www.**universeh**.eu

European Space University for Earth and Humanity

UNIVERSEH is an alliance of five European universities established to develop a new way of collaboration in the field of Space, within the "European Universities" initiative.

The alliance aims to create new higher education interactive experiences for the university community, teachers and students, and for the benefit of society as a whole. Such initiatives will enable broadminded, informed and conscientious European citizens to capture and create new knowledge and become smart actors of European innovation, valorisation and societal dissemination within the Space sector, from science, engineering, liberal arts to culture.

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D3.3 Design of 10 new courses

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PU	Public	X
CO	Confidential, only for members of the consortium	

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Document History

Version	Date	Author	Partner	Summary of main changes
	02/10/2022	Anne-Laure FRANC	UT	First draft / structure and first findings
	31/10/2022	Adam WALTERS	UT	Readthrough and revision

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ABSTRACT

For a university, the courses offered to the students are key elements of its ability to attract young talents and its impact on the jobs sector. Thus, the European Space University for Earth and Humanity (UNIVERSEH) targets to develop high quality courses in the Space field with a large diversity of topics. 16 new courses in different academic fields and with various application segments are going to be implemented in 2022-23.

This document describes the full process developed by the five academic partners of the project to firstly propose and select, then create and implement new courses that will be offered to the UNIVERSEH students.

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CONTENT

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I. From the courses selection…

The UNIVERSEH alliance intends to provide high quality courses in the space field. Thus, a specific methodology has been developed to ensure this: A template for new course proposal has been created to guide the creation process and an iterative selection process is employed. An example of a blank template is given in annexe 1.

A. The template

Each teaching team that plans to submit a course in the framework of UNIVERSEH fills in a course template proposal. This template is an internal document with multiple information as described below.

1. Identification and positioning of the course

First, the templates collects all general information to clearly identify the course. The academic partners from the consortium with the main involved teachers for further contact are listed as well as possible additional partners whether academic or not.

This section also includes the student level and workload. The latter should be compliant with the targeted ECTS proposed by the pedagogical team. The proposed size of UNIVERSEH courses is 3 ECTS.

Then, the matrix developed in D3.1 is filled in as appropriate to associate the course proposal with the academic fields and space segments. In the future, this information will help to reinforce specific disciplines and segments to fully cover the space domain.

2. Five star system

One of the main objectives of the template is to state the criteria for a UNIVERSEH course. We have created a star system to impulse directions for the courses to be developed. During European working groups involving multiple work packages of the project (collaboration with WP2, WP4 and WP6), five stars were defined: Active learning techniques, Digital content, Interdisciplinarity, Multilingualism, and European collaboration. **At least three of the five stars** have been **mandatory** to propose a course for UNIVERSEH. An overview of the five stars is given below.

a) *Active learning techniques*

The essential points of student active learning design are:

- outcome-based, where the course design aims at developing the skills to achieve the program outcomes,
- based on constructive alignment,
- to allow for the student to process and reflect on the knowledge gained
- to provide authentic cases to work with and experiences to mimic future working life,
- to design the assessments to measure practical and generic skills such as critical thinking, analytical competences, communication, collaborative and intercultural skills,
- to consider the student an active agent in his/her education to foster student independence and prepare for lifelong learning.

For the active learning star, the teaching team can get support from WP4 of UNIVERSEH which develops methods like “From student to teacher” or “Hybrid learning and virtual classroom”.

b) *Digital content*

To get this star, a course should contain significant digital content. Digital content is for example pre-recorded content, software, digital tools, asynchronous collaboration by the use of a learning platform (UniverseH moodle platform) and also course design as in hybrid learning, blended learning, and MOOC-like mini-courses with flexible modularized thematic content available online.

Here again, the teachers can benefit from the help of WP4 and suggestions that relate to benefit from the accessibility advantages of digital education.

c) *Interdisciplinarity*

Strong interdisciplinarity is required. The teaching team of an interdisciplinary course must come from (at least) two different academic fields as listed below. The public of students concerned can be either a heterogeneous group of several academic fields or an academic field specifically identified for an introductory course in another academic field. The considered academic fields are the following:

- Science & Engineering
- Economy, Business, Finance
- Medicine & Health
- Social & Human Science
- Art & Cultural Studies
- Innovation & Patents, Entrepreneurship

d) Multilingualism

This star has been defined during joint sessions with WP2 (Mobility and multilingualism). The course should include teaching in at least two different languages with a significant use of each and be given in such a way that all students whatever their language understand all parts of it. It should be noted that the use of teaching in English is not sufficient on its own to earn the multiligualism star.

e) European: Cooperation with another UNIVERSEH partner

The course should result from the cooperation between two UNIVERSEH partners from at least two different countries.

