Study regulations of the
FH Bachelor's course

Drone Engineering

To obtain the academic degree

Bachelor of Science in Engineering
abbreviated BSc

as an appendix to the statutes of the FH Kufstein Tirol

Organizational form: full-time
Duration: 6 semesters
Scope: 180 ECTS
Places for beginners per academic year: 25 full-time

Version 1
Contents based on the accreditation application dated 19.08.2024
Approved by AQ Austria by decision of 25.06.2025
Start with study year 2025/26

Content

1 OCCUPATIONAL PROFILES

1.1 Occupational fields

The drone industry constitutes an economic sector that has steadily gained significance in recent years and is projected to experience substantial growth in the future. This development is attributable, among other factors, to technological advancements — particularly in the field of artificial intelligence — which have expanded the commercial applicability of drones. Already today, Unmanned Aerial Systems (UASs) are employed in a variety of domains, including mapping and surveying, precision agriculture, forest and wildlife monitoring, film production and photography, inspection and maintenance, surveillance and law enforcement, delivery and logistics, as well as disaster management. Further improvements are anticipated through machine learning and artificial intelligence, which are expected to open up new areas of application, especially in the fields of transportation and mobility. The increasing prevalence of smart mobility concepts, particularly in urban environments, is further driving demand for and the development of drone technologies. Innovations in civilian drone technology are expected to bring about a transformation of the entire economy, notably through the deployment of drones in the delivery and logistics sectors.
Accordingly, there is a wide range of employers seeking specially trained drone experts. On the industrial side, this includes manufacturers of civilian and military drones, developers of software solutions for drone technologies, as well as service providers offering drone-related services such as inspections. A further significant area of employment exists in research and development, both in the private and public sectors. Given the diverse range of drone applications, companies from other economic sectors are increasingly taking an interest in drone experts to develop innovative solutions tailored to their specific industries. Notable examples include agriculture and forestry, transportation and logistics, energy and water supply, as well as the construction industry. The drone industry is dynamic and continuously expanding, thereby creating new opportunities and professional fields on an ongoing basis. The following occupational profiles, among others, are available to graduates of the degree program in Drone Engineering:

- **Aviation/Drone Systems Engineers** design and develop prototypes as well as complex drone systems and are responsible for their operation and maintenance.
- **UAS Safety Specialists** monitor compliance with safety standards in the drone industry, such as the airworthiness of drones.
- **UAS Engineers** develop specialized software for flight control and drone navigation, with real-time data analysis being a key component. They design and coordinate tests and analyze the results to ensure the airworthiness and safety of aerial vehicles.
- **Researchers in Aviation & Robotics** develop and enhance technologies in the fields of aviation and robotics, including through experimental studies and data analysis.
- **UAS Business and Customer Relationship Specialists** (e.g., entrepreneurs) identify market gaps and establish enterprises to develop new products or services in the drone sector.
- **UAS Operation Specialists** analyze and optimize flight operations in terms of efficiency, cost, and safety. They also operate unmanned aerial vehicles, planning and executing missions while ensuring navigation, flight safety, and compliance with applicable regulations.

The curriculum of the degree program Drone Engineering reflects the diversity of professional fields and the varying qualification requirements depending on the area of employment, while also preparing students for future innovations that will drive and transform the industry. By receiving practice-oriented training across a wide range of disciplines, students of the program are equipped to become highly valuable professionals and specialists in tomorrow's world of work. Furthermore, English as the medium

of instruction ensures that graduates face no limitations in pursuing career opportunities on a global scale.

1.2 Job descriptions

A **UAS Engineer (Unmanned Aerial Systems Engineer)** is responsible for the development, design, integration, and optimization of unmanned aerial vehicle systems (UAS). This position requires a deep understanding of aerodynamics, flight mechanics, propulsion technology, and control systems in order to design and operate powerful and reliable UAS. The daily work of a UAS Engineer often begins with requirements analysis and concept development, where various design options are assessed and the system architecture is defined. This includes selecting suitable components such as motors, propellers, control systems, and sensors. During the design phase, the engineer creates CAD models, performs simulations, and analyzes aerodynamic parameters to ensure the stability and efficiency of the system. An important task is the integration of sensors and flight control computers, which enable precise navigation and flight attitude control. Modern control methods such as PID or LQR algorithms are used for this purpose. The development of software for autopilot control and data processing is also part of the job.
During testing, prototypes are tested, flight maneuvers are simulated, and performance is assessed in various environments. The data obtained is analyzed to optimize flight behavior and identify potential sources of error. Safety aspects and compliance with aviation regulations play a central role. Therefore, a UAS engineer often works closely with regulatory authorities and interdisciplinary teams to ensure that the systems comply with legal requirements.

A **UAS Operation Specialist (Unmanned Aerial Systems Operation Specialist)** is responsible for planning, executing, and monitoring drone operations. These positions require in-depth knowledge of flight control, navigation, and mission planning, as well as a deep understanding of the legal requirements and safety guidelines for the use of unmanned aerial vehicles. UAS Operation Specialists often work in areas such as aerial surveying, inspection, surveillance, agriculture, or emergency management and are responsible for the efficient and safe execution of UAV missions.
The working day usually begins with the preparation and planning of the drone mission. This includes analyzing the mission area, checking weather conditions, and assessing potential risks. Based on this information, UAS Operation Specialists create detailed flight plans that meet the mission requirements and ensure the safety of all involved. An important aspect of this is coordination with other emergency services and compliance with airspace restrictions and permits.
Before takeoff, UAS Operation Specialists perform comprehensive pre-flight checks to ensure that the systems are functioning properly. This includes calibrating sensors, checking battery capacity, and configuring the flight control software. During the flight, they continuously monitor the UAV systems to ensure that the mission is proceeding as planned. In the event of unforeseen events, they must be able to react quickly and safely to stabilize the drone and ensure a safe flight completion.
After the flight, UAS Operation Specialists document the results and perform post-flight checks to verify the condition of the drone and its components. The collected data is then evaluated, processed, and prepared. This may include analyzing aerial images, interpreting measurement data, or creating reports. Close collaboration with engineers and project managers is essential in order to incorporate the findings into further project work.
A UAS Operation Specialist must not only be technically proficient, but also communicative and safety-conscious. The use of state-of-the-art software for flight planning and monitoring is just as much a part of the daily tasks as continuous training in new technologies and legal regulations in the UAV sector.

A **UAS Safety Specialist (Unmanned Aerial Systems Safety Specialist)** is responsible for safety and risk management processes related to the operation of unmanned aircraft systems (UAS). This role requires comprehensive knowledge of aviation regulations, safety standards, and operational risk assessments. UAS Safety Specialists often work in companies that use drones for commercial purposes, in government agencies, or in research institutions to ensure the safe usage of UAVs.
The workday usually begins with conducting risk analyses for planned drone operations. This includes identifying potential hazards, assessing operational risks, and developing safety protocols. A key aspect is risk assessment in relation to flight disruptions, technical failures, and external influences such as weather conditions or obstacles in the area of operation. UAS safety specialists prepare comprehensive risk analysis reports (e.g., according to SORA - Specific Operations Risk Assessment) and derive appropriate measures for risk mitigation from them.
Another focus is on the development and implementation of safety concepts. This includes the creation of operating instructions, emergency procedures, and safety checklists. In close cooperation with pilots and operation specialists, they monitor compliance with safety guidelines before, during, and after the flight. This includes checking airworthiness, monitoring system integrity, and performing regular safety inspections.
During operations, UAS Safety Specialists are responsible for monitoring safe flight operations. They analyze potential safety issues in real time and initiate immediate measures in the event of incidents. After the mission is complete, safety incidents and irregularities are carefully documented and evaluated. These evaluations form the basis for continuous improvements in safety standards and for the training of UAV personnel. An important part of the job is also training and raising awareness among drone crews on safety-related issues. UAS Safety Specialists develop training programs that teach how to deal with emergencies and the correct application of safety protocols. They always stay up to date with the latest regulations and conduct regular internal audits to ensure compliance with standards. In addition to technical knowledge, this position requires strong organizational skills and a high degree of responsibility. Communication skills are essential for conveying safety-related information clearly and comprehensively. A UAS Safety Specialist plays a key role in minimizing the risks associated with drone operations and ensuring the safety of people, property, and the environment.

A **UAS Business and Customer Relationship Specialist** with a focus on start-ups and strategic management is responsible for developing and implementing business strategies in the field of unmanned aircraft systems (UAS). In a start-up context, the focus is on founding and scaling the company, while in larger companies the focus is on the strategic development of existing business areas. In a start-up environment, the role begins with the development of business ideas related to innovative drone technologies and their commercial applications. This includes identifying market opportunities, conducting competitive analyses, and creating business plans. The specialist develops financing strategies, prepares investor pitches, and acquires customers through targeted networking activities. The ability to translate technological innovations into economically viable business models is essential.
In larger companies, the focus is on the strategic management of existing UAS business areas. The specialist develops long-term market strategies, assesses new business models, and develops concepts for portfolio expansion. An important part of this is partnership development to initiate collaborations with technology providers, logistics companies, or authorities. In addition, he/she monitors market performance and develops growth strategies to strengthen the company's position in the UAS market in the long term. Regardless of the corporate context, the role requires a high degree of entrepreneurial thinking, strong communication skills, and the ability to manage innovative projects efficiently. The specialist acts as an interface between technology development and market strategy, thus contributing significantly to the successful implementation of new business models in the field of drone technology.

A **Researcher in Aviation** is responsible for the scientific research and development of new technologies and concepts in the field of aviation. This position involves conducting basic research, applied

degree programs, and experimental investigations that contribute to the improvement of UAVs (Unmanned Aerial Vehicles) or other aviation systems. Research focuses may include aerodynamics, flight mechanics, propulsion technology, flight control, or innovative swarm algorithms. The daily work of an aviation researcher often begins with literature research and analysis of existing academic papers to identify current research gaps. Hypotheses and research questions are formulated on this basis. The development of mathematical models for the description of complex aerodynamic or structural phenomena is a central component of the theoretical work. This includes the usage of simulation software (e.g., MATLAB, ANSYS, CFD tools) to predict flight behavior or optimize wing shapes.

A **drone systems engineer** is responsible for the development, integration, and optimization of drone systems, including hardware, software, and control components. This role involves the design and implementation of unmanned aerial vehicle (UAV) systems for various applications such as surveying, inspection, logistics, or surveillance. The focus is on developing efficient, reliable, and safe systems that meet specific technical and operational requirements. The workday often begins with a requirements analysis, in which the specific operating conditions and performance requirements of the drone system are defined. Based on these requirements, the systems engineer creates a technical concept that integrates all relevant components—from flight controls and sensors to propulsion systems and communication modules.
During the design phase, the engineer works closely with mechanical and electronic developers to ensure the structural integrity and performance of the drone. This includes selecting suitable motors, propellers, sensors, and control systems, as well as creating detailed CAD models. In addition, simulation-based analyses are performed to verify the stability and maneuverability of the system under various conditions. A central aspect of the work is system integration. This involves combining the various hardware and software components into a functioning overall system. Typical tasks include the implementation of flight control algorithms (e.g., PID controllers) and the integration of navigation systems (GPS, IMU, Lidar). The systems must be thoroughly tested to ensure that all components work together harmoniously. Development is followed by a testing phase in which the drone is tested under real-world conditions. The engineer monitors system performance, collects measurement data, and analyzes the stability and accuracy of flight movements. Any problems that arise are analyzed and resolved through iterative adjustments. During operation, the drone systems engineer is also responsible for maintenance and system optimization. This includes monitoring system performance, performing regular inspections, and updating software components. In the event of technical problems, the engineer is the first point of contact and develops solutions for troubleshooting and performance improvement. The role requires in-depth knowledge of aerodynamics, mechatronics, control engineering, and embedded systems. Communication skills are also required, as the work often takes place in interdisciplinary teams. A drone systems engineer plays a key role in developing innovative and powerful drone systems that meet the requirements of modern applications.

1.3 Qualification profile

The qualification objectives and learning outcomes of the bachelor's degree program in Drone Engineering meet relevant academic and professional requirements, as well as the requirements of ISCED level 07881 (International Standard Classification of Education). The content taught qualifies graduates for the occupational fields mentioned in the previous section.

