

Study regulations of the Bachelor's

Drone Engineering

To obtain the academic degree

Bachelor of Science in Engineering
abbreviated BSc

as an appendix to the statutes of the
HOK | University of Applied Sciences Kufstein Tirol

Organizational form: full-time

Duration: 6 semesters

Scope: 180 ECTS

Places for beginners per academic year: 25 full-time

Version 1

Adopted by the Faculty on May 6, 2026

Program starts WS 2027/28

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1 OCCUPATIONAL PROFILES

1.1 Career opportunities

The drone industry is a sector that has steadily gained importance in recent years and is projected to experience strong growth in the future. This is due, among other things, to technological advances—not least in the field of artificial intelligence—which have expanded the range of commercial applications. UASs are already being used today in areas such as mapping and surveying, precision agriculture, forest and wildlife monitoring, film production and photography, inspection and maintenance, surveillance and law enforcement, delivery and logistics, and disaster management. Further improvements are expected in the future through machine learning and artificial intelligence, which will create new areas of application, particularly in the fields of transportation and mobility. The growing prevalence of smart mobility concepts, particularly in urban areas, is driving demand for and the further development of drones. Innovations in civilian drone technology are expected to transform the entire economy, in part through the use of drones in the delivery and logistics sectors.

Accordingly, there is a broad spectrum of employers seeking specially trained drone experts. On the industry side, there are manufacturers of civilian and military drones, developers of software solutions for drone technologies, and service providers offering drone-related services, such as inspections. A major field of work lies in research and development, both in the private and public sectors. Given the versatile applications of drones, companies from other economic sectors are also increasingly turning to drone experts to develop innovative solutions specifically for their industries. Examples include agriculture and forestry, transportation and logistics, energy and water supply, and the construction industry. The drone industry is dynamic and growing steadily, so new opportunities and career paths are constantly emerging. The following job profiles, among others, are open to graduates of the Drone Engineering program:

- Aviation/Drone Systems Engineers design and develop prototypes as well as complex drone systems and oversee 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 drone flight control and navigation, with real-time data analysis playing a key role. They design and coordinate tests and analyze the results to ensure the airworthiness and safety of aircraft.
- Researchers in Aviation & Robotics develop and improve technologies in the fields of aviation and robotics, including through experimental studies and data analysis.
- UAS Business and Customer Relationship Specialists (e.g., entrepreneurs, etc.) identify market gaps and start companies to develop new products or services in the drone sector.
- UAS Operation Specialists analyze and optimize flight operations with regard to efficiency, costs, and safety. They also operate unmanned aircraft, planning and executing missions while ensuring navigation, flight safety, and compliance with applicable regulations.

The curriculum of the Drone Engineering program addresses the diversity of job roles and the varying qualification requirements depending on the field of work, preparing students for future innovations that will drive and transform the industry. By providing students with hands-on training in a wide range of specialized fields, they become highly valued as tomorrow's qualified professionals. Since the program is taught in English, there are no limits to the career opportunities available worldwide.

1.2 Qualification profile

The qualification objectives and learning outcomes of the bachelor's degree program [Topic] meet both academic and professional requirements and correspond to ISCED Level 07 (International Standard Classification of Education). The content taught qualifies graduates for the professional fields of activity mentioned in previous chapters.

Professional Field	Responsibilities	Competency Description	Competency Mapping	Curriculum/Modules
UAS Engineer	Developing drone applications and their systems	Ability to independently design and program drone systems	Technical Scientific	and Coding
		Ability to independently analyze data for drone applications	Technical scientific	and Data Analysis
		Understand the challenges of flight and meteorology	Technical Scientific	and Flight Engineering
Aviation/Drone Systems Engineer	Developing aviation-related systems	Can articulate the economic aspects of the system and carry out project planning	Technical Scientific	and Business
		Ability to independently analyze data for drone applications	Technical scientific	and Data Analysis
		Ability to independently develop concepts for the use of sensor systems	Technical Scientific	and Data Analysis
		Can design and plan software concepts and architectures for drone applications	Technical Scientific	and Coding
		Understand the challenges of flying and meteorology	Technical Scientific	and Flight Engineering
Researcher in Aviation	Research into new systems, algorithms, and innovations in the field of aviation/UAS	Understand the challenges of flight and meteorology	Technical Scientific	and Flight Engineering
		Ability to independently evaluate and analyze data from various sensors	Technical scientific	and Data Analysis
		Ability to disseminate results scientifically	Personal & Social	Compl (elementary)
		Ability to independently design, implement, and test new software systems and algorithms	Technical Scientific	and Coding

UAS Business and Customer Relationship (e.g., entrepreneur, etc.)	Establishing one's own business activities in UAS Business	Can articulate the economic aspects of the system and carry out project planning	Technical-Scientific	Business
		Ability to disseminate content both academically and from a marketing perspective	Personal & Social	Compliance (Elementary)
		Understand the challenges of aviation and meteorology and can use this knowledge to develop business areas	Technical Scientific and	Flight Engineering
UAS Operations Specialist	Analysis of drone applications and their operational implementation	Can articulate the economic aspects of the system and carry out project planning	Technical Scientific and	Business
		Ability to disseminate content both scientifically and from a marketing perspective	Personal & Social	Compliance (basic)
		Ability to independently evaluate and analyze data from various sensors	Technical Scientific and	Data Analysis
UAS Safety Specialist	Evaluation and testing of drone systems and applications	Can articulate the economic aspects of the system, evaluate them, and carry out project planning	Technical Scientific and	Business
		Ability to disseminate content in a scientific manner	Personal & Social	Compliance (Elementary)
		Understand the challenges of flying and meteorology	Technical Scientific and	Flight Engineering
		Understand the regulatory and safety-related requirements for UAS applications	Technical scientific and	Business

2 CURRICULUM

2.1 Curriculum data

	FT	Any comments
First year of study (YYYY/MM ₊₁)	2027/28	
Standard duration of study (Number of semesters)	6	
SWS (Total for all semesters)	76.5	
ASWS (Total for all semesters)	80.9	
ECTS (Total for all semesters)	180	
Winter Semester Start (Date, Note: possibly calendar week)	Calendar Week 40	
End of WS (Date, Note: possibly calendar week)	Calendar Week 5	
Start of summer semester (Date, Note: possibly calendar week)	Calendar Week 11	
End of semester (Date, Note: possibly calendar week)	Calendar Week 28	
Winter Semester Weeks	15	
SS weeks	15	
Mandatory semester abroad (Semester specification)	5th semester	
Language of Instruction (Specify)	English	
Professional Internship (Semester, duration in weeks per semester)	6th semester 500 hours	

2.2 Curriculum matrix

The curriculum matrix for the Bachelor's program in Drone Engineering is presented below. Due to the consolidation of the course "Business, Economics & Financing" with WING, ESM, CODE, and FMI, the total number of ASWS is reduced to 19.4 in the 3rd semester.

The following list of courses does not include the workload associated with supervising bachelor's theses. Here, 0.2 SWS is allocated per supervised thesis; that is, with 25 accredited study places, this results in an additional ASWS workload of 5 ASWS. In total, this results in an ASWS total of 85.9 ASWS across all 6 semesters, including Bachelor's thesis supervision.

1. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
BU_1	Introduction to Regulations and Safety	ILV		X	2.5	1	2.5	37.5	Business	5
CO_1.1	Introduction to Programming	VO	X	X	1.5	1	1.5	22.5	Coding	3
CO_1.2	Introduction to Programming	UE	X	X	1	1	1	15	Coding	2
DA_1.1	Data & Analytics	VO	X	X	2	1	2	30	Analysis	2
DA_1.2	Data & Analytics	UE	X	X	1.5	1	1.5	22.5	Analysis	3
FE_1.1	Principles of Flight and Aviation	VO	X	X	2	1	2	30	Flight	2
FE_1.2	Principles of Flight and Aviation	UE	X	X	1.5	1	1.5	22.5	Flight	3
FE_2.1	Fundamentals in UAS components	VO	X	X	2	1	2	30	Flight	2
FE_2.2	Fundamentals of UAS components	UE	X	X	1	1	1	15	Flight	2
SP_1	Foreign Language I	ILV		X	4	1	4	60	Compl	6
Total line:					19.0		19.0	285.0		30
Course hours = Total WSH x course weeks					285.0					

2. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
BU_2	Project Management & Systems Engineering	ILV		X	2	1	2	30	Business	4
CO_2.1	UAS Programming	VO	X	X	2	1	2	30	Coding	2
CO_2.2	UAS Programming	UE	X	X	1.5	1	1.5	22.5	Coding	3
DA_2.1	Sensory Analysis for UAS Use Case I	VO	X	X	2	1	2	30	Analysis	2
DA_2.2	Sensory Analysis for UAS Use Case I	UE	X	X	1.5	1	1.5	22.5	Analysis	3
DA_3.1	Sensor Data Management	VO	X	X	1	1	1	15	Analysis	2
DA_3.2	Sensor Data Management	UE	X	X	1.5	1	1.5	22.5	Analysis	3
FE_3.1	Mission Planning & Risk Assessment	VO	X	X	2	1	2	30	Flight	2
FE_3.2	Mission Planning & Risk Assessment	UE	X	X	1.5	1	1.5	22.5	Flight	3
SP_2	Foreign Language II	ILV		X	4	1	4	60	Compl	6
Total line:					19.0		19.0	285.0		30
Course hours = Total WSH x course weeks					285.0					

3. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
BU_3	Business, Economics & Financing	ILV		X	4	0.6	2.4	36.0	Business	6
CO_3.1	Advanced UAS Programming	VO	X	X	2	1	2	30	Coding	2
CO_3.2	Advanced UAS Programming	UE	X	X	1.5	1	1.5	22.5	Coding	3
COM_1	UAS Project	PT	X	X	2	2	4	60	Flight	4
COM_2	Open Category Use Cases	ILV		X	2.5	1	2.5	37.5	Compl	5
DA_4.1	Sensory Analysis for UAS Use Case II	VO	X	X	2	1	2	30	Analysis	2
DA_4.2	Sensory Analysis for UAS Use Case II	UE	X	X	1.5	1	1.5	22.5	Analysis	3
FE_4.1	Autonomous Systems	VO	X	X	2	1	2	30	Flight	2
FE_4.2	Autonomous Systems	UE	X	X	1.5	1	1.5	22.5	Flight	3
Total line:					19.0		19.4	291.0		30
Course hours = Total WSH x course weeks					285.0					

4. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
BU_4	Smart Mobility Concepts	ILV		X	2.5	1	2.5	37.5	Business	5
CO_4.1	Software Architecture for Robotic Systems	VO	X	X	2	1	2	30	Coding	2
CO_4.2	Software Architecture for Robotic Systems	UE	X	X	2	1	2	30	Coding	2
CO_5.1	UAS Simulation	VO	X	X	2	1	2	30	Coding	2
CO_5.2	UAS Simulation	UE	X	X	1.5	1	1.5	22.5	Coding	3
COM_3	Mobility Project	PT	X	X	2	3	6	90	Flight	4
COM_4	Scientific Writing	SE		X	1	1	1	15	Compl	2
FE_5.1	UAS Design	VO	X	X	2	1	2	30	Flight	2
FE_5.2	UAS Design	UE	X	X	1.5	1	1.5	22.5	Flight	3
FE_6.1	U-Space / UTM	ILV	X	X	2.5	1	2.5	37.5	Flight	5
Total line:					19.0		23.0	345.0		30
Course hours = Total WSH x course weeks					285.0					

5. Semester

Course no.	Course title	LV-Typ	T	E	WSH	No. of groups	ASWS	ALVS	MODUL	ECTS
BU_5	Selected Topics in Business	ILV		X	0	1	0	0	Business	6
DA_5	Selected Topics in UAS Sensory, Use Cases and Management	ILV	X	X	0	1	0	0	Analysis	12
FE_6	Selected Topics in UAS Engineering	ILV	X	X	0	1	0	0	Flight	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
COM_5	Bachelor Seminar	SE		X	0.5	1	0.5	7.5	Compl	10
COM_6	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	76.5	80.9	1213.5	180
Total number of courses in 1st year of study	38	38	570	60
Total number of courses in 2nd year of study	38	42.4	636	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	53.5			125
Percentage of technical courses over all semesters based on WSH / ECTS	69.93 %			69.44 %
Total number of specialized courses in English over all semesters	76.5			180
Proportion of specialized courses in English over all semesters (Calculation excluding language courses)	100 %			100 %

2.3 Modularization

Module number:	Flight Engineering	Scope:	
Flight		49	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		
	5. Semester		
Level	1. Semester: Beginner / 1. Semester: Beginners / 2. Semester: Beginner / 2. Semester: Beginners / 3. Semester: Beginner / 3. Semester: Beginners / 4. Semester: Beginner / 4. Semester: Beginners / 5. Semester: Beginner		
Previous knowledge	1. Semester: None / 2. Semester: None / 3. Semester: None / 4. Semester: None / 5. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	<u>UAS Project /PT / LV-Nr: COM 1 / 3.Semester / ECTS: 4</u> - 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.		
	<u>Mobility Project /PT / LV-Nr: COM 3 / 4.Semester / ECTS: 4</u> - 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		
	<u>Principles of Flight and Aviation /VO / LV-Nr: FE 1.1 / 1.Semester / ECTS: 2</u> - 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.		
	<u>Principles of Flight and Aviation /UE / LV-Nr: FE 1.2 / 1.Semester / ECTS: 3</u> - 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.		
	<u>Fundamentals in UAS components /VO / LV-Nr: FE 2.1 / 1.Semester / ECTS: 2</u> - 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/10.1007/978-3-319-66576-4 - Barnhart, R. K., Hottman, S. B., Marshall, D. M., & Shappee, E. (2021). Introduction to Unmanned Aircraft Systems. CRC Press. ISBN: 1000326861, 9781000326864.		
	<u>Fundamentals of UAS components /UE / LV-Nr: FE 2.2 / 1.Semester / ECTS: 2</u> - 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/10.1007/978-3-319-66576-4 - Barnhart, R. K., Hottman, S. B., Marshall, D. M., & Shappee, E. (2021). Introduction to Unmanned Aircraft Systems. CRC Press. ISBN: 1000326861, 9781000326864.		

	<u>Mission Planning & Risk Assessment /VO / LV-Nr: FE 3.1 / 2.Semester / ECTS: 2</u> - 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).
Literature recommendation	<u>Mission Planning & Risk Assessment /UE / LV-Nr: FE 3.2 / 2.Semester / ECTS: 3</u> - 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).
	<u>Autonomous Systems /VO / LV-Nr: FE 4.1 / 3.Semester / ECTS: 2</u> - 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.
	<u>Autonomous Systems /UE / LV-Nr: FE 4.2 / 3.Semester / ECTS: 3</u> - 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.
	<u>UAS Design /VO / LV-Nr: FE 5.1 / 4.Semester / ECTS: 2</u> - 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.
	<u>UAS Design /UE / LV-Nr: FE 5.2 / 4.Semester / ECTS: 3</u> - 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.
	<u>Selected Topics in UAS Engineering /ILV / LV-Nr: FE 6 / 5.Semester / ECTS: 12</u> - Will be delivered by the partner university
	<u>U-Space / UTM /ILV / LV-Nr: FE 6.1 / 4.Semester / ECTS: 5</u> - 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	<u>UAS Project /PT / LV-Nr: COM 1 / 3.Semester / ECTS: 4</u>

	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. <u>Mobility Project /PT / LV-Nr: COM_3 / 4.Semester / ECTS: 4</u> 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.
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Acquisition of skills	<u>Principles of Flight and Aviation /VO / LV-Nr: FE 1.1 / 1.Semester / ECTS: 2</u> 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.
	<u>Principles of Flight and Aviation /UE / LV-Nr: FE 1.2 / 1.Semester / ECTS: 3</u> 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
	<u>Fundamentals in UAS components /VO / LV-Nr: FE 2.1 / 1.Semester / ECTS: 2</u> 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.
	<u>Fundamentals of UAS components /UE / LV-Nr: FE 2.2 / 1.Semester / ECTS: 2</u> 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.