3. Details of the course

The last part of the template presents a first draft of the course content. The prerequisites are listed so that only students with the appropriate background can apply. The learning outcomes are given and a tentative agenda is proposed including the topic and speaker for each session. This work is subsequently refined during the course creation process.

Each completed template has been validated by the UNIVERSEH Academic Council which is the authority responsible for accepting or rejecting any course proposition and suggesting improvements.

As a conclusion, the template is an efficient working document to help the project to clearly identify each course proposal, especially in its European environment. Through its completion, the teachers are made aware of the major criteria to get the UNIVERSEH label and should at the same time develop European collaboration, think of the pedagogical content and the teaching methods. Finally this tool highlights the key points when it comes to select the UNIVERSEH courses.

B. Academic council acceptance

Each teaching team interested in proposing a UNIVERSEH course must fill in the template. Iteration with the European WP3 team is carried out to ensure that the course fits into the project vision. When ready, the templates are submitted to the Academic Council members before the meeting so that the attendees can share their analysis on each proposal during the meeting. This leads to feedbacks and suggestions to the pedagogical team either to ask for additional work on the template before studying it again or to highlight specific points for the course implementation. The teaching team indicates the stars for which they wish to apply. The academic council does not always validate all stars indicated and, in that case, makes suggestions for obtaining them in future. This is to allow teams to concentrate their efforts in the first year of the course.

To date, the validation of UNIVERSEH courses has been discussed during five academic council sessions. The minutes of those meetings are available in Annexe 3: Academic council minutes. The main conclusions are given below.

On September the 13th, 2021, the three first courses were validated with the targeted stars. During the Academic council the 5th of October 2021, the only course presented, was accepted. In December 2021, nine course proposals were received among them six were validated directly. The three others were offered the opportunity to be rediscussed later as they required additional clarification. One course on space tourism was not subsequently presented since the proposer took on additional duties and was no longer available to work on the course. In January, two courses were approved, including one resubmission from December. One course first presented in December still needed further work. Discussions on the Winter School, as no longer urgent due to covid restrictions, were postponed in order to harmonize with the Summer School. In March, the last four courses were accepted which makes a total of sixteen approved courses including a Summer and Winter School.

II. … to their implementation

A. List of new courses

At present, 16 courses have been accepted by the Academic Council of UNIVERSEH. The full list of the validated courses is given in Table 1 as well as some key information: the stars achieved, the involved universities, the first time the course is intended to be run, the student levels.

Table 1: Details of the validated courses.

Course	Star system					Partners	Beginning	Level (EQF)
	Active learning	Digital content	Interdisci plinarity	Multilin gualism	European cooperation			
Stratospheric Balloons: an initiation project	X	X			X	UT3 LTU	Autumn 22	M2 (7)
Introduction to space medicine	X	X	X		X	UT3 LTU AGH	Spring 23	B3 - M1 (6-7)
Cubesat platform: an introduction	X	X			X	INP LTU	Spring 23	M1 (7)
Satellite Communications, Regulation and Business	X	X	X	X	X	INP Uni.Lu	Autumn 22	M2 (7)
Ultimate Question of Life, the Universe, and Everything Module1: The buddies in space	X	X	X	X	X	AGH UT3	Autumn 22	B3 (6)
Ultimate Question of Life, the Universe, and Everything Module 2: History of astronomy	X	X	X	X	x	UT3 AGH	Autumn 22	B3 (6)
Medical engineering for Space and Earth	X	X	X		x	AGH UT3	Autumn 22	B3 - M1 (6-7)
Elastic metamaterials and actuators for space applications	X	X			x	AGH INP	Autumn 22	M2 (7)
Monitoring and economic control of climate change	X	X	X			INP TBS LTU	Autumn 22	M2 (7)
Snow and ice throughout the Solar System	X	X	X		X	LTU AGH	Autumn 22	M1 - M2 (7)

Space Innovation, Business & Law	X	X	X		X	Uni.Lu TBS ISAE	Autumn 22	M1 - M2 (7)
Space dictionary - Dictionary of Space Concepts course	X	X		X	X	HHU AGH	Autumn 22	all students (6-7)
Machine learning in robotics and edge devices for space exploration	X	X			X	AGH LTU	Autumn 22	B3 (6)
Artic Winter School	X	X	X			LTU INP AGH	Spring 23	B1→M2 (6-7)
Critical space studies	X	X	X		X	HHU UT2	Autumn 22	M1 - M2 (7)
Summer School on space resources and mining	X	X	X			AGH LTU Uni. Lu HHU	Spring 22	B1→M2 (6-7)

