in the study work and facilitates reuse.
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Mechanical Engineering

Lightweight Construction	
Projectduration and ECTS Points	January – March Time expense: app. 15-20 units
Prerequisites for participation	- Basic knowledge of engineering subjects (esp. material science, physics, processes) - Interest on sustainability and on mobility aspects (esp. aerospace and automotive) - Engagement and flexibility - Interest on team and disciplinary work
Course description	Contents: - Basic information on lightweight materials (e.g. light alloys and composites, esp. CFRP) - Building up and preparation of tooling - Mixture and processing of thermoset polymers - Laminating of carbon parts - Sandwich processing - Mechanical and non-destructive testing of coupons and parts (ultrasonic testing) Remarks: - So far possible by curriculum, the lab is mandatory, when course “Engineering of lightweight structures” is chosen - Recommended for students in automotive, aerospace and mechanical engineering
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Industrial Measurement and Sensor Technology	
Projectduration and ECTS Points	Flexible • Student Research Project (**3 months fulltime** or **6 months parttime**) with 10 credits • Bachelor Thesis (**4 months fulltime**) with 12 credits • Master Thesis (**6 months fulltime**) with 25 credits
Prerequisites for participation	None
Course description	The Laboratory for Industrial Measurement and Sensor Technology teaches and develops analysis methods for determining geometric and physical quantities such as length, angle, temperature or pressure. Metrology also involves methods for uncertainty evaluation and rigorous uncertainty propagation, to indicate the degree of confidence of a measured. The lab is equipped with modern measurement stations, e.g. Faro Arm, Zeiss coordinate measuring machine or Optonic bin picking. Furthermore a huge verity of visual sensors from ifm or wenglor are used in different set up using e.g. IO Link. https://www.ravensburg.dhbw.de/forschung-transfer/labor-fuer-industrielle-messtechnik
Contact	Prof. Dr. Thomas Dietmüller dietmueller@dhbw-ravensburg.de

“Zukunftsfabrik Bodensee”	
Projectduration and ECTS Points	Flexible • Student Research Project (**3 months fulltime** or **6 months parttime**) with 10 credits • Bachelor Thesis (**4 months fulltime**) with 12 credits • Master Thesis (**6 months fulltime**) with 25 credits
Prerequisites for participation	None
Course description	The “Zukunftsfabrik Bodensee” is a future factory representing a real value chain with networked, adaptive and self-learning systems. On two locations a unique production network is created and connected with a autonomous transport robot. In the network, a "smart product" is manufactured in a large number of variants and returned in the sense of the circular economy. The future factory provides the basis for targeted, practice-oriented research and teaching in the areas of digital twins, AI in production, human-machine interaction, production platforms and the circular economy. https://www.ravensburg.dhbw.de/forschung-transfer/kompetenzzentren/zentrum-fuer-digitalisierung-in-produktion-und-produktentwicklung#zukunftsfabrik-bodensee

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Aerospace Engineering

Flight Simulation	
Projectduration, Exam and ECTS Points	Exam: Students will be expected to contribute to hands-on development work on the simulator, write a formal report and contribute to the technical documentation. ECTS: 10 ECTS points will be awarded for successful participation and completion of a formal technical report of the lab work assignment. Lab work assignments period consists of October through December and April through June (both periods are required). Upon request, additional scope could be negotiated resulting in a higher number of ECTS points awarded.
Prerequisites for participation	Background of electrical, mechanical, aerospace engineering or computer science. Experience in aerospace/flight simulation is helpful but not required. Interest and willingness to learn about subject matter is expected.
Course description	Full scale helicopter flight simulator with original fuselage, glass cockpit and spherical projection system. Lab work assignments include future expansions of the helicopter flight simulator with respect to motion system, control loading system, cockpit and operator station electrical and HMI aspects, core flight simulation models as well as operational support of the simulator.
Contact	Prof. Dr. Thomas Mannchen mannchen@dhbw-ravensburg.de

Flight Control/Handling Qualities	
Projectduration, Exam and ECTS Points	Exam: Students will be expected to contribute to hands-on development work on the simulator, write a formal report and contribute to the technical documentation. ECTS: 10 ECTS points will be awarded for successful participation and completion of a formal technical report of the lab work assignment. Lab work assignments period consists of October through December and April through June (both periods are required). Upon request, additional scope could be negotiated resulting in a higher number of ECTS points awarded.

Prerequisites for participation	Background of aerospace engineering or computer science. Experience in aerospace/flight simulation is very helpful. Interest and willingness to learn about subject matter is expected.
Course description	DHBW is in the process of setting up a moving base VR simulator to conduct academic labs and research. The work consists in the contribution of the set-up if the simulator (flight model, motion cueing system, hardware/software activities) and prepare the applications in terms of flight controls and handling qualities trials.
Contact	Prof. Dr. Philipp Krämer kraemer@dhbw-ravensburg.de

Aerodynamic/CFD

Projectduration and ECTS Points	Exam: Students will be expected to contribute to hands-on development work on the simulator, write a formal report and contribute to the technical documentation. ECTS: 10 ECTS points will be awarded for successful participation and completion of a formal technical report of the lab work assignment. Lab work assignments period consists of October through December and April through June (both periods are required). Upon request, additional scope could be negotiated resulting in a higher number of ECTS points awarded.
Prerequisites for participation	Background of aerospace engineering, aerodynamics and experience in CFD, preferably with FLUEND and/or SIMULIA. Interest and willingness to learn about subject matter is expected.
Course description	DHBW is in the process of setting up a moving base VR simulator to conduct academic labs and research. As a part of this work, the existing aerodynamic flight model sit to be extended for compressible/transonic/supersonic flow by means of CFD. The present aerodynamics is to be validated and extended towards not yet covered conditions.
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Drivetrains for Aircraft and Engines