	<u>Mission Planning & Risk Assessment /VO / LV-Nr: FE 3.1 / 2.Semester / ECTS: 2</u> 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,
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Acquisition of skills	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.
	<u>Mission Planning & Risk Assessment /UE / LV-Nr: FE 3.2 / 2.Semester / ECTS: 3</u> 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.
	<u>Autonomous Systems /VO / LV-Nr: FE 4.1 / 3.Semester / ECTS: 2</u> 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.
	<u>Autonomous Systems /UE / LV-Nr: FE 4.2 / 3.Semester / ECTS: 3</u> 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
	<u>UAS Design /VO / LV-Nr: FE 5.1 / 4.Semester / ECTS: 2</u>

	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.
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Acquisition of skills	- 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>UAS Design /UE / LV-Nr: FE 5.2 / 4.Semester / ECTS: 3</u> 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>Selected Topics in UAS Engineering /ILV / LV-Nr: FE 6 / 5.Semester / ECTS: 12</u> 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.
Course contents	<u>U-Space / UTM /ILV / LV-Nr: FE 6.1 / 4.Semester / ECTS: 5</u> 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.
	<u>UAS Project /PT / LV-Nr: COM 1 / 3.Semester / ECTS: 4</u> 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.
	<u>Mobility Project /PT / LV-Nr: COM 3 / 4.Semester / ECTS: 4</u>

	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.
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Course contents	<u>Principles of Flight and Aviation /VO / LV-Nr: FE 1.1 / 1.Semester / ECTS: 2</u> - 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 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.
	<u>Principles of Flight and Aviation /UE / LV-Nr: FE 1.2 / 1.Semester / ECTS: 3</u> - 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 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.
	<u>Fundamentals in UAS components /VO / LV-Nr: FE 2.1 / 1.Semester / ECTS: 2</u> - 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).
	<u>Fundamentals of UAS components /UE / LV-Nr: FE 2.2 / 1.Semester / ECTS: 2</u>

	- 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
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Course contents	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).
	<u>Mission Planning & Risk Assessment /VO / LV-Nr: FE 3.1 / 2.Semester / ECTS: 2</u> - 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.
	<u>Mission Planning & Risk Assessment /UE / LV-Nr: FE 3.2 / 2.Semester / ECTS: 3</u> - 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.
	<u>Autonomous Systems /VO / LV-Nr: FE 4.1 / 3.Semester / ECTS: 2</u> - 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.
	<u>Autonomous Systems /UE / LV-Nr: FE 4.2 / 3.Semester / ECTS: 3</u> - 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.
	<u>UAS Design /VO / LV-Nr: FE 5.1 / 4.Semester / ECTS: 2</u> - 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>UAS Design /UE / LV-Nr: FE 5.2 / 4.Semester / ECTS: 3</u> - 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.
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Course contents	<u>Selected Topics in UAS Engineering /ILV / LV-Nr: FE 6 / 5.Semester / ECTS: 12</u> 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
	<u>U-Space / UTM /ILV / LV-Nr: FE 6.1 / 4.Semester / ECTS: 5</u> - 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	<u>UAS Project /PT / LV-Nr: COM 1 / 3.Semester / ECTS: 4</u> Group work
	<u>Mobility Project /PT / LV-Nr: COM 3 / 4.Semester / ECTS: 4</u> Group work
	<u>Principles of Flight and Aviation /VO / LV-Nr: FE 1.1 / 1.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises,
	<u>Principles of Flight and Aviation /UE / LV-Nr: FE 1.2 / 1.Semester / ECTS: 3</u> group work, discussion, exercises
	<u>Fundamentals in UAS components /VO / LV-Nr: FE 2.1 / 1.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises,
	<u>Fundamentals of UAS components /UE / LV-Nr: FE 2.2 / 1.Semester / ECTS: 2</u> group work, discussion, exercises
	<u>Mission Planning & Risk Assessment /VO / LV-Nr: FE 3.1 / 2.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises
	<u>Mission Planning & Risk Assessment /UE / LV-Nr: FE 3.2 / 2.Semester / ECTS: 3</u> group work, discussions, exercises
	<u>Autonomous Systems /VO / LV-Nr: FE 4.1 / 3.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises
	<u>Autonomous Systems /UE / LV-Nr: FE 4.2 / 3.Semester / ECTS: 3</u> Group Work, discussions, exercises
	<u>UAS Design /VO / LV-Nr: FE 5.1 / 4.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises
	<u>UAS Design /UE / LV-Nr: FE 5.2 / 4.Semester / ECTS: 3</u> Group Work, discussions, exercises
	<u>Selected Topics in UAS Engineering /ILV / LV-Nr: FE 6 / 5.Semester / ECTS: 12</u> To be defined by the partner university

	<u>U-Space / UTM / ILV / LV-Nr: FE 6.1 / 4.Semester / ECTS: 5</u> Presentation, group work, discussion, exercises
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Evaluation Methods Criteria	<u>UAS Project /PT / LV-Nr: COM 1 / 3.Semester / ECTS: 4</u> Project and documentation
	<u>Mobility Project /PT / LV-Nr: COM 3 / 4.Semester / ECTS: 4</u> Project and documentation
	<u>Principles of Flight and Aviation /VO / LV-Nr: FE 1.1 / 1.Semester / ECTS: 2</u> Portfolio tests
	<u>Principles of Flight and Aviation /UE / LV-Nr: FE 1.2 / 1.Semester / ECTS: 3</u> Portfolio exam
	<u>Fundamentals in UAS components /VO / LV-Nr: FE 2.1 / 1.Semester / ECTS: 2</u> portfolio tests
	<u>Fundamentals of UAS components /UE / LV-Nr: FE 2.2 / 1.Semester / ECTS: 2</u> Portfolio exam
	<u>Mission Planning & Risk Assessment /VO / LV-Nr: FE 3.1 / 2.Semester / ECTS: 2</u> Portfolio test
	<u>Mission Planning & Risk Assessment /UE / LV-Nr: FE 3.2 / 2.Semester / ECTS: 3</u> Portfolio exam
	<u>Autonomous Systems /VO / LV-Nr: FE 4.1 / 3.Semester / ECTS: 2</u> Portfolio exam
	<u>Autonomous Systems /UE / LV-Nr: FE 4.2 / 3.Semester / ECTS: 3</u> Portfolio exam
	<u>UAS Design /VO / LV-Nr: FE 5.1 / 4.Semester / ECTS: 2</u> Portfolio tests
	<u>UAS Design /UE / LV-Nr: FE 5.2 / 4.Semester / ECTS: 3</u> Portfolio exam
	<u>Selected Topics in UAS Engineering /ILV / LV-Nr: FE 6 / 5.Semester / ECTS: 12</u> To be defined by the partner university
	<u>U-Space / UTM /ILV / LV-Nr: FE 6.1 / 4.Semester / ECTS: 5</u> Portfolio exam

Module number:	Data Analysis	Scope:	
Analysis		32	ECTS
Degree program	University of Applied Sciences Bachelor's Program Drone Engineering full-time		
Position in the curriculum	1. Semester		
	2. Semester		
	3. Semester		
	5. Semester		
Level	1. Semester: Beginner / 1. Semester: Beginners / 2. Semester: Beginner / 2. Semester: Beginners / 3. Semester: Beginner / 3. Semester: Beginners / 5. Semester: Beginner		
Previous knowledge	1. Semester: None / 2. Semester: Data & Analysis / 2. Semester: None / 3. Semester: None / 5. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	<u>Data & Analytics /VO / LV-Nr: DA 1.1 / 1.Semester / ECTS: 2</u> - 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., & Schaffer, 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.		
	<u>Data & Analytics /UE / LV-Nr: DA 1.2 / 1.Semester / ECTS: 3</u> - 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., & Schaffer, 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.		
	<u>Sensory Analysis for UAS Use Case I /VO / LV-Nr: DA 2.1 / 2.Semester / ECTS: 2</u> - 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., & Schaffer, 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		
	<u>Sensory Analysis for UAS Use Case I /UE / LV-Nr: DA 2.2 / 2.Semester / ECTS: 3</u> - 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., & Schaffer, 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		
	<u>Sensor Data Management /VO / LV-Nr: DA 3.1 / 2.Semester / ECTS: 2</u> - 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.		
	<u>Sensor Data Management /UE / LV-Nr: DA 3.2 / 2.Semester / ECTS: 3</u>		

	- 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.
	<u>Sensory Analysis for UAS Use Case II /VO / LV-Nr: DA 4.1 / 3.Semester / ECTS: 2</u> - 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.