Regarding the star system, all the courses get the two active learning and digital stars. The interdisciplinary star is only given to courses that mix two academic fields as defined previously. Many courses do not check the multilingualism box at the moment. They mostly intend to use English as the main language which will help opening the course to all students from the consortium with according prerequisites. Each course involves at least two partners, nevertheless, some are not granted the European star as the Academic Council felt that the participation of the different institutions is not enough balanced to justify the star. Courses will be encouraged to increase the number of stars in coming years.

The European network that is built through the co-development of these courses is illustrated in Figure 1. Each European partner is involved in several courses with different universities from the consortium.

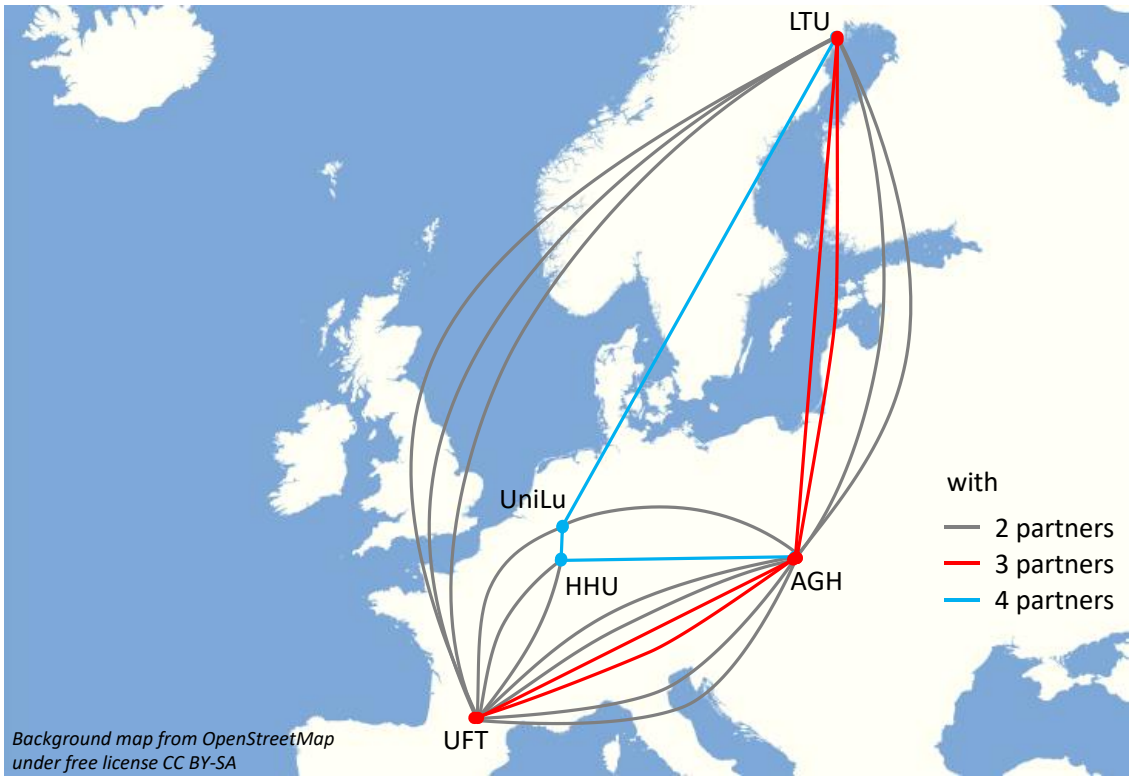

Figure 1: Geographical places of the 16 validated courses.

B. Course design

Working together with WP4, each teaching team is assisted by at least one instructional designer. This collaboration was launched through an online workshop held on the 8th and 9th of February 2022. The main goals were to allow the UNIVERSEH teachers from different courses to meet each other and to introduce key pedagogical concepts the teachers could use in their course. It was also an opportunity to dedicate work sessions to each specific course for developing its content and activities.

C. Current status

As seen in Table 1, the summer school on Space resources and Mining is the only one which has already fully taken place. Fifty students from the five countries of the alliance met at Krakow from the 15th to the 20th of May 2022.