Occupational field	Task	Description of competency	Type of competency	Curriculum module(s)

UAS Engineer	Developing drone applications and their systems	Can independently design and program drone systems.	Professional-scientific	Coding
		Can independently evaluate data for drone applications.	Professional-scientific	Data Analysis
		Is familiar with the challenges of aviation and meteorology.	Professional-scientific	Flight Engineering
Aviation/Drone Systems Engineer	Developing aviation-related systems	Can describe economic aspects of aviation-related systems and carry out project planning.	Professional-scientific	Business
		Can independently evaluate data for drone applications.	Professional-scientific	Data Analysis
		Can independently develop concepts for the use of sensor systems.	Professional-scientific	Data Analysis
		Can design and plan software concepts and architectures for drone applications.	Professional-scientific	Coding
		Are familiar with the challenges of aviation and meteorology.	Professional-scientific	Flight Engineering
Researcher in Aviation	Research into new systems, algorithms, and innovations in the field of aviation/UASs	Are familiar with the challenges of aviation and meteorology.	Professional-scientific	Flight Engineering
		Can independently evaluate and analyze data from different sensors.	Professional-scientific	Data Analysis
		Can disseminate research results.	Personal & social	Compl (ementary)

		Can independently design, implement, and test new software systems and algorithms.	Professional-scientific	Coding
UAS Business and Customer Relationship Specialist (e.g., entrepreneur)	Independently developing business models in the UAS industry	Can describe economic aspects of aviation-related systems and carry out project planning.	Professional-scientific	Business
		Can disseminate content both scientifically and for the purpose of marketing.	Personal & social	Compl (ementary)
		Is familiar with the challenges of aviation and meteorology and can develop business models based on this knowledge.	Professional-scientific	Flight Engineering
UAS Operation Specialist	Analysis of drone applications and their operational implementation	Can describe economic aspects of aviation-related systems and carry out project planning.	Professional-scientific	Business
		Can disseminate content both scientifically and for the purpose of marketing.	Personal & social	Compl (ementary)
		Can independently evaluate and analyze data from different sensors.	Professional-scientific	Data Analysis
UAS Safety Specialist	Evaluation and testing of drone systems and applications	Can describe and evaluate economic aspects of aviation-related systems and carry out project planning.	Professional-scientific	Business
		Can disseminate research results.	Personal & social	Compl (ementary)
		Is familiar with the challenges of	Professional-scientific	Flight Engineering

	aviation and meteorology.		
	Is familiar with the regulatory and safety requirements for UAS applications.	Professional-scientific	Business

2 CURRICULUM

2.1 Curriculum Data

	Full-time	Program for working professionals, a.k.a. part-time program	Comments, if any
Year of first implementation (YYYY/YYYY$_{+1}$)	2025/26		
Standard duration of program (Number of semesters)	6		
SWS (Semester Hours) (Total of all semesters)	74		In the full-time program, courses completed at the respective partner universities as part of the semester abroad are credited towards the total SWS workload.
ECTS Points (Total of all semesters)	180		
Start of Winter Term (CW = Calendar Week)	CW 40		
End of Winter Term (CW = Calendar Week)	CW 5		
Start of Summer Term (CW = Calendar Week)	CW 11		
End of Summer Term (CW = Calendar Week)	CW 28		
Number of weeks in Winter Term	15		
Number of weeks in Summer Term	15		
Compulsory semester abroad	5th semester		
Language of instruction	English		The proportion of courses taught in English is 100%.
Internship	6th semester, 12.5 weeks		A total of 500 hours must be completed over 12.5 weeks of 40 hours per week.

2.2 Curriculum matrix

The table below presents the curriculum matrix for the bachelor's degree program in Drone Engineering. The numbers do not include the workload for the supervision of bachelor's theses. A supervision workload of 0.2 SWS is planned for each supervised thesis, i.e., an additional ASWS workload of 5 ASWS for 25 accredited study places. This results in a total of 79 ASWS over all 6 semesters combined, including the supervision of bachelor's theses.

1. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
1_1	Introduction to Programming	ILV	X	X	2.5	2	5.0	75.0	Coding	5
1_2	Principles of Flight and Aviation	ILV	X	X	2.5	1	2.5	37.5	Flight	5
1_3	Foreign Language I	ILV		X	4.5	1	4.5	67.5	Compl	6
1_4	Data & Analytics	ILV	X	X	2.5	1	2.5	37.5	Analysis	5
1_5	Introduction to Regulations and Safety	ILV		X	2.5	1	2.5	37.5	Business	5
1_6	Fundamentals in UAS components	ILV		X	2	1	2	30	Flight	4
Total line:					16.5		19.0	285.0		30
Course hours = Total WSH x course weeks					247.5					

2. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
2_1	UAS Programming	ILV	X	X	2.5	1	2.5	37.5	Coding	5
2_2	Mission Planning & Risk Assessment	ILV	X	X	2.5	1	2.5	37.5	Flight	5
2_4	Sensory Analysis for UAS Use Case I	ILV	X	X	2.5	1	2.5	37.5	Analysis	5
2_5	Foreign Language II	ILV		X	4.5	1	4.5	67.5	Compl	6
2_6	Project Management & Systems Engineering	ILV		X	2	1	2	30	Business	4
2_7	Sensor Data Management	ILV	X	X	2.5	1	2.5	37.5	Analysis	5
Total line:					16.5		16.5	247.5		30
Course hours = Total WSH x course weeks					247.5					

3. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
3_1	Advanced UAS Programming	ILV	X	X	2.5	1	2.5	37.5	Coding	5
3_2	UAS Project	PT	X	X	2	3	6	90	Flight	4
3_3	Business, Economics & Financing	ILV		X	3	1	3	45	Business	6
3_4	Sensory Analysis for UAS Use Case II	ILV		X	2.5	1	2.5	37.5	Analysis	5
3_5	Open Category Use Cases	ILV		X	2.5	1	2.5	37.5	Business	5
3_5	Autonomous Systems	ILV	X	X	2.5	1	2.5	37.5	Flight	5
Total line:					15.0		19.0	285.0		30
Course hours = Total WSH x course weeks					225.0					

4. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
4_1	Software Architecture for Robotic Systems	ILV	X	X	2	1	2	30	Coding	4
4_2	Mobility Project	PT	X	X	2	3	6	90	Flight	4
4_3	UAS Design	ILV	X	X	2.5	1	2.5	37.5	Flight	5
4_4	U-Space / UTM	ILV	X	X	2.5	1	2.5	37.5	Flight	5
4_5	UAS Simulation	ILV	X	X	2.5	1	2.5	37.5	Coding	5
4_6	Smart Mobility Concepts	ILV		X	2.5	1	2.5	37.5	Business	5
4_7	Scientific Writing	SE		X	1	1	1	15	Compl	2
Total line:					15.0		19.0	285.0		30
Course hours = Total WSH x course weeks					225.0					

5. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
5_1	Selected Topics in Business	ILV		X	0	1	0	0	Compl	6
5_2	Selected Topics in UAS Engineering	ILV	X	X	0	1	0	0	Compl	12
5_3	Selected Topics in UAS Sensory, Use Cases and Management	ILV	X	X	0	1	0	0	Compl	12
Total line:					0		0	0		30
Course hours = Total WSH x course weeks					0					

6. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
6_1	Bachelor Seminar	SE	X	X	0.5	1	0.5	7.5	Compl	10
6_2	Integrated Internship	BPR	X	X	0	1	0	0	Compl	20
Total line:					0.5		0.5	7.5		30
Course hours = Total WSH x course weeks					7.5					

Abbreviations	
E	Lecture in English language
ECTS	ECTS – Credit points
LV	Course
LVS	Course hour(s)
WSH	Weekly semester hour(s)
T	Lecture with technical background
WP	Elective subject

Summary curriculum data

Description	WSH	ASWS	ALVS	ECTS
Total number of courses over all semesters	63.5	74	1110	180
Total number of courses in 1st year of study	33	35.5	532.5	60
Total number of courses in 2nd year of study	30	38	570	60
Total number of courses in 3rd year of study	0.5	0.5	7.5	60
Total number of technical events over all semesters	36.5			126
Percentage of technical courses over all semesters based on WSH / ECTS	57.48 %			70 %
Total number of courses in English over all semesters	63.5			180
Proportion of courses in English over all semesters based on WSH / ECTS	119.81 %			169.81 %

2.3 Module descriptions

Module number:	**Flight Engineering**	**Scope:**	
Flight		**37**	**ECTS**
Degree program	University of Applied Sciences Bachelor's Program Drone Engineering full-time		
Position in the curriculum	1. Semester		
	2. Semester		
	3. Semester		
	4. Semester		
Level	1. Semester: Beginner / 2. Semester: Beginner / 3. Semester: Beginner / 4. Semester: Beginner		
Previous knowledge	1. Semester: None / 2. Semester: None / 3. Semester: None / 4. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	Principles of Flight and Aviation /ILV / LV-Nr: 1_2 / 1.Semester / ECTS: 5 - Principles of Flight eTextbook. https://www.aviationexam.com/ - Illman, Paul E. (2000). The Pilot's Handbook of Aeronautical Knowledge, McGraww-Hill. ISBN: 978-0070317826. - Principles of Flight for PPL and Beyond. (2007). Oxford Aviation Academy Limited. ISBN: 978-0955517747. - Torenbeek, E., & Wittenberg, H. (2020). Flight Physics: Essentials of Aeronautical Disciplines and Technology, with Historical Notes. Springer. ISBN: 978-3030331431. - Federal Aviation Administration (FAA). (2021). Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B). U.S. Department of Transportation. ISBN: 978-1619549920.		
	Fundamentals in UAS components /ILV / LV-Nr: 1_6 / 1.Semester / ECTS: 4 - Tal, D. (2021). Drone Technology in Architecture, Engineering and Construction. John Wiley & Sons Inc. ISBN: 978-1119545880. - Casagrande, G., Szabó, G., & Sik, A. (Eds.). (2018). Small Flying Drones Applications for Geographic Observation. Springer. ISBN: 978-3-319-66576-4. https://doi.org/10.1007/97 - Barnhart, R. K., Hottman, S. B., Marshall, D. M., & Shappee, E. (2021). Introduction to Unmanned Aircraft Systems. CRC Press. ISBN: 1000326861, 9781000326864.		

	Mission Planning & Risk Assessment /ILV / LV-Nr: 2_2 / 2.Semester / ECTS: 5 - Ahrens, C. D., & Henson, R. (2021). Meteorology Today: An Introduction to Weather, Climate, and the Environment (13th ed.). Cengage Learning. ISBN: 0357452720, 978-0357452721 - Federal Aviation Administration (FAA). (2021). Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B). U.S. Department of Transportation. ISBN: 978-1619549920. - EASA, Safety Management, https://www.easa.europa.eu/en/domains/safety-management/safety-risk-management - Kourousis, K. I. (2020). Special Issue: Civil and Military Airworthiness: Recent Developments and Challenges. (ISSN 2226-4310).
	UAS Project /PT / LV-Nr: 3_2 / 3.Semester / ECTS: 4 - Goodpasture, J. (2010). Project Management the Agile Way: Making it Work in the Enterprise. J. Ross Publishing Inc. ISBN: 978-1604270273. - Langer, A. M. (2016). Guide to Software Development: Designing and Managing the Life Cycle. Springer. ISBN: 978-1447167990.
	Autonomous Systems /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5 - Barfoot, T. D. (2024). State Estimation for Robotics. Cambridge University Press. ISBN: 978-1009299909. https://doi.org/10.1017/9781009299909 - LaValle, S. M. (2006). Planning Algorithms. Cambridge University Press. ISBN: 978-0521862059. - Siegwart, R., Nourbakhsh, I. R., & Scaramuzza, D. (2011). Introduction to Autonomous Mobile Robots (2nd ed.). The MIT Press. ISBN: 978-0262015356.
	Mobility Project /PT / LV-Nr: 4_2 / 4.Semester / ECTS: 4 - Goodpasture, J. (2010). Project Management the Agile Way: Making it Work in the Enterprise. J. Ross Publishing. ISBN: 978-1604270273. Langer, A. M. (2016). Guide to Software Development: Designing and Managing the Life Cycle. Springer. ISBN: 978-1447167990
	UAS Design /ILV / LV-Nr: 4_3 / 4.Semester / ECTS: 5 - Gundlach, J. (2014). Designing Unmanned Aircraft Systems: A Comprehensive Approach (2nd ed). AIAA Education Series. ISBN: 978-1624102615. - Karakoc, T. H., & Özbek, E. (2024). Unmanned Aerial Vehicle Design and Technology. Springer Cham. ISBN: 978-3031453205, https://doi.org/10.1007/978-3-031-45321-2. - Quan, Q., Dai, X., & Wang, S. (2020). Multicopter Design and Control Practice. Springer Singapore. ISBN: 978-9811531378. https://doi.org/10.1007/978-981-15-3138-5.