Literature recommendation	- Schirrmann, M. (2022). UAV Imagery for Precision Agriculture. Remote Sensing, MDPI. ISSN 2072-4292
	<u>Sensory Analysis for UAS Use Case II /UE / LV-Nr: DA 4.2 / 3.Semester / ECTS: 3</u> - 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
	<u>Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: DA 5 / 5.Semester / ECTS: 12</u> - Will be delivered by the partner university
Acquisition of skills	<u>Data & Analytics /VO / LV-Nr: DA 1.1 / 1.Semester / ECTS: 2</u> 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.
	<u>Data & Analytics /UE / LV-Nr: DA 1.2 / 1.Semester / ECTS: 3</u> 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 • - perform integral calculations for determining areas under curves, volumes, and other quantities essential for data modeling and analysis.
	<u>Sensory Analysis for UAS Use Case I /VO / LV-Nr: DA 2.1 / 2.Semester / ECTS: 2</u> 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 calibrating sensors and validating data against ground truth.
	<u>Sensory Analysis for UAS Use Case I /UE / LV-Nr: DA 2.2 / 2.Semester / ECTS: 3</u> 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 calibrating sensors and validating data against ground truth
	<u>Sensor Data Management /VO / LV-Nr: DA 3.1 / 2.Semester / ECTS: 2</u>

	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
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Acquisition of skills	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.
	<u>Sensor Data Management /UE / LV-Nr: DA 3.2 / 2.Semester / ECTS: 3</u> 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
	<u>Sensory Analysis for UAS Use Case II /VO / LV-Nr: DA 4.1 / 3.Semester / ECTS: 2</u> 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.
	<u>Sensory Analysis for UAS Use Case II /UE / LV-Nr: DA 4.2 / 3.Semester / ECTS: 3</u> 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
	<u>Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: DA 5 / 5.Semester / ECTS: 12</u> 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.
Course contents	<u>Data & Analytics /VO / LV-Nr: DA 1.1 / 1.Semester / ECTS: 2</u>

	- 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.
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Course contents	<u>Data & Analytics /UE / LV-Nr: DA 1.2 / 1.Semester / ECTS: 3</u> - 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.
	<u>Sensory Analysis for UAS Use Case I /VO / LV-Nr: DA 2.1 / 2.Semester / ECTS: 2</u> - 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.
	<u>Sensory Analysis for UAS Use Case I /UE / LV-Nr: DA 2.2 / 2.Semester / ECTS: 3</u> - 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.
	<u>Sensor Data Management /VO / LV-Nr: DA 3.1 / 2.Semester / ECTS: 2</u> - 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). - 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).
	<u>Sensor Data Management /UE / LV-Nr: DA 3.2 / 2.Semester / ECTS: 3</u>

	- 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). - 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.,
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Course contents	images).
	<u>Sensory Analysis for UAS Use Case II /VO / LV-Nr: DA 4.1 / 3.Semester / ECTS: 2</u> - 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.
	<u>Sensory Analysis for UAS Use Case II /UE / LV-Nr: DA 4.2 / 3.Semester / ECTS: 3</u> - 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.
	<u>Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: DA 5 / 5.Semester / ECTS: 12</u> 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: - Legal and Ethical Considerations in Drone Use - Drone Flight Control and Autonomy - Drone-Based Mapping and Surveying - Data Processing and Analysis - Drone Sensory Technologies
Teaching and learning methods	<u>Data & Analytics /VO / LV-Nr: DA 1.1 / 1.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises,
	<u>Data & Analytics /UE / LV-Nr: DA 1.2 / 1.Semester / ECTS: 3</u> group work, discussion, exercises
	<u>Sensory Analysis for UAS Use Case I /VO / LV-Nr: DA 2.1 / 2.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises
	<u>Sensory Analysis for UAS Use Case I /UE / LV-Nr: DA 2.2 / 2.Semester / ECTS: 3</u> Presentations, group work, discussions, excersices
	<u>Sensor Data Management /VO / LV-Nr: DA 3.1 / 2.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises
	<u>Sensor Data Management /UE / LV-Nr: DA 3.2 / 2.Semester / ECTS: 3</u> group work, discussions, exercises
	<u>Sensory Analysis for UAS Use Case II /VO / LV-Nr: DA 4.1 / 3.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises
	<u>Sensory Analysis for UAS Use Case II /UE / LV-Nr: DA 4.2 / 3.Semester / ECTS: 3</u>

	Group Work, Discussions, exercises
	<u>Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: DA 5 / 5.Semester / ECTS: 12</u>
	To be defined by the partner university

Evaluation Methods Criteria	<u>Data & Analytics /VO / LV-Nr: DA 1.1 / 1.Semester / ECTS: 2</u> Portfolio exam
	<u>Data & Analytics /UE / LV-Nr: DA 1.2 / 1.Semester / ECTS: 3</u> Portfolio exam
	<u>Sensory Analysis for UAS Use Case I /VO / LV-Nr: DA 2.1 / 2.Semester / ECTS: 2</u> Portfolio tests
	<u>Sensory Analysis for UAS Use Case I /UE / LV-Nr: DA 2.2 / 2.Semester / ECTS: 3</u> Portfolio exam
	<u>Sensor Data Management /VO / LV-Nr: DA 3.1 / 2.Semester / ECTS: 2</u> Portfolio exam
	<u>Sensor Data Management /UE / LV-Nr: DA 3.2 / 2.Semester / ECTS: 3</u> Portfolio exam
	<u>Sensory Analysis for UAS Use Case II /VO / LV-Nr: DA 4.1 / 3.Semester / ECTS: 2</u> Portfolio exam
	<u>Sensory Analysis for UAS Use Case II /UE / LV-Nr: DA 4.2 / 3.Semester / ECTS: 3</u> Portfolio exam
	<u>Selected Topics in UAS Sensory, Use Cases and Management /ILV / LV-Nr: DA 5 / 5.Semester / ECTS: 12</u> To be defined by the partner university

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 / 1. Semester: Beginners / 2. Semester: Beginner / 2. Semester: Beginners / 3. Semester: Beginner / 3. Semester: Beginners / 4. Semester: Beginner / 4. Semester: Beginners		
Previous knowledge	1. Semester: None / 2. Semester: Introduction to Programming / 2. Semester: None / 3. Semester: Drone Programming / 4. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	<u>Introduction to Programming /VO / LV-Nr: CO 1.1 / 1.Semester / ECTS: 3</u> - 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.		
	<u>Introduction to Programming /UE / LV-Nr: CO 1.2 / 1.Semester / ECTS: 2</u> - 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.		
	<u>UAS Programming /VO / LV-Nr: CO 2.1 / 2.Semester / ECTS: 2</u> - 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-Azuella, H. (2020). Advanced Robotic Vehicles Programming: An Ardupilot and Pixhawk Approach. Apress. ISBN: 978-1484255308. https://doi.org/10.1007/978-1484255308 . - 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		
	<u>UAS Programming /UE / LV-Nr: CO 2.2 / 2.Semester / ECTS: 3</u> - 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-Azuella, H. (2020). Advanced Robotic Vehicles Programming: An Ardupilot and Pixhawk Approach. Apress. ISBN: 978-1484255308. https://doi.org/10.1007/978-1484255308 . - 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		
	<u>Advanced UAS Programming /VO / LV-Nr: CO 3.1 / 3.Semester / ECTS: 2</u> - 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/10.1007/978-3319325507 . - Dada, E. G. (2017). Swarm Robotics Cooperative Movement Control Using PSO & IPM Algorithms. Lambert Academic Publishing. ISBN: 978-3659799907.		
	<u>Advanced UAS Programming /UE / LV-Nr: CO 3.2 / 3.Semester / ECTS: 3</u>		