All the other courses are planned to begin during the present 2022-2023 academic year. Thus, at the time of writing, most of them are under development in the learning management system Moodle. A screenshot of the Moodle homepage is shown in Figure 2 and lists all the new courses. This can be found at the following address https://edu.universeh.eu/

The summaries of the 16 courses are given in Annexe 2: Course summaries.

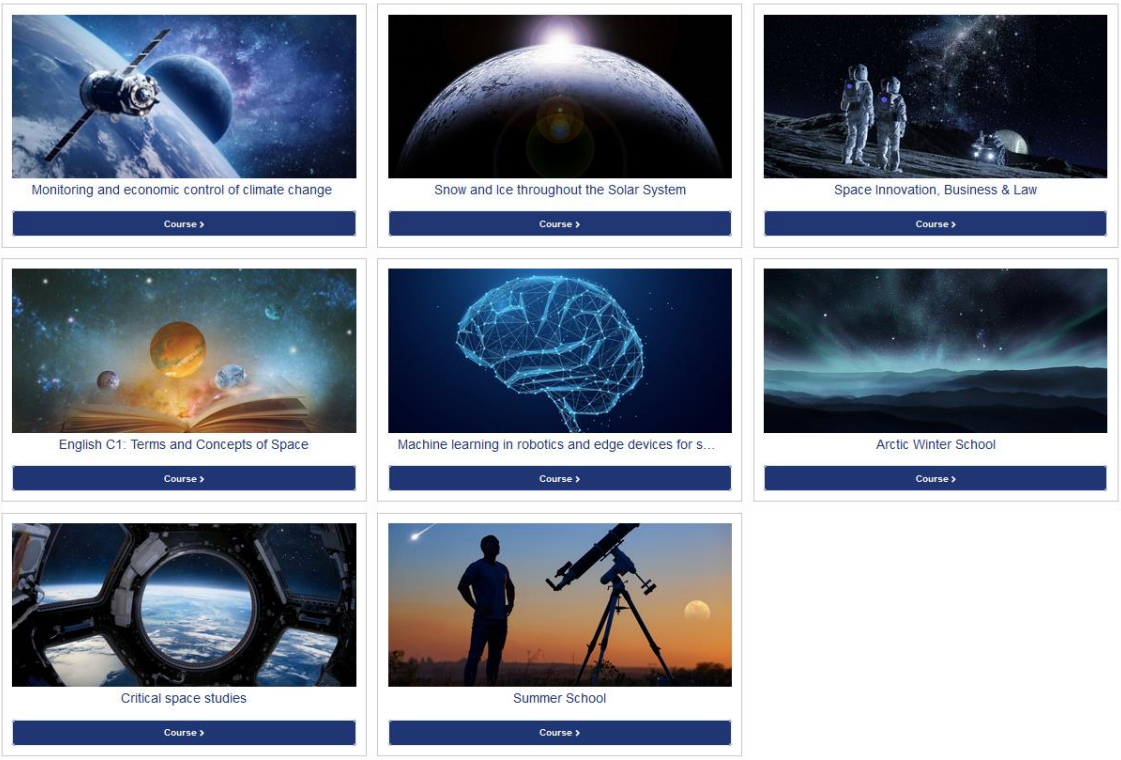

Figure 2: Homepage of the Moodle learning management system.

D. Evaluation

The creation of the European shared courses is an on-going process. Thus, an evaluation will be carried out in order to get feedback on the first implementation. For this purpose, two questionnaires are under development. The first one focuses on the UNIVERSEH students' point of view and the second one on the UNIVERSEH teachers' experience. They will help to improve both the courses for next years and the development process for the courses to be validated in the future.

III. Conclusion

A process for the course design has been developed. It includes a proposal that focuses on European cooperation (involving both teachers and student), active learning

techniques, digital content implementation, interdisciplinarity and multilingualism especially to allow a student mix from various home universities as well hybrid teaching. Then, each teaching team can benefit from a team of instructional designers involved in the project who assists them in the course creation. In the future, the whole process will be refined thanks to the evaluation forms being finalized.

The first two years of the project allowed the consortium to initiate a strong European collaboration through the development of new courses. Hence, an emerging network of "UNIVERSEH teachers" from the five academic partners currently builds various contents that are going to be taught as of September 2022. It is planned that the students who are (or will be) enrolled in one or more UNIVERSEH courses will get a certificate supplement to their home university diploma in order to officially highlight their success in the UNIVERSEH courses. This will also help to increase UNIVERSEH visibility towards Space companies.