Literature recommendation	U-Space / UTM /ILV / LV-Nr: 4_4 / 4.Semester / ECTS: 5 - Bartsch, R., & Coyne, J. (2020). Drones in Society: Exploring the Strange New World of Unmanned Aircraft. Routledge. ISBN: 978-1472451125. - EASA. (2023). U-space ConOps and Architecture (4th ed.). EUROCONTROL, CORUS-XUAM Consortium, https://www.sesarju.eu/sites/default/files/documents/reports/U-space%20CONOPS%204th%20edition.pdf
Acquisition of skills	Principles of Flight and Aviation /ILV / LV-Nr: 1_2 / 1.Semester / ECTS: 5 Upon completing this course, students will be able to: - Identify the Components and Systems of Aircraft and Unmanned Aerial Systems (UAS): Recognize the key components of manned and unmanned aircraft, including propulsion systems, control systems, and avionics; explain the functions of these components and systems. - Apply the Principles of Aerodynamics to UAS Design: Analyze the design considerations specific to UAS using knowledge of aerodynamics; discuss how UAS designs accommodate their unique operational environments and purposes. - Implement Flight Planning and Navigation Techniques: Plan flights by considering route selection, altitude, and airspace restrictions; utilize navigation tools and technologies to ensure precision and safety during flights. - Demonstrate Understanding of Basic Meteorological Concepts: Describe fundamental meteorological principles, including the dynamics of the atmosphere and weather systems; explain the factors influencing weather conditions.
	Fundamentals in UAS components /ILV / LV-Nr: 1_6 / 1.Semester / ECTS: 4 Upon completing this course, students will be able to: - Identify and Understand Unmanned Aerial System (UAS) Components: Recognize the various components of a UAS, including the frame, motors, propellers, battery, flight controller, and sensors; explain the functions of these components within the UAS. - Evaluate Propulsion Systems: Assess the types of motors and propellers used in UAS; explain how different configurations affect performance, stability, and flight duration. - Analyze Power Supply and Management: Describe the types of batteries used in UAS and their management systems; analyze how power supply impacts the weight, balance, and endurance of UAS operations. - Operate Flight Control Systems: Explain how flight controllers manage UAS stability and navigation; integrate and interpret sensor data for effective UAS operation. - Implement Communication and Telemetry Systems: Evaluate the technologies used for UAS communication and telemetry, including radio, Wi-Fi, and cellular connections; explain how these technologies affect control range and data transmission. - Select and Integrate Payloads: Select and integrate various payloads (e.g., cameras, sensors, cargo) based on the UAS's purpose; consider factors like weight, power consumption, and data collection needs. - Apply Basic Maintenance and Troubleshooting: Develop skills in maintaining drone components for optimal performance; troubleshoot common issues related to hardware and software malfunctions.
	Mission Planning & Risk Assessment /ILV / LV-Nr: 2_2 / 2.Semester / ECTS: 5 Upon completing this course, students will be able to: - Conduct Comprehensive Mission Analysis: Demonstrate understanding of mission objectives, requirements, and constraints; apply steps to perform a thorough analysis, considering scope, resources, timelines, and potential risks, including weather-related risks. - Develop Effective Mission Plans: Create detailed and actionable mission plans that outline the steps, resources, and timelines; incorporate contingency planning for unpredictability in weather and other external factors. - Utilize Decision-Making Tools and Techniques: Employ various decision-making tools and techniques for mission planning and execution; ensure optimal decision-making under uncertain or changing circumstances. - Conduct Risk Assessment Including SORA: Perform comprehensive risk assessments using methods like SORA (Specific Operations Risk Assessment); address all main components of risk to ensure mission safety and compliance.
	UAS Project /PT / LV-Nr: 3_2 / 3.Semester / ECTS: 4 Upon completing this course, students will be able to: - Execute Projects Using Professional Project Management Techniques: Apply professional project management techniques to efficiently plan, execute, and complete projects. - Understand and Demonstrate Systematic Project Processing: Recognize the importance of systematic, meticulous, and timely processing of projects; implement these practices to ensure project success. - Demonstrate Familiarity with Project Roles: Identify and understand the specific roles within a project team; fulfill these roles effectively to contribute to project objectives. - Understand and Demonstrate Effective Project Communication: Acknowledge the importance of project communication in all project stages, including conversations, documentation, descriptions, and presentations. - Apply Expert Knowledge to Solve Specific Problems: Utilize expert knowledge and solve specific problems encountered during projects; implement practical solutions to overcome challenges.
	Autonomous Systems /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5

	Upon completing this course, students will be able to: - Demonstrate a Solid Foundation in Autonomous Navigation: Describe the principles of autonomous navigation, including different strategies such as waypoint navigation, visual navigation, and SLAM. Apply these strategies to various autonomous system applications. - Design and Implement Path Planning Algorithms: Design and implement various path planning algorithms, including grid-based, graph-based, and sampling-based methods; generate optimal paths for autonomous systems in complex environments.

	- Integrate Sensory Inputs for Navigation: Master data integration from multiple sensors such as LiDAR, GPS, IMU, and cameras and facilitate accurate localization, mapping, and navigation of autonomous systems using this data. - Apply SLAM Techniques: Understand and apply Simultaneous Localization and Mapping (SLAM) techniques; Enable autonomous systems to build and navigate maps of their environments. - Develop Obstacle Detection and Avoidance Mechanisms: Design real-time mechanisms for detecting and avoiding obstacles; ensure safe navigation of autonomous systems in dynamic environments. - Evaluate Navigation Strategies in Different Contexts: Assess the strengths and limitations of various navigation and path planning strategies; apply these strategies in different contexts, such as urban environments, indoor spaces, and off-road terrain.
Acquisition of skills	Mobility Project /PT / LV-Nr: 4_2 / 4.Semester / ECTS: 4 Upon completing this course, students will be able to: - Execute Projects Using Professional Project Management Techniques: Apply professional project management techniques to efficiently plan, execute, and complete projects. - Understand and Demonstrate Systematic Project Processing: Recognize the importance of systematic, meticulous, and timely processing of projects and implement these practices to ensure project success. - Demonstrate Familiarity with Project Roles: Identify and understand the specific roles within a project team and fulfill these roles effectively to contribute to project objectives. - Understand and Demonstrate Effective Project Communication: Acknowledge the importance of project communication in all project stages, including conversations, documentation, descriptions, and presentations. - Apply Expert Knowledge to Solve Specific Problems: Utilize expert knowledge, solve specific problems encountered during projects, and implement practical solutions to overcome challenges.
	UAS Design /ILV / LV-Nr: 4_3 / 4.Semester / ECTS: 5 Upon completing this course, students will be able to: - Master Aerodynamic Principles for Drones: Explain how aerodynamic principles such as lift, drag, thrust, and weight management apply to drone design; optimize flight performance and efficiency by applying these aerodynamic principles in drone development. - Select and Integrate Materials and Structures: Identify appropriate materials for drone construction, considering strength, weight, and durability trade-offs; design drone structures that effectively accommodate selected materials while meeting design specifications. - Demonstrate Understanding of the Fundamentals of Additive Manufacturing Processes: Describe additive manufacturing processes relevant to drone design, including fused deposition modeling (FDM), selective laser sintering (SLS), and stereolithography (SLA); explain the principles of these processes in the context of drone manufacturing. - Apply Design for Additive Manufacturing (DfAM) Principles: Implement DfAM principles to optimize drone designs for weight reduction, part consolidation, and performance enhancement; leverage additive manufacturing capabilities to improve structural geometries and overall design efficiency. - Select Materials for Additive Manufacturing: Evaluate and select appropriate materials for drone components based on their mechanical properties, weight, durability, and compatibility with additive manufacturing processes; justify material choices by assessing their suitability for specific drone parts and functions. - Prototype and Test Drone Designs: Utilize additive manufacturing for rapid prototyping of drone designs, facilitating quick iterations based on testing and feedback; conduct testing protocols specific to drones to evaluate and refine prototypes effectively.
	U-Space / UTM /ILV / LV-Nr: 4_4 / 4.Semester / ECTS: 5 Upon completing this course, students will be able to: - Demonstrate Understanding of U-Space and UTM Concepts: Explain the foundational principles of U-Space in Europe and UTM systems globally; identify the objectives, components, and functions of U-Space and UTM in ensuring safe and efficient drone operations in shared airspace. - Navigate Regulatory and Legal Frameworks: Interpret the regulatory and legal frameworks that underpin the U-Space and UTM system; ensure compliance with national and international aviation standards and regulations. - Implement U-Space Services: Describe the services provided within U-Space, such as e-registration, e-identification, geofencing, and traffic information; demonstrate the ability to implement these services in drone operations effectively. - Apply Traffic Management Strategies: Develop strategies for managing drone traffic, including conflict detection and resolution; implement strategic deconfliction and dynamic airspace configuration techniques. - Assess and Mitigate Risks in Drone Operations: Conduct risk assessment specific to drone operations within U-Space; apply mitigation strategies considering factors such as airspace density, ground risk, and weather conditions. - Integrate Drones into Multi-Modal Transport Systems: Explore the integration of drone operations with other modes of transportation within smart cities and urban mobility contexts; enhance the efficiency and accessibility of transport systems through drone integration.
Course contents	Principles of Flight and Aviation /ILV / LV-Nr: 1_2 / 1.Semester / ECTS: 5

	- Flight Mechanics: Understanding the fundamental forces of flight (lift, drag, weight, and thrust) and how they influence an aircraft's movement and stability. - Aerodynamics: Introduction to airflow around the aircraft's body, its effects on flight characteristics, and its significance in UAS design. - UAS and Instruments: Overview of the significant systems in human-crewed and crewless aircraft, including propulsion, navigation, and control systems. - UAS Types and Technologies: Detailed examination of various types of UASs, their design considerations, and the technologies that enable their flight capabilities. - Flight Control and Navigation: Understanding how UAS are controlled remotely and autonomously, including GPS, gyroscopes, and other sensors. - Operational Applications of UASs: Exploring the diverse uses of UASs in commercial, environmental, and

Course contents	humanitarian fields, as well as their impact on various industries. - Future Trends in Aviation and UAS Technology: The latest advancements in UAS technology, potential future applications, and the direction of the aviation industry. - Fundamentals of Meteorology: Introduction to meteorology, including atmospheric structure, composition, and the global climate system. The basics of weather phenomena and their formation. - Weather systems and patterns: Examination of different weather systems (e.g., fronts, high- and low-pressure systems) and patterns, including their development and weather forecasting principles.
	Fundamentals in UAS components /ILV / LV-Nr: 1_6 / 1.Semester / ECTS: 4 - Introduction to UAS Anatomy: Overview of the basic structure of drones, including the frame, propulsion system, power source, and control system. - Propulsion System: Deep dive into motors, propellers, and electronic speed controllers (ESCs) and how they work together to control the movement and altitude of the UAS. - Power Source: Understanding battery technology used in UAS, including types of batteries (e.g., LiPo), battery management, and factors affecting flight time and performance. - Flight Controllers: Examination of the flight controllers, managing stability, navigation, and data from various sensors. - Sensors and Navigation: Overview of sensors commonly used in UAS, such as GPS, gyros, accelerometers, and barometers, and their roles in positioning and navigation. - Communication Systems: Understanding the technology behind remote control and telemetry, including radio frequency (RF) communication, First Person View (FPV) systems, and digital transmission technologies. - Payloads and Add-ons: Exploration of various payloads UAS can carry, including cameras, surveying equipment, and cargo, and their impact on UAS design and operation. - Software and Firmware: Introduction to the software that controls UAS, including firmware for flight controllers and applications for flight planning and data analysis. - Maintenance and Troubleshooting: Basic maintenance practices for keeping UAS operational and troubleshooting common issues related to UAS components. - Design Considerations: Factors influencing the design of drones, such as aerodynamics, weight distribution, and intended use (e.g., racing, photography, surveying).
	Mission Planning & Risk Assessment /ILV / LV-Nr: 2_2 / 2.Semester / ECTS: 5 - Introduction to Mission Planning: Basic mission planning concepts, including objective setting, resource allocation, timing, and contingency planning. - Route and Timing Adjustments: Techniques for adjusting mission routes and timing. Strategies for avoiding adverse weather conditions and optimizing mission success. - Safety Precautions and Risk Management: Identifying risks to operations and personnel and implementing safety measures and emergency plans to mitigate the impact of unpredictable circumstances. - Real-Time Monitoring: Discussion on the importance of real-time monitoring during mission execution. Utilizing technology for ongoing weather assessment and making in-mission adjustments as necessary. - Introduction to Risk Assessment: Knowledge about Specific Operations Risk Assessment (SORA) and related concepts.
	UAS Project /PT / LV-Nr: 3_2 / 3.Semester / ECTS: 4 This course is designed to prepare students for real-world problems by engaging them in group projects that tackle practice-relevant tasks. These tasks are preferably based on commissions from business partners or public institutions or involve field experiences under the guidance of the course instructor. Students will apply their previously acquired knowledge, integrate their observations and experiences within the context of the practical project, deepen their subject-specific competencies, and strengthen complementary skills such as social competence, risk management, budgeting competence, and economically responsible decision-making. Students receive project briefs from the course instructor or external partners (e.g., associations or companies) and independently plan, coordinate, budget, monitor, evaluate, and report on the projects. The course instructor provides guidance and project coaching as needed.
	Autonomous Systems /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5 - Introduction to Autonomous Systems: Overview of various autonomous systems, including ground vehicles, aerial drones, and maritime vehicles. Exploring the scope and challenges of autonomy. - Fundamentals of Path Planning: Introduction to concepts and algorithms used in path planning, such as grid-based, graph-based, and sampling-based methods. Discussion on A*, Dijkstra's algorithm, RRT (Rapidly-exploring Random Tree), and their variations. - Localization and Mapping: Techniques for determining the system's position within its environment and creating maps. Discussion on SLAM (Simultaneous Localization and Mapping) and its variants, including visual SLAM and LiDAR-based approaches. - Navigation and Obstacle Avoidance: Strategies for autonomous navigation in dynamic environments, including static and moving obstacle avoidance. Overview of reactive and predictive models for safe navigation. - Machine Learning and AI in Autonomy: Exploration of the role of machine learning and artificial intelligence in enhancing the capabilities of autonomous systems, including decision-making, object detection, and adaptive path planning. - Control Systems for Autonomous Operation: Basics of control theory as applied to autonomous systems, including PID control, feedforward control, and state feedback control. Discussion on how these systems execute planned paths and maintain stability.