Projectduration and ECTS Points	Exam: Students will be expected to contribute to hands-on development work on the simulator, write a formal report and contribute to the technical documentation. ECTS:

	10 ECTS points will be awarded for successful participation and completion of a formal technical report of the lab work assignment. Lab work assignments period consists of October through December and April through June (both periods are required). Upon request, additional scope could be negotiated resulting in a higher number of ECTS points awarded.
Prerequisites for participation	Background of aerospace engineering, or electrical engineering. Experience design of electrical propulsions and/or testing would be a plus. Interest and willingness to learn about subject matter is expected.
Course description	As part of a long-term student project, DHBW is developing a man-portable electrical drive train for paraglider propulsion. The system aims to providing the propulsion required to transport one person with deployed paraglider into an atmospheric layer where thermal lift is provided for a self-sustained flight. Tasks include the conclusion of the design, production of a prototype and analysis of the drive train in a drive train test bench.
Contact	Prof. Dr. Philipp Krämer kraemer@dhbw-ravensburg.de

UAV/Lighter-than-air	
Projectduration and ECTS Points	
Prerequisites for participation	
Course description	Finite Element Method: Introduction and usage of the numerical approach for mechanical problems using the finite element method; as well as theoretical in the course and practical in the PC laboratory: - FEM Basics - FEM application - FEM for mechanical problems, for computational fluid dynamics, for thermic simulations - Composition of the stiffness matrices, Basics of the linear elasticity theory, definition of the Functionals, Material behaviour, Coordination transformation - Theoretical examples in 2D regarding bar and beams - Introduction in FEM software; Basics in element distribution, Pre-Processing, Definition of boundary conditions, Starting Simulations and evaluation in the Post-Processing - Introduction of different model definitions for the FE model and different definitions for boundary conditions. - Non-linear simulations with contact definitions Usage examples in the FE laboratory

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Industrial Engineering

Project eMule 7.0 **Digital Twin**			
ECTS Points	10	**Graded**	Yes
Workload in hours	Total: 300 Mandatory attendance:100 Independent study: 200		
Course description	Development of a digital twin concept for the vehicle Kawasaki Mule 610. Digital twins enable real-time monitoring of equipment and systems, allowing for predictive maintenance by detecting anomalies, predicting failures, and optimizing maintenance schedules. This application helps minimize downtime, reduce costs, and improve operational efficiency. Further development of a digital image (digital twin) of the vehicle and its components. The concept should be further developed by the student based on the data generated so far. Creating a three-dimensional (3D) setting for Friedrichshafen city and incorporate a 3D representation of the Emule vehicle as a Digital Twin. This endeavor aims to enhance the accuracy of determining the vehicle's precise position by utilizing GPS.coordinates and implementing of a Telematics system.		
Aims and skills	Integrating of state-of-the-art technologies, including Artificial Intelligence (AI), the Internet of Things (IoT), Distributed Ledger Technology (DLT), and Cyber-Physical Systems (CPS), into a vehicle. Additionally, the Unreal Engine was utilized to create a three-dimensional (3D) digital representation of Friedrichshafen city, allowing for virtual monitoring and implementation using Digital Twin technology. This project is carried out in collaboration with the partner universities worldwide.		

Prerequisites	Good knowledge of the open software tools: unreal engine, Blender, InfluxDB/Grafana, data networks, Python and **Telematics.**
Assessment	Term paper (Bachelor and Master Thesis are possible)
Project supervisors	Khamis Jakob jakob@dhbw-ravensburg.de Prof. Dr. Stephan Sauter sauter@dhbw-ravensburg.de

Project eMule 7.0
Electro Mobility

ECTS Points	10	**Graded**	Yes
Workload in hours	Total: 300 Mandatory attendance:200 Independent study: 100		
Course description	**Installation of an energy storage system** (54V DC, 13 kWh) in the form of Li-Ion batteries (round cells) in the All Terrain Vehicle (ATV) Kawasaki Mule 610, 4×4. Digital Image (digital twin) of the vehicle The vehicle originally had a 13kW petrol engine. It was electrified some time ago. That means: The gasoline engine and its components have been removed and an electric motor of the same power has been installed instead. The electric motor is electrically driven by a 10 kWh energy storage system (Li-ion batteries). Now the old energy storage system and its control should be replaced. The new energy storage system was to be made from 980 Li-Ion batteries (18650 / 3.6V 3500mAh) and installed in an almost completed battery box. To monitor the temperature during the charging / discharging process, an electronic control should be developed and implemented in the battery box.		
Aims and skills	- Development and installation of a charging system for the energy storage system - Correct wiring / connection of the Li-Ion batteries and BMS. - Installation / wiring of the battery cooling system - Development and installation of thermal sensors - Carrying out measurements and function tests - Performance and construction according to German Vehicle test certificate (TUV) approval of the built-in energy storage system Additionally: _Development of a mechatronic concept for the vehicle gear _Development of an autonomous driving concept		

	_practical implementation of the developed concepts This project is carried out in collaboration with the partner universities worldwide.
Prerequisites	Reading and creating of electronic/electrical circuits and mechanical schematics. Good knowledge of Arduino programming and data Networks
Assessment	Term paper (Bachelor and Master Thesis are possible)
Project supervisor	Khamis Jakob jakob@dhbw-ravensburg.de