	- 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.
	<u>Software Architecture for Robotic Systems /VO / LV-Nr: CO 4.1 / 4.Semester / ECTS: 2</u> - Siciliano, B., & Khatib, O. (Eds.). (2016). Springer Handbook of Robotics. Springer. ISBN: 978-3319325507. https://doi.org/10.1007/97

Literature recommendation	- Corke, P., Jachimczyk, W., & Pillat, R. (2023). Robotics, Vision and Control: Fundamental Algorithms In MATLAB (3rd ed.). Springer Cham. ISBN: 978-3031072628. https://doi.org/10.1007/978-3031072628. - Bräunl, T. (2022). Embedded Robotics: From Mobile Robot Design to Autonomous Vehicles with Raspberry Pi and Arduino. Springer. ISBN: 978-9811608049. https://doi.org/10.1007/978-9811608049.
	<u>Software Architecture for Robotic Systems /UE / LV-Nr: CO 4.2 / 4.Semester / ECTS: 2</u> - Siciliano, B., & Khatib, O. (Eds.). (2016). Springer Handbook of Robotics. Springer. ISBN: 978-3319325507. https://doi.org/10.1007/978-3319325507. - Corke, P., Jachimczyk, W., & Pillat, R. (2023). Robotics, Vision and Control: Fundamental Algorithms In MATLAB (3rd ed.). Springer Cham. ISBN: 978-3031072628. https://doi.org/10.1007/978-3031072628. - Bräunl, T. (2022). Embedded Robotics: From Mobile Robot Design to Autonomous Vehicles with Raspberry Pi and Arduino. Springer. ISBN: 978-9811608049. https://doi.org/10.1007/978-9811608049.
	<u>UAS Simulation /VO / LV-Nr: CO 5.1 / 4.Semester / ECTS: 2</u> - 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	<u>UAS Simulation /UE / LV-Nr: CO 5.2 / 4.Semester / ECTS: 3</u> - 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.
	<u>Introduction to Programming /VO / LV-Nr: CO 1.1 / 1.Semester / ECTS: 3</u> 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.
	<u>Introduction to Programming /UE / LV-Nr: CO 1.2 / 1.Semester / ECTS: 2</u> 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 • 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 • adapt them independently for problem situations • Distinguish algorithms and data structures based on their complexity • 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 • choose, configure and use a suitable development environment
	<u>UAS Programming /VO / LV-Nr: CO 2.1 / 2.Semester / ECTS: 2</u>

	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. <u>UAS Programming /UE / LV-Nr: CO 2.2 / 2.Semester / ECTS: 3</u> 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.
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Acquisition of skills	• Develop Flight Control Algorithms: Develop and implement algorithms for primary flight control operations (take-off, 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
	<u>Advanced UAS Programming /VO / LV-Nr: CO 3.1 / 3.Semester / ECTS: 2</u> 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.
	<u>Advanced UAS Programming /UE / LV-Nr: CO 3.2 / 3.Semester / ECTS: 3</u> 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 issue
	<u>Software Architecture for Robotic Systems /VO / LV-Nr: CO 4.1 / 4.Semester / ECTS: 2</u> 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).
	<u>Software Architecture for Robotic Systems /UE / LV-Nr: CO 4.2 / 4.Semester / ECTS: 2</u> 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
	<u>UAS Simulation /VO / LV-Nr: CO 5.1 / 4.Semester / ECTS: 2</u>

	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,
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Acquisition of skills	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.
	<u>UAS Simulation /UE / LV-Nr: CO 5.2 / 4.Semester / ECTS: 3</u> 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	<u>Introduction to Programming /VO / LV-Nr: CO 1.1 / 1.Semester / ECTS: 3</u> - 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.
	<u>Introduction to Programming /UE / LV-Nr: CO 1.2 / 1.Semester / ECTS: 2</u> - 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.
	<u>UAS Programming /VO / LV-Nr: CO 2.1 / 2.Semester / ECTS: 2</u> - 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. - 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.
	<u>UAS Programming /UE / LV-Nr: CO 2.2 / 2.Semester / ECTS: 3</u> - 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. - 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.
	<u>Advanced UAS Programming /VO / LV-Nr: CO 3.1 / 3.Semester / ECTS: 2</u>

	- 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
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Course contents	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.
	<u>Advanced UAS Programming /UE / LV-Nr: CO 3.2 / 3.Semester / ECTS: 3</u> - 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.
	<u>Software Architecture for Robotic Systems /VO / LV-Nr: CO 4.1 / 4.Semester / ECTS: 2</u> - 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.
	<u>Software Architecture for Robotic Systems /UE / LV-Nr: CO 4.2 / 4.Semester / ECTS: 2</u> - 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.
	<u>UAS Simulation /VO / LV-Nr: CO 5.1 / 4.Semester / ECTS: 2</u> - 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 life-cycle (initial design to deployment, iterative testing, refinement).
	<u>UAS Simulation /UE / LV-Nr: CO 5.2 / 4.Semester / ECTS: 3</u>

	- 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 life-cycle (initial design to deployment, iterative testing, refinement).
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Teaching and learning methods	<u>Introduction to Programming /VO / LV-Nr: CO 1.1 / 1.Semester / ECTS: 3</u> Presentation, group work, discussion, exercises
	<u>Introduction to Programming /UE / LV-Nr: CO 1.2 / 1.Semester / ECTS: 2</u> group work, discussion, exercises
	<u>UAS Programming /VO / LV-Nr: CO 2.1 / 2.Semester / ECTS: 2</u> Presentations, Group work, discussion, exercises
	<u>UAS Programming /UE / LV-Nr: CO 2.2 / 2.Semester / ECTS: 3</u> Presentations, group work, discussions, exercises
	<u>Advanced UAS Programming /VO / LV-Nr: CO 3.1 / 3.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises
	<u>Advanced UAS Programming /UE / LV-Nr: CO 3.2 / 3.Semester / ECTS: 3</u> Group Work, discussions, exercises
	<u>Software Architecture for Robotic Systems /VO / LV-Nr: CO 4.1 / 4.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises
	<u>Software Architecture for Robotic Systems /UE / LV-Nr: CO 4.2 / 4.Semester / ECTS: 2</u> Group Work, discussions, exercises
	<u>UAS Simulation /VO / LV-Nr: CO 5.1 / 4.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises
	<u>UAS Simulation /UE / LV-Nr: CO 5.2 / 4.Semester / ECTS: 3</u> Group Work, Discussions, Exercises
Evaluation Methods Criteria	<u>Introduction to Programming /VO / LV-Nr: CO 1.1 / 1.Semester / ECTS: 3</u> Exam
	<u>Introduction to Programming /UE / LV-Nr: CO 1.2 / 1.Semester / ECTS: 2</u> Portfolio exam
	<u>UAS Programming /VO / LV-Nr: CO 2.1 / 2.Semester / ECTS: 2</u> Portfolio tests
	<u>UAS Programming /UE / LV-Nr: CO 2.2 / 2.Semester / ECTS: 3</u> Portfolio exam
	<u>Advanced UAS Programming /VO / LV-Nr: CO 3.1 / 3.Semester / ECTS: 2</u> Portfolio exam
	<u>Advanced UAS Programming /UE / LV-Nr: CO 3.2 / 3.Semester / ECTS: 3</u> Portfolio exam
	<u>Software Architecture for Robotic Systems /VO / LV-Nr: CO 4.1 / 4.Semester / ECTS: 2</u> Portfolio tests
	<u>Software Architecture for Robotic Systems /UE / LV-Nr: CO 4.2 / 4.Semester / ECTS: 2</u> Portfolio exam
	<u>UAS Simulation /VO / LV-Nr: CO 5.1 / 4.Semester / ECTS: 2</u> Portfolio tests
	<u>UAS Simulation /UE / LV-Nr: CO 5.2 / 4.Semester / ECTS: 3</u> Portfolio exam