	Mobility Project /PT / LV-Nr: 4_2 / 4.Semester / ECTS: 4 This course is designed to prepare students for real-world problems by engaging them in group projects that tackle practice-relevant tasks. These tasks are preferably based on commissions from business partners or public institutions or involve field experiences under the guidance of the course instructor. Students will apply their previously acquired knowledge, integrate their observations and experiences within the context of the practical project, deepen their subject-specific competencies, and strengthen complementary skills such as social competence, risk management, budgeting competence, and economically responsible decision-making. Students receive project briefs from the course instructor or external partners (e.g., associations or companies) and independently plan, coordinate, budget, monitor, evaluate, and report on the projects. The course

Course contents	instructor provides guidance and project coaching as needed.
	UAS Design /ILV / LV-Nr: 4_3 / 4.Semester / ECTS: 5 - Drone Components and Materials: Detailed exploration of drone components, including frame, propulsion system, power supply, control system, and payloads; selection of materials to optimize weight, durability, and performance. - Design for Specific Applications: Approaches to designing drones for specific applications, such as aerial photography, payload delivery, or environmental monitoring; considerations for payload integration, flight range, and durability. - Manufacturing and Assembly Processes: Overview of the manufacturing and assembly processes for drones, including prototyping techniques, mass production challenges, and quality control measures.
	U-Space / UTM /ILV / LV-Nr: 4_4 / 4.Semester / ECTS: 5 - Introduction to U-Space: Overview of U-Space or Unmanned Aircraft System Traffic Management (UTM) concepts, objectives, and the framework for safely integrating drones into the airspace. - U-Space Services: Detailed examination of U-Space services, including e-identification, geofencing, flight authorization, and traffic information. - Regulatory Environment: Understanding of the regulatory landscape for U-Space, including current regulations, standards, and future developments at national and international levels. - Drone Registration and E-Identification: Process for registering drones and technology behind electronic identification systems. - Airspace Management and Conflict Resolution: Strategies for managing drone operations in shared airspace, including conflict detection and resolution strategies. - Remote Identification and Tracking: Importance of remote identification and tracking of drones for security, safety, and compliance. - Integration with Human-Crewed Aviation: Challenges and strategies for integrating drone traffic with human-crewed aviation within the same airspace.
Teaching and learning methods	Principles of Flight and Aviation /ILV / LV-Nr: 1_2 / 1.Semester / ECTS: 5 Presentation, group work, discussion, exercises,
	Fundamentals in UAS components /ILV / LV-Nr: 1_6 / 1.Semester / ECTS: 4 Presentation, group work, discussion, exercises,
	Mission Planning & Risk Assessment /ILV / LV-Nr: 2_2 / 2.Semester / ECTS: 5 Presentation, group work
	UAS Project /PT / LV-Nr: 3_2 / 3.Semester / ECTS: 4 Group work
	Autonomous Systems /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5 Presentation, group work, discussion, exercises
	Mobility Project /PT / LV-Nr: 4_2 / 4.Semester / ECTS: 4 Group work
	UAS Design /ILV / LV-Nr: 4_3 / 4.Semester / ECTS: 5 Presentation, group work, discussion, exercises
	U-Space / UTM /ILV / LV-Nr: 4_4 / 4.Semester / ECTS: 5 Presentation, group work, discussion, exercises
Evaluation Methods Criteria	Principles of Flight and Aviation /ILV / LV-Nr: 1_2 / 1.Semester / ECTS: 5 Portfolio tests
	Fundamentals in UAS components /ILV / LV-Nr: 1_6 / 1.Semester / ECTS: 4 portfolio tests
	Mission Planning & Risk Assessment /ILV / LV-Nr: 2_2 / 2.Semester / ECTS: 5 Portfolio test
	UAS Project /PT / LV-Nr: 3_2 / 3.Semester / ECTS: 4 Project and documentation
	Autonomous Systems /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5 Exam
	Mobility Project /PT / LV-Nr: 4_2 / 4.Semester / ECTS: 4 Project and documentation
	UAS Design /ILV / LV-Nr: 4_3 / 4.Semester / ECTS: 5 Portfolio tests

Evaluation Methods Criteria	U-Space / UTM /ILV / LV-Nr: 4_4 / 4.Semester / ECTS: 5 Exam

Module number:	**Data Analysis**	**Scope:**	
Analysis		**20**	**ECTS**
Degree program	University of Applied Sciences Bachelor's Program Drone Engineering full-time		
Position in the curriculum	1. Semester		
	2. Semester		
	3. Semester		
Level	1. Semester: Beginner / 2. Semester: Beginner / 3. Semester: Beginner		
Previous knowledge	1. Semester: None / 2. Semester: Data & Analysis / 2. Semester: None / 3. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	Data & Analytics /ILV / LV-Nr: 1_4 / 1.Semester / ECTS: 5 - James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). An Introduction to Statistical Learning: with Applications in R (2nd ed.). Springer. ISBN: 978-1071614174. - Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer. ISBN: 978-0387310732. - Oppenheim, A. V., & Schafer, R. W. (2014). Discrete-Time Signal Processing (3rd ed.). Pearson. ISBN: 978-0131988422. - Shumway, R. H., & Stoffer, D. S. (2017). Time Series Analysis and Its Applications: With R Examples (4th ed.). Springer. ISBN: 978-3319524511.		
	Sensory Analysis for UAS Use Case I /ILV / LV-Nr: 2_4 / 2.Semester / ECTS: 5 - James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). An Introduction to Statistical Learning: with Applications in R (2nd ed.). Springer. ISBN: 978-1071614174. - Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer. ISBN: 978-0387310732. - Oppenheim, A. V., & Schafer, R. W. (2021). Discrete-Time Signal Processing (3rd ed.). Pearson. ISBN: 978-0137549771. - Shumway, R. H., & Stoffer, D. S. (2018). Time Series Analysis and Its Applications: With R Examples (4th ed.). Springer. ISBN: 978-3319524511. DOI:10.1002/9781119528227		
	Sensor Data Management /ILV / LV-Nr: 2_7 / 2.Semester / ECTS: 5 - Elmasri, R., & Navathe, S. B. (2021). Fundamentals of Database Systems (7th ed.). Pearson. ISBN: 978-0137502523. - Silberschatz, A., Korth, H. F., & Sudarshan, S. (2020). Database System Concepts (7th ed.). McGraw-Hill Education. ISBN: 978-1260084504. - Pivert, O. (2018). NoSQL Data Models: Trends and Challenges, Wiley-ISTE, ISBN: 978-1786303646 - Dunning, T., & Friedman, E. (2014). Time Series Databases: New Ways to Store and Access Data. O'Reilly Media. ISBN: 978-1491914724.		
	Sensory Analysis for UAS Use Case II /ILV / LV-Nr: 3_4 / 3.Semester / ECTS: 5 - Kerle, N., Nex, F., Gerke, M., Duarte, D., & Vetrivel, A. (2020). UAV-based structural damage mapping: A review. ISPRS Journal of Photogrammetry and Remote Sensing, 159, 104-119. - Nex, F., & Remondino, F. (2014). UAV for 3D mapping applications: A review. Applied Geomatics, 6(1), 1-15. - Schirrmann, M. (2022). UAV Imagery for Precision Agriculture. Remote Sensing, MDPI. ISSN 2072-4292		
Acquisition of skills	Data & Analytics /ILV / LV-Nr: 1_4 / 1.Semester / ECTS: 5 Upon completing this course, students will be able to: - Understand Fundamental Statistical Principles: Explain key concepts such as probability distributions, statistical inference, hypothesis testing, and descriptive statistics essential for data analysis. - Apply Data Collection Techniques: Design experiments and surveys with effective data collection techniques, utilizing sampling methods to collect data accurately while minimizing bias. - Perform Exploratory data analysis: Use exploratory data analysis (EDA) techniques to summarize the main characteristics of data through visual and quantitative methods, identifying patterns, trends, and anomalies. - Utilize Mathematical Principles: Apply basic mathematical principles, including algebra, geometry, and particularly integral calculation, to solve problems related to data analysis and interpretation, and perform integral calculations for determining areas under curves, volumes, and other quantities essential for data modeling and analysis.		
	Sensory Analysis for UAS Use Case I /ILV / LV-Nr: 2_4 / 2.Semester / ECTS: 5		

	Upon completing this course, students will be able to: - Identify UAS sensor technologies: Describe the types of sensors commonly used in drones, including optical, thermal, multispectral, LiDAR, and radar sensors, and explain their use cases. - Plan and Conduct Sensor Data Collection: Develop and execute plans for UAS flights to efficiently collect data from onboard sensors, evaluating the impact of flight parameters on data quality. - Process Raw Sensor Data: Apply basic techniques for processing raw sensor data, such as image stitching, filtering, and preliminary analysis, to prepare data for further interpretation. - Analyze Sensor Data for Applications: Implement simple analysis methods to sensor data to extract useful information for applications in agriculture, environmental monitoring, or infrastructure inspection. - Integrate Sensor Data with GIS: Integrate processed sensor data with Geographic Information Systems (GIS) to enhance spatial analysis and visualization. - Ensure Sensor Data Quality and Accuracy: Evaluate data quality and accuracy in sensory analysis, including

Acquisition of skills	calibrating sensors and validating data against ground truth.
	Sensor Data Management /ILV / LV-Nr: 2_7 / 2.Semester / ECTS: 5 Upon completing this course, students will be able to: - Implement and Manage Data Storage Solutions: Identify the most suitable data storage solutions for drone data, considering data volume, security, accessibility, and cost for on-premises and cloud-based storage options. - Explain Database System Purposes and Functions: Describe the purposes of database systems and how they function. - Utilize and Compare Database Systems: Use different database systems and compare their features and performance. - Understand Relational Database Systems: Demonstrate a detailed understanding of relational database systems. - Develop and Implement Data Structures: Create and implement data structures to solve specific problems. - Represent Real-World Situations as Data Models: Independently represent real-world situations as a data model. - Translate Data Models into Relational Data Structures: Convert data models into relational data structures. - Interact with Database Systems: Operate and manage interactions with various database systems. - Perform Basic NoSQL Database Management: Conduct basic database management activities in NoSQL systems. - Apply Specialized Database Systems: Apply other database systems practically, such as those for time series data.
	Sensory Analysis for UAS Use Case II /ILV / LV-Nr: 3_4 / 3.Semester / ECTS: 5 Upon completing this course, students will be able to: - Demonstrate Knowledge of Advanced Drone Sensors: Explain advanced sensor technologies used in drones, including multispectral, hyperspectral, thermal, LiDAR, and radar sensors, and describe their principles, capabilities, and limitations. - Apply Complex Data Analysis Techniques: Perform advanced data processing and analysis on sensor data, including image classification, pattern recognition, and change detection, using tools such as machine learning and AI for enhanced insights. - Master data Fusion and Integration Techniques: Fuse data from multiple sensors to create comprehensive datasets that provide richer insights than could be obtained from any single sensor and use the algorithms and software tools that facilitate this process. - Deploy Application-Specific Sensors: Select and configure drone sensor payloads optimized for specific applications, such as precision agriculture, environmental monitoring, infrastructure inspection, and disaster management. - Translate Data into Actionable Insights: Convert complex datasets into clear, actionable insights for decision-makers and present findings in a manner accessible to non-expert audiences.
Course contents	Data & Analytics /ILV / LV-Nr: 1_4 / 1.Semester / ECTS: 5 - Introduction to Data Analysis: Overview of data analysis, its importance in various fields, and an introduction to the data types (quantitative vs. qualitative). - Mathematics for Data Analysis: Essential mathematical concepts, including algebra and geometry, and an introduction to calculus with a focus on integral calculation. - Basic Statistical Principles: Introduction to descriptive statistics, probability theory, distributions, and the central limit theorem. - Data Collection Methods: Exploration of various data collection techniques, sampling methods, and the design of experiments and surveys for accurate data gathering. - Exploratory Data Analysis (EDA): Techniques for summarizing and visualizing data to identify patterns, outliers, and insights.
	Sensory Analysis for UAS Use Case I /ILV / LV-Nr: 2_4 / 2.Semester / ECTS: 5 - Introduction to UAS Sensors: Overview of common types of sensors used in UAS, including optical, thermal, LiDAR, radar, and multispectral sensors, and their operational principles. - Sensor Selection for Applications: Criteria for selecting appropriate sensors based on specific use cases, such as agriculture, surveying, search and rescue, or environmental monitoring. - Data Acquisition and Processing: Techniques for collecting data using drone-mounted sensors, including considerations for flight planning to optimize data quality. - Optical and Thermal Imaging Analysis: Basics of processing and analyzing images from optical and thermal cameras, including applications for inspection, surveillance, and environmental monitoring. - LiDAR and 3D Mapping: Introduction to Light Detection and Ranging (LiDAR) technology for creating high-resolution maps and 3D models with applications in forestry management and urban planning. - Radar and Sonar Sensors: Exploration of radar and sonar sensors for obstacle detection, terrain following, and altitude measurement in various flying conditions. - Multispectral and Hyperspectral Imaging: Applications of multispectral and hyperspectral imaging in precision agriculture, vegetation health assessment, and environmental research. - Integration and Fusion of Sensor Data: Techniques for combining data from multiple sensors to enhance analysis, improve accuracy, and support decision-making. - Machine Learning and AI for Sensor Data Analysis: Introduction to using machine learning algorithms and artificial intelligence to interpret sensor data, identify patterns, and automate decision processes.
	Sensor Data Management /ILV / LV-Nr: 2_7 / 2.Semester / ECTS: 5

	- Fundamentals of Database Systems and Data Management: Core principles of database systems and data management. - Data Modeling: Developing data models including single entities, attributes, cardinality, conditionality, and relationship types. - Normalization and Keys: Identifying candidate keys, superkeys, and primary keys; normalizing data structures to at least 1NF, 2NF, and 3NF. - SQL Interaction: Using SQL for data definition language (DDL), data manipulation language (DML), and data query language (DQL).

Course contents	- NoSQL Database Management: Basic management activities on advanced database concepts within the NoSQL domain. - Time Series and Unstructured Data Management: Managing time series data sets and unstructured data (e.g., images).
	Sensory Analysis for UAS Use Case II /ILV / LV-Nr: 3_4 / 3.Semester / ECTS: 5 - Sensor Selection for Applications: Criteria for selecting appropriate sensors based on specific use cases, such as agriculture, surveying, search and rescue, or environmental monitoring. - Data Acquisition and Processing: Techniques for collecting data using drone-mounted sensors, including considerations for flight planning to optimize data quality. - Optical and Thermal Imaging Analysis: Basics of processing and analyzing images from optical and thermal cameras, including applications for inspection, surveillance, and environmental monitoring. - LiDAR and 3D Mapping: Introduction to Light Detection and Ranging (LiDAR) technology for creating high-resolution maps and 3D models with applications in forestry management and urban planning. - Radar and Sonar Sensors: Exploration of radar and sonar sensors for obstacle detection, terrain following, and altitude measurement in various flying conditions. - Multispectral and Hyperspectral Imaging: Applications of multispectral and hyperspectral imaging in precision agriculture, vegetation health assessment, and environmental research. - Integration and Fusion of Sensor Data: Techniques for combining data from multiple sensors to enhance analysis, improve accuracy, and support decision-making. - Machine Learning and AI for Sensor Data Analysis: Introduction to using machine learning algorithms and artificial intelligence to interpret sensor data, identify patterns, and automate decision processes.
Teaching and learning methods	Data & Analytics /ILV / LV-Nr: 1_4 / 1.Semester / ECTS: 5 Presentation, group work, discussion, exercises,
	Sensory Analysis for UAS Use Case I /ILV / LV-Nr: 2_4 / 2.Semester / ECTS: 5 Presentation, group work, discussion, exercises
	Sensor Data Management /ILV / LV-Nr: 2_7 / 2.Semester / ECTS: 5 Presentation, group work, discussion, exercises
	Sensory Analysis for UAS Use Case II /ILV / LV-Nr: 3_4 / 3.Semester / ECTS: 5 Presentation, group work, discussion, exercises
Evaluation Methods Criteria	Data & Analytics /ILV / LV-Nr: 1_4 / 1.Semester / ECTS: 5 Exam
	Sensory Analysis for UAS Use Case I /ILV / LV-Nr: 2_4 / 2.Semester / ECTS: 5 Portfolio tests
	Sensor Data Management /ILV / LV-Nr: 2_7 / 2.Semester / ECTS: 5 Exam
	Sensory Analysis for UAS Use Case II /ILV / LV-Nr: 3_4 / 3.Semester / ECTS: 5 Exam

Module number:	**Business**	**Scope:**	
Business		**25**	**ECTS**
Degree program	University of Applied Sciences Bachelor's Program Drone Engineering full-time		
Position in the curriculum	1. Semester		
	2. Semester		
	3. Semester		
	4. Semester		
Level	1. Semester: Beginner / 2. Semester: Beginner / 3. Semester: Beginner / 4. Semester: Beginner		
Previous knowledge	1. Semester: None / 2. Semester: None / 3. Semester: None / 4. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	Introduction to Regulations and Safety /ILV / LV-Nr: 1_5 / 1.Semester / ECTS: 5 - Zavrsnik, A. (2016). Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance, Springer. https://doi.org/10.1007/97. - European Union Aviation Safety Agency (EASA). Drones & Air Mobility. https://www.easa.europa.eu/en/domains/civil-drones - Federal Aviation Administration (FAA). (2021). Remote Pilot – Small Unmanned Aircraft Systems Study Guide (FAA-G-8082-22). U.S. Department of Transportation. - European Union Aviation Safety Agency (EASA). (2024). Easy Access Rules for Unmanned Aircraft Systems (Regulations (EU) 2019/947 and 2019/945. https://www.easa.europa.eu/en/document-library/easy-access-rules/easy-access-rules-unmanned-aircraft-systems-regulations-eu		
	Project Management & Systems Engineering /ILV / LV-Nr: 2_6 / 2.Semester / ECTS: 4 - Lock, D. (2017). Project Management (7th ed.). Routledge. ISBN: 978-1138713543. - Kuster, J., Bachmann, C., Hubmann, M., Lippmann, R., & Schneider, P. (2023). Project Management Handbook Agile – Traditional – Hybrid. Springer. ISBN: 978-3662662106. https://doi.org/10.1007/978-3-662-66211-3.		
	Business, Economics & Financing /ILV / LV-Nr: 3_3 / 3.Semester / ECTS: 6 - Weygandt, J. J., Kimmel, P. D., & Kieso, D. E. (2020). Accounting Principles. John Wiley & Sons (14th ed.). ISBN: 978-1119707110. - Horngren, C. T., Datar, S. M., & Rajan, M. V. (2017). Cost Accounting: A Managerial Emphasis (16th ed.). Pearson. ISBN: 978-0134475585. - Mankiw, N. G. (2020). Principles of Economics (9th ed.). Cengage Learning. ISBN: 978-0357038314. - Krugman, P., & Wells, R. (2021). Macroeconomics (6th ed.). Worth Publishers. ISBN: 978-1319105990. - David, F. R., & David, F. R. (2019). Strategic Management: Concepts and Cases (17th ed.). Pearson. ISBN: 978-0134153971.		
	Open Category Use Cases /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5 - Sehrawat, V. (2020). Drones and the Law: International Responses to Rapid Drone Proliferation. Emerald Group Publishing. ISBN: 978-1800432499. - Pitta, S. D. & Price, D. G. (2016). Professional Drone Pilot's Handbook & FAA Remote Pilot Test Guide. Association of Professional Drone Pilots, Inc. ISBN: 978-1535567305.		
	Smart Mobility Concepts /ILV / LV-Nr: 4_6 / 4.Semester / ECTS: 5 - Shaheen, S. (2018). Shared Mobility: The Potential of Ride Hailing and Pooling. In: Sperling, D., Ed., Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future (2nd ed.). Island Press, 55-76. https://doi.org/10.5822/978-1-61091-906-7_3 - United Nations Economic Commission for Europe (UNECE). (2020). A Handbook on Sustainable Urban Mobility and Spatial Planning. eISBN: 978-9210048590. unece.org/DAM/trans/main/wp5/publications/1922152E_WEB_light.pdf - AiRMOUR Project. (2023). Guidebook for UAM Integration. AIRMORE Project. https://airmour.eu/deliverables/ - International Rule Set for Urban/Innovative/Advanced Air Mobility (FAA, EASA, etc.).		
Acquisition of skills	Introduction to Regulations and Safety /ILV / LV-Nr: 1_5 / 1.Semester / ECTS: 5		

	Upon completing this course, students will be able to: - Understand Aviation Regulations and Compliance: Demonstrate knowledge of national and international regulations governing aviation and UAS operations, including the roles of regulatory bodies such as the FAA (Federal Aviation Administration) and EASA (European Aviation Safety Agency). - Navigate Authorization Procedures for Aviation Operations: Demonstrate the ability to navigate the authorization processes for manned and unmanned aviation activities, including securing necessary licenses, permits, and clearances. - Conduct Risk Assessments for Aviation Operations: Apply risk management principles to assess the safety risks associated with aviation operations, developing strategies for mitigation and response to ensure operational safety. - Manage Airspace for Safe Operations: Manage the complexities of airspace management, including classifications, restrictions, and using controlled and uncontrolled airspace for different flight operations. - Implement Safety Management Systems (SMS): Develop competencies in designing and implementing safety management systems in aviation contexts, focusing on safety policy, risk management, safety assurance, and safety promotion. - Pass the A1 /A3 category as a UAS pilot (open category).

Acquisition of skills	Project Management & Systems Engineering /ILV / LV-Nr: 2_6 / 2.Semester / ECTS: 4 Upon completing this course, students will be able to: - Navigate Project Management Concepts: Demonstrate understanding of key concepts in technical project management. - Apply Project Management Methods: Evaluate different project management methods and the roles involved. - Utilize Modern Software Tools: Apply project management principles using tools like GitLab, GitHub, and Jira. - Design Safety-Critical Systems: Design safety-critical systems, including systems engineering and requirements analysis.
	Business, Economics & Financing /ILV / LV-Nr: 3_3 / 3.Semester / ECTS: 6 In the field of Accounting: The students: - Can explain the basic concepts and sub-areas of accounting. - Can apply fundamental legal provisions of sales tax law. - Can recognize, examine, process, and record documents in an income-expenditure account and file them. - Can explain the areas of responsibility of cost accounting and name subdivisions of cost accounting. - Can use cost accounting as a basis for pricing. In the field of Business Administration: The students: - Are familiar with different legal forms of companies. - Can apply various tools for investment decision-making. - Can design a business plan. In the field of Economics: The students: - Can delineate and explain the basics of economics. - Can classify and assess microeconomic and macroeconomic decisions. - Can evaluate different economic systems and economic orders. - Are familiar with the basics of network economics.
	Open Category Use Cases /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5 Upon completing this course, students will be able to: - Apply the Regulatory Framework for Drone Operations: Demonstrate a detailed understanding of the regulatory framework governing open-category drone operations, including specific limitations, requirements, and types of operations permitted without specific authorizations. - Identify Drone Use Cases: Identify and evaluate potential use cases (GIS, video, construction) within legal and safety parameters. - Plan Operations: Develop operational plans that are compliant with open category regulations, addressing all aspects from flight planning to risk management in accordance with legal requirements. - Utilize Technology Effectively: Leverage technology effectively for drone applications, implementing optimal hardware and software solutions for enhanced efficiency and effectiveness. - Demonstrate Effective Communication and Lobbying Skills: Communicate benefits and limitations of open-category drone operations effectively in presentations and reports to stakeholders. - Pass the A2 category as a UAS pilot (open category).
	Smart Mobility Concepts /ILV / LV-Nr: 4_6 / 4.Semester / ECTS: 5 Upon completing this course, students will be able to: - Understand the Principles of Smart Mobility: Explain foundational concepts of smart mobility, including its goals to enhance transportation efficiency, reduce environmental impact, and improve accessibility through technology integration. - Evaluate Smart Transportation Technologies: Analyze the range of technologies driving smart mobility, such as autonomous vehicles, electric mobility, and advanced traffic management systems, and explain associated benefits and challenges. - Design Integrated Mobility Solutions: Design and propose integrated mobility solutions leveraging multiple modes of transportation (public transit, ridesharing, biking) and technology platforms to meet diverse mobility needs. - Assess the Impact of Smart Mobility on Urban Planning: Examine the influence of smart mobility concepts on urban and regional planning, including redesigning urban spaces to accommodate new transportation modes and promote sustainable mobility patterns. - Implement Sustainable Transportation Strategies: Evaluate strategies for promoting sustainable transportation, including incentives for electric vehicle adoption, development of charging infrastructure, and policies to encourage active transportation (walking and biking).
Course contents	Introduction to Regulations and Safety /ILV / LV-Nr: 1_5 / 1.Semester / ECTS: 5

	- Aviation Regulation Overview: Introduction to the framework of national and international aviation regulations. Focus on the bodies responsible for creating and enforcing these rules, such as the FAA and EASA. - Authorization Procedures for Human-Crewed and Crewless Flights: Detailed exploration of the process for obtaining authorization to operate both human-crewed and crewless aircraft, including licensing, certifications, and

Course contents	special permissions. - Risk Assessment in Aviation Operations: Techniques and methodologies for assessing risks associated with flight operations, including the consideration of potential hazards, evaluation of risk severity and likelihood, and the implementation of mitigation strategies. - Safety Management Systems (SMS): Principles of SMS in aviation, covering policy, risk management, assurance, and promotion in both commercial and private aviation. - Airspace Management and Classification: Comprehensive overview of airspace classification, from controlled to uncontrolled airspace, including the rules governing aircraft operation within these spaces. - UAS-Specific Regulations and Operational Limits: Examination of regulations designed explicitly for UAS operations, including flight altitude limits, no-fly zones, and line-of-sight operations. - Incident Reporting and Investigation: Procedures for reporting aviation incidents and accidents, considering the role of investigation authorities and how findings contribute to improving aviation safety.
	Project Management & Systems Engineering /ILV / LV-Nr: 2_6 / 2.Semester / ECTS: 4 - Introduction to Project Management: Overview of project management principles, the role of a project manager, and the importance of project management in achieving business objectives. - Project Life Cycle: Exploration of the stages of a project from initiation and planning through execution, monitoring, control, and closure, as well as consideration of unique aspects of managing technology and engineering projects. - Project Planning and Scope Management: Techniques for defining project scope, setting objectives, and developing detailed work plans, including creating work breakdown structures (WBS) and scope management. - Time and Cost Management: Strategies for estimating project duration and costs, scheduling activities, and efficient resource management. - Quality Management: Principles of quality management in projects, including setting standards, quality assurance, and quality control measures. - Risk Management: Potential risk identification, impact assessment, and risk mitigation strategy development. - Communication and Stakeholder Management: Techniques for effective communication and managing relationships with stakeholders, including team members, clients, suppliers, and other project stakeholders. - Agile and Traditional Project Management Methodologies: Comparison of traditional (e.g., Waterfall) and agile project management methodologies, including when and how to apply them effectively in different project contexts. - Project Management Tools And Software: Introduction to the tools and software (e.g., Microsoft Project, Trello, Jira) available to assist in project planning, scheduling, resource allocation, and monitoring. - Systems Engineering of Safety-Critical Systems: Requirements analysis and design of safety-critical systems.
	Business, Economics & Financing /ILV / LV-Nr: 3_3 / 3.Semester / ECTS: 6 Business Administration: - Entrepreneurial Fundamentals: Discussion of business-related topics such as legal forms, purchase contracts and regulations, and commercial registers. - Financing Methods: Introduction to equity financing, restructuring financing, debt financing, and modern financing methods. - Business Plan Development: Business plan development, including financial planning. - Strategic Management: Planning and analysis in strategic management. - Investment Calculation Methods: Calculation techniques for static and dynamic investment. Economics: - Economic fundamentals: Introduction to the basics of economics. - Market theory and price theory: Exploring market dynamics and pricing. - Microeconomics, Macroeconomics, Network Economics: Foundational concepts in microeconomics, macroeconomics, network economics. - Economic Indicators: Exploration of economic indicators like GDP, HDI, inflation, deflation, and stagflation. Financing: - Fundamentals of Accounting: Introduction to the basics of accounting. - Cash Accounting: Exploration of cash-based accounting methods. - Cost Accounting Areas: Introduction of different areas within cost accounting, including cost concepts in decision making, cost classification and allocation, COGS, overhead application, conversion cost, and total cost formula. - Cost Accounting for Pricing: Overview of procurement, differential, and sales calculations, as well as actual cost accounting.
	Open Category Use Cases /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5 - Global Drone Regulations: Overview of global drone regulations with a focus on the open category, exploring criteria and limitations across different jurisdictions. - Risk Assessment Techniques: Applying techniques for conducting risk assessments and implementing risk mitigation strategies for various drone operations. - Exploration of Use Cases: Exploring permitted use cases under the open category, such as real estate photography, agricultural monitoring, small-scale mapping, and infrastructure inspection. - Operational Planning: Operational planning for open category drone missions. - Hands-On Simulations: Hands-on sessions using drone simulation software and application in real-world use cases.
	Smart Mobility Concepts /ILV / LV-Nr: 4_6 / 4.Semester / ECTS: 5