Module number:	Business	Scope:	
Business		26	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		
	5. Semester		
Level	1. Semester: Beginner / 2. Semester: Beginner / 3. Semester: Beginner / 4. Semester: Beginner / 5. Semester: Beginner		
Previous knowledge	1. Semester: None / 2. Semester: None / 3. Semester: None / 4. Semester: None / 5. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	<u>Introduction to Regulations and Safety /ILV / LV-Nr: BU 1 / 1.Semester / ECTS: 5</u> - Završnik, A. (2016). Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance, Springer. https://doi.org/10.1007/977 . - 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		
	<u>Project Management & Systems Engineering /ILV / LV-Nr: BU 2 / 2.Semester / ECTS: 4</u> - 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 .		
	<u>Business, Economics & Financing /ILV / LV-Nr: BU 3 / 3.Semester / ECTS: 6</u> - 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.		
	<u>Smart Mobility Concepts /ILV / LV-Nr: BU 4 / 4.Semester / ECTS: 5</u> - 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.).		
	<u>Selected Topics in Business /ILV / LV-Nr: BU 5 / 5.Semester / ECTS: 6</u> - Will be delivered by the partner university		
Acquisition of skills	Introduction to Regulations and Safety /ILV / LV-Nr: BU 1 / 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).
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Acquisition of skills	<u>Project Management & Systems Engineering /ILV / LV-Nr: BU 2 / 2.Semester / ECTS: 4</u> 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.
	<u>Business, Economics & Financing /ILV / LV-Nr: BU 3 / 3.Semester / ECTS: 6</u> 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.
	<u>Smart Mobility Concepts /ILV / LV-Nr: BU 4 / 4.Semester / ECTS: 5</u> 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).
	<u>Selected Topics in Business /ILV / LV-Nr: BU 5 / 5.Semester / ECTS: 6</u> 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.
Course contents	<u>Introduction to Regulations and Safety /ILV / LV-Nr: BU 1 / 1.Semester / ECTS: 5</u>

	- 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 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.
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Course contents	- 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.
	<u>Project Management & Systems Engineering /ILV / LV-Nr: BU_2 / 2.Semester / ECTS: 4</u> - 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.
	<u>Business, Economics & Financing /ILV / LV-Nr: BU_3 / 3.Semester / ECTS: 6</u> 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.
	<u>Smart Mobility Concepts /ILV / LV-Nr: BU_4 / 4.Semester / ECTS: 5</u> - 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 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.
	<u>Selected Topics in Business /ILV / LV-Nr: BU_5 / 5.Semester / ECTS: 6</u>

	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
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Course contents	- Business Informatics - e-Commerce & e-Business - Information Management
Teaching and learning methods	<u>Introduction to Regulations and Safety /ILV / LV-Nr: BU 1 / 1.Semester / ECTS: 5</u> Presentation, group work, discussion, exercises, presentation,
	<u>Project Management & Systems Engineering /ILV / LV-Nr: BU 2 / 2.Semester / ECTS: 4</u> Presentation, group work, discussion, exercises
	<u>Business, Economics & Financing /ILV / LV-Nr: BU 3 / 3.Semester / ECTS: 6</u> Presentation, group work, discussion, exercises
	<u>Smart Mobility Concepts /ILV / LV-Nr: BU 4 / 4.Semester / ECTS: 5</u> Group work, presentation, lecture
	<u>Selected Topics in Business /ILV / LV-Nr: BU 5 / 5.Semester / ECTS: 6</u> To be defined by the partner university
Evaluation Methods Criteria	<u>Introduction to Regulations and Safety /ILV / LV-Nr: BU 1 / 1.Semester / ECTS: 5</u> Exam
	<u>Project Management & Systems Engineering /ILV / LV-Nr: BU 2 / 2.Semester / ECTS: 4</u> Project and documentation
	<u>Business, Economics & Financing /ILV / LV-Nr: BU 3 / 3.Semester / ECTS: 6</u> Exam
	<u>Smart Mobility Concepts /ILV / LV-Nr: BU 4 / 4.Semester / ECTS: 5</u> Exam
	<u>Selected Topics in Business /ILV / LV-Nr: BU 5 / 5.Semester / ECTS: 6</u> To be defined by the partner university

Module number:	Complementary	Scope:	
Compl		49	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		
	6. Semester		
Level	1. Semester: A1 bis C2 (GER) / 2. Semester: A1 bis C2 (GER) / 3. Semester: Beginner / 4. Semester: Beginner / 6. Semester: Beginner		
Previous knowledge	1. Semester: Beginner Modules: - Chinese, German, Spanish at levels A1/A2 with target level A2: no prior knowledge permitted. Upper Beginner Modules: - German at levels A2/B1 with target level B1.1: solid prior knowledge at A1 level required. Advanced Modules: - Business German, Business French, Business Italian, Business Spanish at levels B1/B2 with target level B2.1: solid prior knowledge at A2 level required. - Business English for Academic and Professional Purposes at levels B2+/C1 with target level C1: prior knowledge at B2 level or completion of an English bridging/preparatory course required. - Business English for Academic and Professional Purposes at levels C1/C2 with target level C2.1: solid prior knowledge at B2.2 level required. / 2. Semester: Beginner Modules: - Chinese, German, Spanish at levels A1/A2 with target level A2: no prior knowledge permitted. Upper Beginner Modules: - German at levels A2/B1 with target level B1.1: solid prior knowledge at A1 level required. Advanced Modules: - Business German, Business French, Business Italian, Business Spanish at levels B1/B2 with target level B2.1: solid prior knowledge at A2 level required. - Business English for Academic and Professional Purposes at levels B2+/C1 with target level C1: prior knowledge at B2 level or completion of an English bridging/preparatory course required. - Business English for Academic and Professional Purposes at levels C1/C2 with target level C2.1: solid prior knowledge at B2.2 level required. / 3. Semester: None / 4. Semester: None / 6. Semester: None		
Blocked	no		
Participant group	A-levels and/or corresponding previous training, beginners		
Literature recommendation	<u>Open Category Use Cases /ILV / LV-Nr: COM 2 / 3.Semester / ECTS: 5</u> - Sehwat, 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.		
	<u>Scientific Writing /SE / LV-Nr: COM 4 / 4.Semester / ECTS: 2</u> - 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.		
	<u>Bachelor Seminar /SE / LV-Nr: COM 5 / 6.Semester / ECTS: 10</u> - 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.		
	<u>Integrated Internship /BPR / LV-Nr: COM 6 / 6.Semester / ECTS: 20</u> - 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		
	<u>Foreign Language I /ILV / LV-Nr: SP 1 / 1.Semester / ECTS: 6</u> Textbook to be arranged; authentic materials, such as articles from English-language magazines (including professional journals), newspapers, and online media source		
	<u>Foreign Language II /ILV / LV-Nr: SP 2 / 2.Semester / ECTS: 6</u> Textbook to be arranged; authentic materials, such as articles from English-language magazines (including professional journals), newspapers, and online media source		
Acquisition of skills	<u>Open Category Use Cases /ILV / LV-Nr: COM 2 / 3.Semester / ECTS: 5</u>		