	- Smart Mobility: Introduction to smart mobility components and their role in smart cities. Exploring goals like congestion reduction, improved accessibility, and sustainability. - Key Technologies Driving Smart Mobility: Exploration of IoT (Internet of Things), AI, blockchain, and 5G connectivity; applying technologies enabling real-time data collection, analysis, and automated decision-making. - Autonomous Vehicles: Detailed look at the development and impact of autonomous vehicles (cars, drones, public transport); discussion of integration challenges, safety, and public acceptance. - Electric Vehicles (EVs) and Charging Infrastructure: The role of electric vehicles in promoting sustainable mobility, challenges in adoption, and the development of charging infrastructure to support EV proliferation. - Shared Mobility Services: Examination of shared mobility models, such as bike-sharing, car-sharing, and ride-hailing services, discussing their impact on urban mobility patterns and the role of digital platforms. - Public Transportation and ITS (Intelligent Transportation Systems): Innovations in public transportation, including

Course contents	smart ticketing, real-time tracking, and ITS for traffic management and control; consideration of smart technology for enhancing the efficiency and user experience of public transport. - Urban Planning and (Air) Mobility as a Service (MaaS): Principles of urban planning for air mobility.
Teaching and learning methods	Introduction to Regulations and Safety /ILV / LV-Nr: 1_5 / 1.Semester / ECTS: 5 Presentation, group work, discussion, exercises, presentation,
	Project Management & Systems Engineering /ILV / LV-Nr: 2_6 / 2.Semester / ECTS: 4 Presentation, group work, discussion, exercises
	Business, Economics & Financing /ILV / LV-Nr: 3_3 / 3.Semester / ECTS: 6 Presentation, group work, discussion, exercises
	Open Category Use Cases /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5 Presentation, group work, discussion, exercises
	Smart Mobility Concepts /ILV / LV-Nr: 4_6 / 4.Semester / ECTS: 5 Group work, presentation, lecture
Evaluation Methods Criteria	Introduction to Regulations and Safety /ILV / LV-Nr: 1_5 / 1.Semester / ECTS: 5 Exam
	Project Management & Systems Engineering /ILV / LV-Nr: 2_6 / 2.Semester / ECTS: 4 Project and documentation
	Business, Economics & Financing /ILV / LV-Nr: 3_3 / 3.Semester / ECTS: 6 Exam
	Open Category Use Cases /ILV / LV-Nr: 3_5 / 3.Semester / ECTS: 5 Portfolio tests
	Smart Mobility Concepts /ILV / LV-Nr: 4_6 / 4.Semester / ECTS: 5 Exam

Module number:	**Coding**	**Scope:**	
Coding		**24**	**ECTS**
Degree program	University of Applied Sciences Bachelor's Program Drone Engineering full-time		
Position in the curriculum	1. Semester		
	2. Semester		
	3. Semester		
	4. Semester		
Level	1. Semester: Beginner / 2. Semester: Beginner / 3. Semester: Beginner / 4. Semester: Beginner		
Previous knowledge	1. Semester: None / 2. Semester: Introduction to Programming / 3. Semester: Drone Programming / 4. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	Introduction to Programming /ILV / LV-Nr: 1_1 / 1.Semester / ECTS: 5 - Deitel, H. & Deitel, P. (2017). Java How to Program, Early Objects (11th ed.). Pearson. - Evans, B. & Flanagan, D. (2018). Java in a Nutshell (7th ed.). O'Reilly. - Sedgewick, R. & Wayne, K. (2021). Computer science: An interdisciplinary approach. Addison-Wesley Professional. ISBN: 978-0137459582. - Sedgewick, R. & Wayne, K. (2017). Introduction to programming in Java: an interdisciplinary approach. Addison-Wesley Professional. ISBN: 978-0134512389. - Sedgewick, R., Wayne, K., & Dondero, R. (2016): Introduction to Programming in Python: An Interdisciplinary Approach. Addison-Wesley Professional. ISBN: 978-0134076539.		
	UAS Programming /ILV / LV-Nr: 2_1 / 2.Semester / ECTS: 5 - Audronis, T. (2017). Designing Purpose-Built Drones for Ardupilot Pixhawk 2.1. Packt Publishing. ISBN: 978-1786469168. - Mendoza-Mendoza, J. A., Gonzalez-Villela, V. J., Sepulveda-Cervantes, G., Mendez-Martinez, M., & Sossa-Azuela, H. (2020). Advanced Robotic Vehicles Programming: An Ardupilot and Pixhawk Approach. Apress. ISBN: 978-1484255308. https://doi.org/10.1007/97. - Quan, Q., Dai, X., & Wang, S. (2020). Multicopter Design and Control Practice. Springer Singapore. ISBN: 978-9811531378. https://doi.org/10.1007/978-981-15-3138-5		
	Advanced UAS Programming /ILV / LV-Nr: 3_1 / 3.Semester / ECTS: 5 - Dong, X., Chen, M., Wang, X., & Gao, F. (2023). Intelligent Coordination of UAV Swarm Systems. MDPI. ISBN: 978-3036586595. - Siciliano, B., & Khatib, O. (Eds.). (2016). Springer Handbook of Robotics. Springer. ISBN: 978-3319325507. https://doi.org/10.1007/97. - Dada, E. G. (2017). Swarm Robotics Cooperative Movement Control Using PSO & IPM Algorithms. Lambert Academic Publishing. ISBN: 978-3659799907.		
	Software Architecture for Robotic Systems /ILV / LV-Nr: 4_1 / 4.Semester / ECTS: 4 - Siciliano, B., & Khatib, O. (Eds.). (2016). Springer Handbook of Robotics. Springer. ISBN: 978-3319325507. https://doi.org/10.1007/97. - Corke, P., Jachimczyl, W., & Pillat, R. (2023). Robotics, Vision and Control: Fundamental Algorithms In MATLAB (3rd ed.). Springer Cham. ISBN: 978-3031072628. https://doi.org/10.1007/97. - Bräunl, T. (2022). Embedded Robotics: From Mobile Robot Design to Autonomous Vehicles with Raspberry Pi and Arduino. Springer. ISBN: 978-9811608049. https://doi.org/10.1007/97.		
	UAS Simulation /ILV / LV-Nr: 4_5 / 4.Semester / ECTS: 5 - Zipfel, P. H. (2014). Modeling and Simulation of Aerospace Vehicle Dynamics (3rd ed.). AIAA Education Series. ISBN: 978-1624102509. - Marqués, P. & Ronch, A. D. (2017). Advanced UAV Aerodynamics, Flight Stability and Control. Wiley. ISBN: 978-1118928691. DOI: 10.1002/9781118928691.		
Acquisition of skills	Introduction to Programming /ILV / LV-Nr: 1_1 / 1.Semester / ECTS: 5		

	Upon completing this course, students will be able to: - Apply Principles of Procedural and Object-Oriented Programming: Demonstrate basic procedural and object-oriented programming knowledge, independently develop solutions for typical tasks using basic elements of a modern programming language, and implement solutions in applications. - Understand Fundamental Algorithms and Data Structures: Demonstrate understanding of basic algorithms and data structures, select appropriate algorithms and data structures for specific problems, or adapt them independently for problem situations. Distinguish algorithms and data structures based on their complexity and create efficient algorithms and language structures. - Assess, Configure, and Utilize Language Elements and Development Environments: Analyze programming examples, demonstrate a detailed understanding of language elements of modern programming languages, and choose, configure, and use a suitable development environment.

Acquisition of skills	UAS Programming /ILV / LV-Nr: 2_1 / 2.Semester / ECTS: 5 Upon completing this course, students will be able to: - Understand Drone Programming Frameworks and Environments: Describe and explain major programming frameworks and development environments used in drone programming, such as DroneKit, ROS (Robot Operating System), and the DJI SDK. - Develop Flight Control Algorithms: Develop and implement algorithms for primary flight control operations (takeoff, landing, waypoint navigation) using a programming language suited for drone development. - Integrate and Manage Sensor Data: Write programs that can integrate and process data from various drone sensors, such as GPS, IMUs (Inertial Measurement Units), and cameras, to make informed flight decisions. - Utilize APIs for Drone Control: Leverage application programming interfaces (APIs) provided by drone manufacturers or open-source communities to control drone features and access sensor data. - Apply Best Practices in Software Development: Employ best practices in software development, including version control, testing, and debugging, to ensure reliable and maintainable drone software.
	Advanced UAS Programming /ILV / LV-Nr: 3_1 / 3.Semester / ECTS: 5 Upon completing this course, students will be able to: - Understand Swarm Intelligence Principles: Explain the fundamental concepts of swarm intelligence (decentralized control, self-organization, emergent behavior) applicable to drones. - Develop Algorithms for Swarm Coordination: Design and implement algorithms for coordination and collective decision-making among drones in a swarm (formation flying, obstacle avoidance, task allocation). - Utilize Communication Protocols for Swarm Operations: Explain and apply communication protocols facilitating efficient information exchange between swarm drones (considering communication range and bandwidth limitations). - Design Swarm Behaviors for Specific Applications: Customize drone swarm behaviors for specific applications (aerial mapping, surveillance, search and rescue, entertainment shows). - Evaluate and Test Swarm Systems: Evaluate drone swarm performance through simulation and real-world testing, identifying and resolving behavior and functionality issues.
	Software Architecture for Robotic Systems /ILV / LV-Nr: 4_1 / 4.Semester / ECTS: 4 Upon completing this course, students will be able to: - Understand the Fundamentals of Robotic Software Architecture: Identify and describe basic concepts, components, and characteristics of robotic software architecture (specifically mobile computing, e.g., ROS 2). - Design Robotic Applications Using Architectural Patterns: Apply common architectural patterns (structural, concurrency, behavioral) when designing robotic applications. - Optimize Performance for Mobile Apps: Develop strategies to optimize mobile applications for performance, considering limited computing resources and battery life. - Ensure Scalability and Maintainability: Design mobile software systems that are scalable, maintainable, and adaptable to changing requirements and technologies. - Incorporate Data Management and Persistence: Implement adequate data storage, retrieval, and synchronization practices, considering intermittent connectivity and limited storage capacity. - Utilize Cloud Services and APIs: Leverage cloud computing services and external APIs to enhance mobile application capabilities (offloading computation, storage, enriched functionalities).
	UAS Simulation /ILV / LV-Nr: 4_5 / 4.Semester / ECTS: 5 Upon completing this course, students will be able to: - Understand the Principles of Drone Simulation: Explain the foundational concepts of drone simulation, including types of simulations (e.g., flight dynamics, sensor simulation, environmental interaction) and their applications in research, development, and training. - Operate Drone Simulation Software: Demonstrate proficiency using various drone simulation software and tools (e.g., Gazebo, AirSim, V-REP) for different use cases. - Model Drone Flight Dynamics: Model drone flight dynamics within simulation environments, accurately representing flight physics, including lift, drag, thrust, and gravity effects. - Simulate Sensor Data: Simulate sensor inputs (GPS, IMU, LiDAR, cameras) to test sensor fusion algorithms and data processing pipelines in a controlled environment. - Design Virtual Environments: Design and customize virtual environments for drone simulations (urban landscapes, natural terrains, obstacle courses) to replicate real-world scenarios. - Test and Validate Drone Systems: Utilize drone simulations to test and validate drone designs, flight control algorithms, and operational procedures, identifying potential issues before real-world deployment.
Course contents	Introduction to Programming /ILV / LV-Nr: 1_1 / 1.Semester / ECTS: 5 - Fundamentals of Computer Programming: Introduction to the basic programming concepts, including what programming is, how it works, and its significance in creating software applications. - Basic Components of Programming: Variables and Data Types, Control Structures, Functions and Procedures, Data Structures - Object-Oriented Programming (OOP): Principles of OOP (classes, objects, inheritance, encapsulation, polymorphism), and its benefits for simplifying program design and development. - Algorithm Development: Developing algorithms for different use cases and complex data structures.
	UAS Programming /ILV / LV-Nr: 2_1 / 2.Semester / ECTS: 5

	- Programming Languages and Environments: Introduction to commonly used languages in drone programming (e.g., Python, C++, ROS) and suitable environments for drone software. - Understanding the Drone Software Stack: Layers of drone software operating, from the operating system and firmware to application software and user interfaces. - Firmware Programming: Basics of programming the drone's firmware, focusing on real-time operating systems (RTOS), and the interaction with drone hardware.