	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
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Acquisition of skills	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).
	<u>Scientific Writing /SE / LV-Nr: COM 4 / 4.Semester / ECTS: 2</u> 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.
	<u>Bachelor Seminar /SE / LV-Nr: COM 5 / 6.Semester / ECTS: 10</u> 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).
	<u>Integrated Internship /BPR / LV-Nr: COM 6 / 6.Semester / ECTS: 20</u> 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.
	<u>Foreign Language I /ILV / LV-Nr: SP 1 / 1.Semester / ECTS: 6</u> The participants: • (A1 – Beginner) Can understand and use familiar, everyday expressions and very simple sentences aimed at satisfying concrete needs. • (A1 – Beginner) Can introduce themselves and others, ask people questions about personal details – e.g., where they live, people they know, and things they have – and can respond to such questions. • (A1 – Beginner) Can communicate in a simple way if the interlocutor speaks slowly and clearly and is willing to help. • (A2 – Elementary) Can understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, work, local area) • (A2 – Elementary) Can communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. • (A2 – Elementary) Can describe in simple terms aspects of their background, immediate environment, and matters in areas of immediate need. • (B1 – Intermediate) Can understand the main points of clear standard speech on familiar matters regularly encountered in work, school, leisure, etc. • (B1 – Intermediate) Can deal with most situations likely to arise while travelling in an area where the language is spoken and can produce simple connected text on topics that are familiar or of personal interest. • (B1 – Intermediate) Can describe experiences and events, dreams, hopes, and ambitions and briefly give reasons and explanations for opinions and plans. • (B2 – Upper Intermediate) Can understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in their field of specialization. Can interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party. Can produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options. • (C1 – Advanced) Can understand a wide range of demanding, longer texts, and recognize implicit meaning. • (C1 – Advanced) Can express themselves fluently and spontaneously without much obvious searching for expressions and can use the language flexibly and effectively for social, academic, and professional purposes • (C1 – Advanced) Can produce clear, well-structured, detailed text on complex subjects, showing controlled use of organizational patterns, connectors, and cohesive devices. • (C2 – Near-native proficiency) Can understand with ease virtually everything heard or read. • (C2 – Near-native proficiency) Can summarize information from different spoken and written sources, reconstructing arguments and accounts in a coherent presentation. • (C2 – Near-native proficiency) Can express themselves spontaneously, very fluently, and precisely, differentiating finer shades of meaning even in more complex situations.
	<u>Foreign Language II /ILV / LV-Nr: SP 2 / 2.Semester / ECTS: 6</u>

	The participants: • (A1 – Beginner) Can understand and use familiar, everyday expressions and very simple sentences aimed at satisfying concrete needs. • (A1 – Beginner) Can introduce themselves and others, ask people questions about personal details – e.g., where they live, people they know, and things they have – and can respond to such questions.
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Acquisition of skills	• (A1 – Beginner) Can communicate in a simple way if the interlocutor speaks slowly and clearly and is willing to help. • (A2 – Elementary) Can understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, work, local area) • (A2 – Elementary) Can communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. • (A2 – Elementary) Can describe in simple terms aspects of their background, immediate environment, and matters in areas of immediate need. • (B1 – Intermediate) Can understand the main points of clear standard speech on familiar matters regularly encountered in work, school, leisure, etc. • (B1 – Intermediate) Can deal with most situations likely to arise while travelling in an area where the language is spoken and can produce simple connected text on topics that are familiar or of personal interest. • (B1 – Intermediate) Can describe experiences and events, dreams, hopes, and ambitions and briefly give reasons and explanations for opinions and plans. • (B2 – Upper Intermediate) Can understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in their field of specialization. Can interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party. Can produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options. • (C1 – Advanced) Can understand a wide range of demanding, longer texts, and recognize implicit meaning. • (C1 – Advanced) Can express themselves fluently and spontaneously without much obvious searching for expressions and can use the language flexibly and effectively for social, academic, and professional purposes • (C1 – Advanced) Can produce clear, well-structured, detailed text on complex subjects, showing controlled use of organizational patterns, connectors, and cohesive devices. • (C2 – Near-native proficiency) Can understand with ease virtually everything heard or read. • (C2 – Near-native proficiency) Can summarize information from different spoken and written sources, reconstructing arguments and accounts in a coherent presentation. • (C2 – Near-native proficiency) Can express themselves spontaneously, very fluently, and precisely, differentiating finer shades of meaning even in more complex situations.
Course contents	<u>Open Category Use Cases /ILV / LV-Nr: COM 2 / 3.Semester / ECTS: 5</u> - 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.
	<u>Scientific Writing /SE / LV-Nr: COM 4 / 4.Semester / ECTS: 2</u> 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.
	<u>Bachelor Seminar /SE / LV-Nr: COM 5 / 6.Semester / ECTS: 10</u> 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 scientific methods. The bachelor's thesis may include practical references from a professional internship, addressing a current and concrete problem both scientifically and practically.
	<u>Integrated Internship /BPR / LV-Nr: COM 6 / 6.Semester / ECTS: 20</u> 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.
	<u>Foreign Language I /ILV / LV-Nr: SP 1 / 1.Semester / ECTS: 6</u>

	A1 – Beginner Understand and use familiar, everyday expressions and very simple sentences aimed at satisfying concrete needs. Introduce themselves and others, ask people questions about personal details – e.g., where they live, the people they know, or the things they have – and respond to such questions. Communicate in a simple way if the conversation partners speak slowly and clearly and are prepared to help. A2 – Elementary Knowledge Understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, work, local environment). Communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Describe in simple terms their background, education, immediate environment, and matters in areas of immediate need. B1 – Intermediate Language Use
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Course contents	Use clear standard language in academic and business contexts and communicate about familiar topics related to work, school, leisure, etc., applying relevant conversational skills. Express themselves simply and coherently on familiar topics and areas of personal interest. Report on experiences and events, describe dreams, hopes, and ambitions, and briefly give reasons and explanations for opinions and plans. B2 – Independent Language Use Express themselves on the main ideas of complex texts on both concrete and abstract topics in academic and business contexts and participate in technical discussions in their own field of specialization. Communicate with such a degree of fluency and spontaneity that normal conversation with native speakers is quite possible without strain for either party. Express themselves clearly and in detail on a wide range of subjects, explain a viewpoint on a topical issue, and outline the advantages and disadvantages of various options. C1 – Advanced Language Proficiency Understand a wide range of demanding, longer texts and recognize implicit meanings. Use the language effectively and flexibly in academic and business contexts and express themselves fluently and spontaneously without much obvious searching for words. Produce clear, well-structured, detailed text on complex subjects, showing controlled use of organizational patterns, connectors, and cohesive devices. C2 – Near-Native Proficiency Communicate effortlessly in all language situations. Summarize information from various written and spoken sources and reconstruct arguments and accounts in a coherent presentation. Express themselves spontaneously, very fluently, and precisely, differentiating finer shades of meaning even in more complex situations. <u>Foreign Language II /ILV / LV-Nr: SP 2 / 2.Semester / ECTS: 6</u> A1 – Beginner Understand and use familiar, everyday expressions and very simple sentences aimed at satisfying concrete needs. Introduce themselves and others, ask people questions about personal details – e.g., where they live, the people they know, or the things they have – and respond to such questions. Communicate in a simple way if the conversation partners speak slowly and clearly and are prepared to help. A2 – Elementary Knowledge Understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, work, local environment). Communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Describe in simple terms their background, education, immediate environment, and matters in areas of immediate need. B1 – Intermediate Language Use Use clear standard language in academic and business contexts and communicate about familiar topics related to work, school, leisure, etc., applying relevant conversational skills. Express themselves simply and coherently on familiar topics and areas of personal interest. Report on experiences and events, describe dreams, hopes, and ambitions, and briefly give reasons and explanations for opinions and plans. B2 – Independent Language Use Express themselves on the main ideas of complex texts on both concrete and abstract topics in academic and business contexts and participate in technical discussions in their own field of specialization. Communicate with such a degree of fluency and spontaneity that normal conversation with native speakers is quite possible without strain for either party. Express themselves clearly and in detail on a wide range of subjects, explain a viewpoint on a topical issue, and outline the advantages and disadvantages of various options. C1 – Advanced Language Proficiency Understand a wide range of demanding, longer texts and recognize implicit meanings. Use the language effectively and flexibly in academic and business contexts and express themselves fluently and spontaneously without much obvious searching for words. Produce clear, well-structured, detailed text on complex subjects, showing controlled use of organizational patterns, connectors, and cohesive devices. C2 – Near-Native Proficiency Communicate effortlessly in all language situations. Summarize information from various written and spoken sources and reconstruct arguments and accounts in a coherent presentation. Express themselves spontaneously, very fluently, and precisely, differentiating finer shades of meaning even in more complex situations.
Teaching and learning methods	<u>Open Category Use Cases /ILV / LV-Nr: COM 2 / 3.Semester / ECTS: 5</u> Presentation, group work, discussion, exercises <u>Scientific Writing /SE / LV-Nr: COM 4 / 4.Semester / ECTS: 2</u> Presentation, group work, discussion, exercises <u>Bachelor Seminar /SE / LV-Nr: COM 5 / 6.Semester / ECTS: 10</u> Presentation <u>Integrated Internship /BPR / LV-Nr: COM 6 / 6.Semester / ECTS: 20</u> Presentation

	<u>Foreign Language I /ILV / LV-Nr: SP 1 / 1.Semester / ECTS: 6</u> Blended Learning
	<u>Foreign Language II /ILV / LV-Nr: SP 2 / 2.Semester / ECTS: 6</u> Blended Learning
Evaluation Methods Criteria	<u>Open Category Use Cases /ILV / LV-Nr: COM 2 / 3.Semester / ECTS: 5</u> Portfolio tests

Evaluation Methods Criteria	<u>Scientific Writing /SE / LV-Nr: COM 4 / 4.Semester / ECTS: 2</u> Scientific paper, presentation
	<u>Bachelor Seminar /SE / LV-Nr: COM 5 / 6.Semester / ECTS: 10</u> Bachelor Thesis
	<u>Integrated Internship /BPR / LV-Nr: COM 6 / 6.Semester / ECTS: 20</u> Documentation
	<u>Foreign Language I /ILV / LV-Nr: SP 1 / 1.Semester / ECTS: 6</u> Portfolio exam
	<u>Foreign Language II /ILV / LV-Nr: SP 2 / 2.Semester / ECTS: 6</u> Portfolio exam

2.4 Internship

Students independently select an internship position. In doing so, they can draw on the extensive range of internship listings provided by Kufstein University of Applied Sciences in Tyrol. The program director verifies that the internship activities align with the program's curriculum and qualification profiles. Subsequently, the program administration assesses whether the professional internship aligns with the program's educational objectives and whether the student can be assigned tasks appropriate to his or her level of qualification. A detailed internship guide assists students with organizing their practical semester; the IRO and program administration are also available to students for questions and support.

Students must apply for the professional internship using a form (= job description). The form includes key information about the student and the internship supervisor, as well as the objectives and tasks/activities at the internship company. The internship is confirmed or approved by the signatures of the program administration and the internship supervisor.

The student must reflect on, document, and present the experiences and insights gained, as well as evaluate the internship site. 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 an internship guide listing the tasks to be completed. A key requirement is to compare the agreed-upon objectives with the actual outcomes. The documentation prepared by the student and the supervisor is evaluated by the program director. If the achievement of the objectives and alignment with the student's skill level are not ensured, the respective internship site will be excluded from future placements. A list of internship sites and the corresponding reports are available to subsequent students via the Moodle learning platform.

2.5 Semester abroad

In the 5th semester, students complete a semester abroad at a partner university of Kufstein University of Applied Sciences in Tyrol. A total workload of 30 ECTS must be documented at the respective partner university.

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

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

or to expand them with complementary knowledge. To this end, students can choose from the portfolio of approximately 250 partner universities of Kufstein University of Applied Sciences in Tyrol—subject to

the availability of study places—and take courses at these institutions. Depending on the university, students have access to a variety of courses in different areas of specialization. This allows students to delve deeper into subject areas that are not currently offered at the bachelor's level at Kufstein University of Applied Sciences in Tyrol (e.g., robotics, human-computer interaction, machine learning, etc.). The allocation of study places abroad is handled uniformly across the university, taking into account the academic performance of the respective students throughout their studies to date, in cases where more students are interested in a study place than are offered by the partner university. Over the past few years, students across all degree programs have been offered significantly more study abroad spots than were actually needed, ensuring that Kufstein University of Applied Sciences in Tyrol has consistently been able to provide opportunities for studying abroad. The program also offers counseling, as needed, regarding the most appropriate academic focus for the semester abroad.

3 ADMISSION REQUIREMENTS

Admission requirements at Kufstein University of Applied Sciences in Tyrol are governed by the following provisions:

1. The general admission requirements are governed by § 4 FHG, as amended; this applies to **individuals who hold a general university entrance qualification**.

2. **Individuals without a high school diploma** must take an **entrance qualification examination** in accordance with § 64a of the University Act of 2002, as amended. Subject to a regulation issued by a university's rectorate, these individuals obtain general university entrance qualifications for bachelor's degree programs within a field of study group by passing the entrance qualification examination. Successful completion of the university entrance qualification examination thus entitles the student to admission to all degree programs within the field of study group for which the qualification was obtained. The university entrance qualification examination may be taken for specific fields of study in accordance with a regulation issued by a university's rectorate; for Kufstein University of Applied Sciences in Tyrol, the relevant field of study is: Social and Economic Sciences (e.g., Business Administration, Business Education, Statistics, Sociology).

Applicants who have completed a 3-year **vocational secondary school program**, completed an **apprenticeship in the dual system**, or obtained a **subject-specific German Fachhochschulreife** qualify to study at Kufstein University of Applied Sciences, Tyrol, by passing supplementary exams in German, English, and mathematics. In the case of the German Fachhochschulreife, the supplementary exam must be taken only in those of the three subjects in which the grade on the transcript is "Unsatisfactory" or lower. All supplementary exams must be successfully completed before the start of the third semester.

3. For **individuals with relevant dual vocational training, completion of an apprenticeship** in one of the following **fields**, as specified in the current announcement by the Federal Ministry of Economy, Family, and Youth, is a prerequisite for admission:

- Construction and Building Services
- Office, Administration, Organization
 - Chemistry and Plastics
 - Electrical Engineering, Electronics
 - Commerce
 - Information and Communication Technology
 - Metalworking and Mechanical Engineering
 - Media Design and Photography
 - Paper manufacturing, paper processing, printing
 - Transportation and warehousing

4. **Applicants who have graduated** from one of the following relevant **vocational secondary schools** with a program of at least three years may also be admitted:

- Vocational, technical, and arts and crafts schools
- Technical schools for business professions
- Higher vocational school for business professions
- Higher vocational schools for technical professions
- Business schools

5. If foreign certificates are not deemed equivalent in terms of content and requirements of an Austrian high school diploma, supplementary exams in English and mathematics must be taken before the start of studies. These exams may be taken either through external providers or at the Kufstein University of Applied Sciences Tyrol International Business School for a fee.

Newly established apprenticeship programs in similar fields must be recognized accordingly.

The **individuals described in sections 3 and 4** must, as an admission requirement, complete **supplementary exams** by the start of the third semester and, if necessary, take corresponding preparatory courses. This is possible at the International Business School of Kufstein University of Applied Sciences Tyrol.

The following supplementary exams are required for this group:

- German
- English
- Mathematics

Below is an overview of which German FOS/BOS specializations qualify as relevant admission requirements. In these cases, supplementary exams in mathematics, German, and English must be taken during the first semester (if a "Mangelhafter" or a lower grade was received in these subjects).

	DRO ft
FOS	
- Technology	Yes
- Business & Administration	Yes
- Social Services	Yes
- Agriculture, Biotechnology, and Environmental Technology	Yes
- Design	Yes
- Health	Yes
- International Business	Yes
BOS	
- Technology	Yes
- Business & Administration	Yes
- Social Services	Yes
- Agriculture, Organic and Environmental Technology	Yes
- Health	Yes
- International Business	Yes
For internships in related fields (marketing, business, administration), other fields of study may also be accepted (upon consultation with the program director)	

All instruction is conducted 100% in English. A proven language proficiency level of at least B2 is therefore required.