Course contents	- APIs and SDKs for Drone Development: Exploring Application Programming Interfaces (APIs) and Software Development Kits (SDKs) provided by drone manufacturers for developing custom applications. - Autonomous Flight Programming: Techniques for programming drones to fly autonomously, including waypoint navigation, object avoidance, and decision-making algorithms. - Sensor Integration and Data Processing: Programming drones to interpret data from onboard sensors (e.g., GPS, IMU, cameras) for navigation, stabilization, and task execution. - Best Practices and Debugging: Effective programming practices for drone development, including version control, testing strategies, and debugging techniques.
	Advanced UAS Programming /ILV / LV-Nr: 3_1 / 3.Semester / ECTS: 5 - Introduction to Swarm Intelligence: Basics of swarm intelligence and its application in nature and robotics, including decentralized control and emergent behavior concepts. - Fundamentals of Drone Swarm Programming: Overview of the architecture and programming models used in drone swarm operations, including centralized and decentralized control mechanisms. - Communication Protocols: Understanding communication methods and protocols enabling drones within a swarm to share information and make collective decisions. - Swarm Coordination Algorithms: Detailed examination of algorithms for spatial organization, task allocation, and collision avoidance among drones in a swarm. - Simulation and Modeling: Using simulation software to model drone swarm behavior and test programming strategies in a virtual environment before real-world deployment. - Sensor Fusion and Situational Awareness: Techniques for integrating data from multiple sensors across the swarm to achieve a unified perception of the environment. - Autonomy and Decision-Making: Strategies for achieving autonomous decision-making within drone swarms, adapting to changing conditions and objectives without direct human intervention.
	Software Architecture for Robotic Systems /ILV / LV-Nr: 4_1 / 4.Semester / ECTS: 4 - Fundamentals of Robotic Software Architecture: Introduction to software architecture as applied to mobile systems, including drones, smartphones, and other portable devices. - Design Patterns and Best Practices: Overview of common design patterns used in robotic software development (structural, concurrency behavioral); strategies for efficient data management and battery usage. - Connectivity and Networking: Managing connections in mobile systems, considering intermittent connectivity, data synchronization, and APIs. - Security and Privacy: Best practices for ensuring the security of robotic systems (data encryption, user authentication, sensitive information safeguarding). - Cross-Platform Development: Approaches to developing software that runs across multiple robotic platforms (native, hybrid, cross-platform tools). - Emerging Technologies: Discussing the impact of emerging technologies (5G, edge computing, IoT) on robotic software architecture.
	UAS Simulation /ILV / LV-Nr: 4_5 / 4.Semester / ECTS: 5 - Introduction to Drone Simulation: Significance of simulation in drone design, testing, and training. Overview of simulation tools and environments, with a focus on Unreal Engine. - Basics of Unreal Engine for Drone Simulation: Introduction to Unreal Engine architecture, key features, and advantages for drone simulation. - Simulating Real-World Environments: Techniques for creating realistic simulation environments in Unreal Engine (terrain generation, environmental conditions, dynamic obstacles). - Drone Physics and Dynamics in Simulation: Implementing realistic drone physics and flight dynamics within the simulation (aerodynamic effects, propulsion, control systems). - Sensor Simulation: Simulating drone sensors (cameras, LiDAR, GPS) in Unreal Engine and integrating sensor data for navigation and obstacle detection. - Testing and Validation: Using simulations to test drone designs, flight control algorithms, and safety protocols. Discussion on the role of simulation in validating drone performance under various conditions. - Integration with Drone Development: Exploring the integration of simulation in the overall drone development lifecycle (initial design to deployment, iterative testing, refinement).
Teaching and learning methods	Introduction to Programming /ILV / LV-Nr: 1_1 / 1.Semester / ECTS: 5 Presentation, group work, discussion, exercises
	UAS Programming /ILV / LV-Nr: 2_1 / 2.Semester / ECTS: 5 Group work, discussion, exercises, presentation,
	Advanced UAS Programming /ILV / LV-Nr: 3_1 / 3.Semester / ECTS: 5 Presentation, group work, discussion, exercises
	Software Architecture for Robotic Systems /ILV / LV-Nr: 4_1 / 4.Semester / ECTS: 4 Presentation, group work, discussion, exercises
	UAS Simulation /ILV / LV-Nr: 4_5 / 4.Semester / ECTS: 5 Presentation, group work, discussion, exercises
Evaluation Methods Criteria	Introduction to Programming /ILV / LV-Nr: 1_1 / 1.Semester / ECTS: 5 Exam
	UAS Programming /ILV / LV-Nr: 2_1 / 2.Semester / ECTS: 5

	Portfolio tests
	Advanced UAS Programming /ILV / LV-Nr: 3_1 / 3.Semester / ECTS: 5 Project and documentation

Evaluation Methods Criteria	Software Architecture for Robotic Systems /ILV / LV-Nr: 4_1 / 4.Semester / ECTS: 4 Portfolio tests
	UAS Simulation /ILV / LV-Nr: 4_5 / 4.Semester / ECTS: 5 Portfolio tests

Module number:	**Complementary**	**Scope:**	
Compl		**74**	**ECTS**
Degree program	University of Applied Sciences Bachelor's Program Drone Engineering full-time		
Position in the curriculum	1. Semester		
	2. Semester		
	4. Semester		
	5. Semester		
	6. Semester		
Level	1. Semester: Beginner / 2. Semester: Beginner / 4. Semester: Beginner / 5. Semester: Beginner / 6. Semester: Beginner		
Previous knowledge	1. Semester: None / 2. Semester: Foreign Language I / 4. Semester: None / 5. Semester: None / 6. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	Foreign Language I /ILV / LV-Nr: 1_3 / 1.Semester / ECTS: 6 Coursebook – as agreed upon; authentic materials, e.g., magazines (including professional journals), newspapers, and online media in the target language		
	Foreign Language II /ILV / LV-Nr: 2_5 / 2.Semester / ECTS: 6 Coursebook – as agreed upon; authentic materials, e.g., magazines (including professional journals), newspapers, and online media in the target language		
	Scientific Writing /SE / LV-Nr: 4_7 / 4.Semester / ECTS: 2 - Day, R. A., & Gastel, B. (2016). How to Write and Publish a Scientific Paper (8th ed.). Greenwood. ISBN: 978-1440842801. - Alley, M. (2018). The Craft of Scientific Writing (4th ed.). Springer. ISBN: 978-1441982872.		
	Selected Topics in Business /ILV / LV-Nr: 5_1 / 5.Semester / ECTS: 6 - Will be delivered by the partner university		
	Selected Topics in UAS Engineering /ILV / LV-Nr: 5_2 / 5.Semester / ECTS: 12 - Will be delivered by the partner university		
	Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: 5_3 / 5.Semester / ECTS: 12 - Will be delivered by the partner university		
	Bachelor Seminar /SE / LV-Nr: 6_1 / 6.Semester / ECTS: 10 - Day, R. A., & Gastel, B. (2016). How to Write and Publish a Scientific Paper (8th ed.). Greenwood. ISBN: 978-1440842801. - Alley, M. (2018). The Craft of Scientific Writing (4th ed.). Springer. ISBN: 978-1441982872.		
	Integrated Internship /BPR / LV-Nr: 6_2 / 6.Semester / ECTS: 20 - Sweitzer, H. F., & King, M. A. (2019). The Successful Internship: Personal, Professional, and Civic Development in Experiential Learning (5th ed.). Cengage Learning. ISBN: 978-0357040818.		
Acquisition of skills	Foreign Language I /ILV / LV-Nr: 1_3 / 1.Semester / ECTS: 6		

	The modules are designed according to the Common European Framework of Reference for Languages. Students will acquire language skills and develop abilities necessary for economic-oriented professional or academic activities within these modules. The following competencies are taught according to the CEFR, meaning, upon completion of the module, successful graduates will master the following activities in the target language: A1 – Beginner: Understand and use familiar, everyday expressions and very simple sentences aimed at satisfying concrete needs. Introduce themselves and others and ask and answer questions about personal details such as where they live, people they know, and things they have. Communicate in a simple manner if the interlocutor speaks slowly and clearly and is prepared to help. A2 – Elementary: Understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, local geography, employment). Communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Describe in simple terms aspects of their background, immediate environment, and matters in areas of immediate need. B1 – Intermediate: Understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure, etc. Deal with most situations likely to arise while traveling in an area where the language is spoken. Produce simple connected text on topics that are familiar or of personal interest. Describe experiences and events, dreams, hopes, and ambitions, and briefly give reasons and explanations for opinions and plans. B2 – Upper Intermediate: Understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in their field of specialization. Interact with a degree of fluency and spontaneity that makes regular interaction with native speakers possible without strain for either party. Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue, giving the advantages and disadvantages of

Acquisition of skills	various options. C1 – Advanced: Understand a wide range of demanding, longer texts and recognize implicit meaning. Express ideas fluently and spontaneously without much obvious searching for expressions. Use language flexibly and effectively for social, academic, and professional purposes. Produce clear, well-structured, detailed text on complex subjects, showing controlled use of organizational patterns, connectors, and cohesive devices. C2 – Proficiency: Understand with ease virtually everything heard or read. Summarize information from different spoken and written sources, reconstructing arguments and accounts cohesively. Express themselves spontaneously, very fluently, and precisely, differentiating finer shades of meaning even in more complex situations.
	Foreign Language II /ILV / LV-Nr: 2_5 / 2.Semester / ECTS: 6 The modules are designed according to the Common European Framework of Reference for Languages (CEFR). Within these modules, students will acquire the language skills and develop the abilities necessary for a business-oriented professional or academic activity. The following competencies are imparted according to the CEFR, meaning that upon completion of the module, successful graduates will be able to perform the following activities in the target language: A1-A2 Basic communication skills B1-B2 Advanced language use and communication skills B2-C1 Independent language use to proficient language knowledge and communication skills C1-C2 Proficient language knowledge to fluent, competent communication skills
	Scientific Writing /SE / LV-Nr: 4_7 / 4.Semester / ECTS: 2 Upon completion of the course, students will be able to: - Appropriately formulate research questions. - Plan methodical approaches to answer research questions. - Research, evaluate, and cite specialized literature. - Conduct research and write a scientific paper of moderate complexity and manageable scope.
	Selected Topics in Business /ILV / LV-Nr: 5_1 / 5.Semester / ECTS: 6 The students are able to: - Describe and apply fundamental concepts and methods from business administration. - Describe and apply in-depth concepts and interrelations from business administration. - Critically evaluate and question methods and concepts of business administration. - Apply and analyze methods and concepts of business administration to issues in the field of robotics and drones.
	Selected Topics in UAS Engineering /ILV / LV-Nr: 5_2 / 5.Semester / ECTS: 12 Upon completion of the course, students will be able to: - Describe and apply fundamental concepts and methods from drone engineering. - Describe and apply in-depth concepts and interrelations from drone engineering. - Critically evaluate and question methods and concepts of drone engineering. - Apply and analyze methods and concepts of engineering to issues in the field of robotics and drones.
	Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: 5_3 / 5.Semester / ECTS: 12 Upon completion of the course, students will be able to: - Describe and apply fundamental concepts and methods from drone sensory and use cases. - Describe and apply in-depth concepts and interrelations from drone sensory and use cases. - Critically evaluate and question methods and concepts of drone sensory and use cases. - Apply and analyze methods and concepts of sensory to issues in the field of robotics and drones.
	Bachelor Seminar /SE / LV-Nr: 6_1 / 6.Semester / ECTS: 10 Upon completion of the course, students will be able to: - Independently narrow down a topic from the field of web-based technologies, web business, or adjacent areas, scientifically prepare it, and independently develop a self-formulated research question - Independently and self-organized, conduct the scientific work process and present and discuss their work results in the seminar. - Use the available resources appropriately and purposefully (especially time management and research skills) and produce a scientific bachelor's thesis according to the standards of scientific work and the formal requirements of the relevant guidelines (improvement of expressive skills).
	Integrated Internship /BPR / LV-Nr: 6_2 / 6.Semester / ECTS: 20

	Upon completion of the course, students will be able to: - Apply the knowledge acquired during their studies in professional practice. - Understand processes in the professional environment. - Solve issues within the scope of professional projects and implement solutions (practical competence). - Independently develop and advance arguments, problem-solving approaches, and strategies (problem-solving competence). - Demonstrate advanced social and communication competencies in academic and professional settings.

Course contents	Foreign Language I /ILV / LV-Nr: 1_3 / 1.Semester / ECTS: 6 A1 – Beginner: Understand and use familiar everyday expressions and very simple sentences aimed at satisfying concrete needs. Introduce oneself and others and ask and answer questions about personal details such as where one lives, people one knows, and things one has. Communicate in a simple way if the interlocutor speaks slowly and clearly and is willing to help. A2 – Elementary: Understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, work, local geography). Communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Describe one's background and education, immediate environment, and matters related to immediate needs in simple terms. B1 – Intermediate: Use clear standard language and deal with familiar matters encountered in work, school, leisure, etc. Have relevant conversational skills for traveling in the language area. Express oneself simply and coherently regarding familiar topics and personal interests. Report on experiences and events, describe dreams, hopes, and ambitions, and briefly give reasons or explanations for opinions and plans. B2 – Upper Intermediate: Express oneself on the main ideas of complex texts on both concrete and abstract topics, including technical discussions in one's area of expertise. Communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without much effort on either side. Express oneself clearly and in detail on a wide range of topics, explain a viewpoint on a current issue, and indicate the advantages and disadvantages of various options. C1 – Advanced: Understand a wide range of demanding, longer texts and recognize implicit meaning. Express oneself fluently and spontaneously without much obvious searching for expressions. Use language flexibly and effectively for social, academic, and professional purposes. Express oneself clearly, structured, and in detail on complex subjects, using various linking words and textual devices appropriately. C2 – Proficiency: Effortlessly understand practically everything heard or read. Summarize information from different spoken and written sources, reconstructing arguments and accounts in a coherent presentation. Express oneself spontaneously, very fluently, and precisely, differentiating finer shades of meaning even in more complex situations.
	Foreign Language II /ILV / LV-Nr: 2_5 / 2.Semester / ECTS: 6 The offered study-integrated language modules are designed according to the methodological principles of a communicative, action-oriented approach. The competency levels of the module offerings are aligned with the Common European Framework of Reference for Languages (CEFR), and a central objective is for students to improve their communication skills by at least one level. Additionally, there is a clear focus on acquiring academic and business-oriented skills in the target language. A1-A2 Basic communication skills B1-B2 Advanced language use and communication skills B2-C1 Independent language use to proficient language knowledge and communication skills C1-C2 Proficient language knowledge to fluent, competent communication skills
	Scientific Writing /SE / LV-Nr: 4_7 / 4.Semester / ECTS: 2 This introductory course on academic research and writing aims to familiarize students with the peculiarities, rules, and fundamentals of science and scholarly work. The focus is on learning and understanding deductive and inductive methods and empirical procedures for gaining knowledge. Students are prepared to independently write seminar papers according to the common standards, including dealing with literature and understanding the quality of academic works. Emphasis is placed on intellectual honesty and intersubjective comprehensibility.
	Selected Topics in Business /ILV / LV-Nr: 5_1 / 5.Semester / ECTS: 6 This module provides flexibility for students during their semester abroad by offering a variety of elective options at partner universities in economically oriented sciences. National credits will be converted into equivalent ECTS points as necessary, and students will follow the examination regulations of the partner university. Example subject areas include: - Organizational Management - Accounting - Controlling - Sales Economics - Marketing and Corporate Communication - Strategic Management - Corporate Governance - Procurement, Production, and Logistics - Business Informatics - e-Commerce & e-Business - Information Management
	Selected Topics in UAS Engineering /ILV / LV-Nr: 5_2 / 5.Semester / ECTS: 12

	This module provides flexibility for students during their semester abroad by offering a variety of elective options at partner universities in economically oriented sciences. National credits will be converted into equivalent ECTS points as necessary, and students will follow the examination regulations of the partner university. Example subject areas include: - Advanced Programming - Advanced Aeronautical/Drone Design - Advanced Analysis of Data (e.g., Multimedia, Time Series) - Introductory Courses in Game Design - Augmented and Virtual Reality - Human-Computer Interaction and User Experience Design (UX) - Software Engineering and Testing
	Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: 5_3 / 5.Semester / ECTS: 12 This module provides flexibility for students during their semester abroad by offering a variety of elective options at partner universities in economically oriented sciences. National credits will be converted into equivalent ECTS points as necessary, and students will follow the examination regulations of the partner university. Example subject areas include:

Course contents	- Legal and Ethical Considerations in Drone Use - Drone Flight Control and Autonomy - Drone-Based Mapping and Surveying - Data Processing and Analysis - Drone Sensory Technologies
	Bachelor Seminar /SE / LV-Nr: 6_1 / 6.Semester / ECTS: 10 Students regularly report on the progress of their bachelor's thesis in coordination with their supervisor. In a seminar format, they present their current work status in small groups through brief presentations and discuss their results. Students receive instructions and templates for writing their bachelor's thesis, ensuring appropriate scientific guidance. They write their final bachelor's thesis with individual support from a lecturer, addressing a relevant question using using scientific methods. The bachelor's thesis may include practical references from a professional internship, addressing a current and concrete problem both scientifically and practically.
	Integrated Internship /BPR / LV-Nr: 6_2 / 6.Semester / ECTS: 20 This course supplements students' theoretical knowledge through practical activities and exposure to economic-legal issues in a real-world setting. Students must complete at least 500 working hours of employment at an external company, equivalent to 12.5 weeks of full-time employment (assuming a 40-hour work week). The professional internship aims to: - Help students acclimate to professional life and gain confidence through practical experience. - Enable students to apply their theoretical knowledge in real-world situations. - Provide insights into professional processes, workflows, and environments. Support during the internship includes: - Reflection on experiences. - Discussion of challenges. - Sharing and analysis of experience reports.
Teaching and learning methods	Foreign Language I /ILV / LV-Nr: 1_3 / 1.Semester / ECTS: 6 Blended learning
	Foreign Language II /ILV / LV-Nr: 2_5 / 2.Semester / ECTS: 6 Blended learning
	Scientific Writing /SE / LV-Nr: 4_7 / 4.Semester / ECTS: 2 Presentation, group work, discussion, exercises
	Selected Topics in Business /ILV / LV-Nr: 5_1 / 5.Semester / ECTS: 6 To be defined by the partner university
	Selected Topics in UAS Engineering /ILV / LV-Nr: 5_2 / 5.Semester / ECTS: 12 To be defined by the partner university
	Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: 5_3 / 5.Semester / ECTS: 12 To be defined by the partner university
	Bachelor Seminar /SE / LV-Nr: 6_1 / 6.Semester / ECTS: 10 Presentation
	Integrated Internship /BPR / LV-Nr: 6_2 / 6.Semester / ECTS: 20 Presentation
Evaluation Methods Criteria	Foreign Language I /ILV / LV-Nr: 1_3 / 1.Semester / ECTS: 6 Portfolio tests
	Foreign Language II /ILV / LV-Nr: 2_5 / 2.Semester / ECTS: 6 Portfolio tests
	Scientific Writing /SE / LV-Nr: 4_7 / 4.Semester / ECTS: 2 Scientific paper, presentation
	Selected Topics in Business /ILV / LV-Nr: 5_1 / 5.Semester / ECTS: 6 To be defined by the partner university
	Selected Topics in UAS Engineering /ILV / LV-Nr: 5_2 / 5.Semester / ECTS: 12 To be defined by the partner university
	Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: 5_3 / 5.Semester / ECTS: 12

	To be defined by the partner university
	Bachelor Seminar /SE / LV-Nr: 6_1 / 6.Semester / ECTS: 10 Bachelor Thesis

Evaluation Methods Criteria	Integrated Internship /BPR / LV-Nr: 6_2 / 6.Semester / ECTS: 20 Documentation

2.4 Internship

Students independently select their internship placement. In doing so, they may utilize the extensive range of internship postings provided by the University of Applied Sciences Kufstein Tirol. The Director of Studies of the degree program evaluates the professional relevance of the internship activities in relation to the curriculum and qualification profiles of the degree program. In the following, the Director of Studies assesses whether the internship aligns with the educational objectives of the degree program and whether the student can participate in the internship in a manner appropriate to their qualification level. A comprehensive internship guide supports students in organizing their internship semester. In case of questions and for additional support, both the International Relations Office (IRO) and the Director of Studies are available to assist students.

The internship must be formally requested by the student using a designated form (i.e., job description form). This form includes key information about the student and the internship supervisor, as well as the objectives and tasks/activities to be undertaken at the internship organization. The internship is confirmed and approved through the signatures of both the Director of Studies and the internship supervisor. The student is required to reflect upon, document, and present the experiences and insights gained during the internship, and must evaluate the internship placement. Conversely, the internship supervisor must evaluate the student. The student must prepare an interim report, a final report, and a presentation, as well as complete an evaluation form. At the beginning of the internship, the student receives a detailed internship guide outlining the objectives of the internship. A central requirement for a successful internship is a congruence between the agreed-upon objectives and those actually achieved. The documentation prepared by both the student and the supervisor is reviewed by the Director of Studies. If the objectives are not met or the work done as part of the internship placement does not correspond to the student's qualification level, the respective internship provider will be excluded from future placements. A list of internship placements and corresponding reports is made available to future students via the Moodle learning platform.

2.5 Semester Abroad

During their mandatory semester abroad, students enrolled in the Drone Engineering program have the opportunity to deepen their knowledge acquired in the following areas during the first four semesters:

- UAS Engineering (12 ECTS),
- UAS Sensory, Use Cases and Management (12 ECTS)
- Business (4 ECTS)

In addition, they can use the semester abroad to broaden their knowledge through courses covering complementary skills and competencies. Subject to the availability of study places, students may choose from the portfolio of approximately 230 partner universities of the University of Applied Sciences Kufstein Tirol and enroll in courses at these institutions. Depending on the host university, students have access to a variety of courses with different academic focuses. This allows them to specialize in topics that are not currently offered at the bachelor's level at the University of Applied Sciences Kufstein Tirol (e.g., robotics, human-computer interaction, machine learning, etc.).

The allocation of study places abroad is conducted uniformly across the university and, in cases where demand exceeds the number of places offered by a partner institution, is based on the academic performance of the applicants to date. In recent years, the total number of available study abroad places across all degree programs has significantly exceeded actual demand, thereby ensuring that the University can afford this opportunity to all students. The degree program provides academic advising as needed to support students in selecting a meaningful academic focus for their semester abroad.

3 ADMISSION REQUIREMENTS

The admission requirements at the University of Applied Sciences Kufstein Tirol are regulated in accordance with the following provisions:

1. The general admission requirements are regulated by Section 4 FHG (Universities of Applied Sciences Act), as amended. These provisions apply to **applicants with a general university entrance qualification**.

2. **Applicants without a school-leaving certificate** must take a **university entrance qualification examination** in accordance with Section 64a UG 2002 (Universities Act 2002), as amended. In accordance with a decree issued by the rectorate of a university, these applicants acquire the general university entrance qualification for bachelor's degree programs in a group of disciplines by passing the university entrance qualification examination. Successful completion of the university entrance qualification examination thus entitles the holder to admission to all degree programs in the respective group of degree programs for which the university entrance qualification was acquired. The university entrance qualification examination can be obtained in accordance with a regulation of the rectorate of a university for certain groups of disciplines, whereby the following group is relevant for the University of Applied Sciences Kufstein Tirol: Social and Economic Science Studies (e.g., business administration, business education, statistics, sociology).
Applicants who have completed a 3-year **vocational secondary school** (*Berufsbildende Mittlere Schule*), have completed an **apprenticeship in the dual system**, or have obtained **a subject-relevant German entrance qualification for universities of applied sciences** (*Fachhochschulreife*) are entitled to study at the University of Applied Sciences Kufstein Tirol provided they pass additional examinations in German, English, and Mathematics. In the case of the German *Fachhochschulreife*, the additional examination must only be taken in those of the three subjects in which the certificate grade is "insufficient" (*mangelhaft*) or worse. Any additional examinations must be successfully completed before the start of the third semester.

3. For **applicants with relevant dual training**, an **apprenticeship qualification** in one of the following **subject areas** satisfies the admission requirements, as decreed by the Federal Ministry responsible:

- Construction and building services
- Office, administration, and organization
- Chemistry and plastics
- Electrical engineering and electronics
- Trade
- Information and communication technology
- Metal technology and mechanical engineering
- Media design and photography
- Paper production, paper processing, and printing
- Transportation and storage

4. **Applicants with a degree from** one of the following subject-specific **vocational secondary schools** (*Berufsbildende Mittlere Schulen*) may also be admitted:

- Hotel management schools, tourism management schools, hospitality management schools (three-year courses)
- Commercial schools (of at least three years' duration)
- Industrial, technical, and arts and crafts colleges
- Secondary schools for economic professions
- Secondary schools for technical professions
- Technical colleges for tourism professions
- Technical schools for economic professions (three-year courses)
- Business schools (of at least three years' duration)

- Technical colleges for agricultural and forestry professions (of at least three years' duration)
- Business schools (three-year courses)

5. If the equivalence of international certificates with regard to the content and requirements of an Austrian school-leaving examination is not established, supplementary examinations must be taken in the subjects English and Mathematics before applicants embark on the program. Such examinations can be taken either with external providers or, for a fee, at the University of Applied Sciences Kufstein Tirol Business School.
Newly emerging apprenticeships in similar disciplines are to be recognized in accordance with the above stipulations.

Applicants subject to the provisions of (3) and (4) above must complete their **additional entry examinations** by the beginning of their third semester and, if necessary, take appropriate preparatory courses. Such courses are offered at the University of Applied Sciences Kufstein.

The following additional examinations are required for this group of applicants:
- German
- English
- Mathematics

Below is an overview of which subject areas of the German FOS/BOS (*Fachoberschulen*/*Berufsoberschulen* – subject-specific/vocational upper secondary schools) are considered relevant entry requirements. Here, additional examinations must be taken within the first semesters in the subjects Mathematics, German, and English (if a grade of "insufficient" [*mangelhaft*] or lower was achieved in these subjects).

Relevant subject areas FOS/BOS

	DRO Bvz
FOS	
- Technology	Yes
- Economics & Administration	Yes
- Social services	Yes
- Agriculture, biotechnology, and environmental technology	Yes
- Design	Yes
- Health	Yes
- International economics	Yes
BOS	
- Technology	Yes
- Economics & Administration	Yes
- Social services	Yes
- Agriculture, biotechnology, and environmental technology	Yes
- Health	Yes
- International economics	Yes
In the case of relevant internships (marketing, commerce, administration), other subject areas can also be accepted (after consultation with the Director of Studies).	

The language of instruction of the program in Drone Engineering is exclusively English. A documented language proficiency of B2 or higher (CEFR) is required.