IV. Acronyms

AGH: University of Science and Technology of Kraków (Akademia Górniczo-Hutnicza), Poland

B1-3: Bachelor and year

M1-2: Masters and year

ECTS: European Credit Transfer and accumulation System

EQF: European Qualifications Framework

INP: Institut National Polytechnique de Toulouse, France

ISAE: Institut Supérieur de l'Aéronautique et de l'Espace, France

LTU: Luleå University of Technology, Sweden

HHU: Heinrich Heine University Düsseldorf (HHU), Germany

UFT: Université Fédérale Toulouse Midi-Pyrénées, France

UniLu: University of Luxembourg, Luxembourg

UT2: Université de Toulouse 2 Jean Jaurès, France

UT3: Université de Toulouse 3 Paul Sabatier, France

V. Annexes

A. Annexe 1: Template for implementation and evaluation of courses

Universeh New Course Proposal

Last update: …/…/….. – Please use filename "Course number_Short course name_Partners involved_Version date" – Format: .doc for iterations and .pdf for Academic Council submission.

Course Title:	
Coordinator's name and contact email	
Structure (University, Institute, Department…)	

General information	
Level (Bachelor B1, B2…), Master (M1, M2) or PhD Integration in an existing programme, if already identified.	
ECTS Credits	
Estimated number of students from each involved institution	
Estimated Global Volume (hours)	(including personal workload of student)
Estimated period: (1st semester…)	
Teaching languages	For the lectures: For the student documents: For the interactions (guide work, projects…) between and with the students:

Interested/Open to other participation in course creation ☐ **Partner already identified** ☐	
Partner identified for sharing the course:	
Other participants *(fill in as appropriate)*	
Academic partners involved, from the consortium or from outside the consortium	
Other partners involved (companies, associations…)	
Guests speakers	
Other participants needed (give details of your needs)	

Academic fields & Space segments involved *(mark with a cross as appropriate)*					
Application segment / Academic field	Our Earth and space	Sustainable Space (access to space; around Earth)	Space Settlement and resources	Space Exploration & discovery	Comments
Science & Engineering					
Economy, Business, Finance					
Medicine & Health					
Social & Human Sciences					
Art & Cultural Studies					
Innovation & Patents, Entrepreneurship					

5 Star System* *(a minimum of three stars must be selected, please shortly justify each star proposed)*	
★ **Active learning techniques**	
★ **Digital content**	
★ **Interdisciplinarity**	
★ **Multilingualism**	
★ **European: Cooperation with another Universeh partner**	*Please specify % contribution to course production and if any parts of the course are given in parallel (i.e. 10-hour course = 20 hours because given by two different teachers in 2 locations) It is useful to specify number of hours by each participant if possible.*

**For further information please refer to the document "Guidelines for granting the stars in the 5 Star system for new courses".*

In addition to the 5 Star system, Universeh new courses should also:
- be planned to integrate in existing programmes as soon as possible.
- be given in the University creating the course and in another University of the Consortium in the experimental deployment phase (Academic year 2022-2023)

Profile and prerequisites for the course – *Please specify as precisely as possible the student population identified for the course*
Mobility? - *Please specify any mobility to be planned for the students, estimated number of students, period of mobility, and estimated date, if possible.*

Learning outcomes

Written in terms of learning objectives targeting a particular skill

See for ex.:

- *https://members.aect.org/pdf/proceedings/proceedings15/2015i/15_04.pdf*
- *https://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy/*

Learning Approach and Global Tentative Agenda

Example:
- *composed of*
  - *x lectures of x hours given by…, during N1 hours approximately provided by Univ1*
  - *x lectures of x hours given by…, during N1 hours approximately provided by Univ2*
  - *student projects during N2 hours approximately, jointly provided by Univ1 and 2*
- *short program associated to the course (launch meeting of students/teachers, …)*
- *Autumn, Winter or Spring or Summer… schools*
- *Examination/validation*

Ideas for collaboration with another partner of the Consortium

Collaboration with another partner refers to:
- *Collaboration in creating and making the course (one of the 5 stars of the 5 Star System)*
- *Collaboration to share courses for the 2022-2023 Academic year (mandatory).*

Please specify in this section any ideas regarding collaboration: if you already contacted a partner to engage discussions, if the collaboration has already been discussed, formalized or engaged, or if you only have identified a potential area of cooperation with a partner, but not yet contacted them.

Half-page maximum description of the course as it will appear publicly on the website and adapted for students

Any other relevant information

Process

This document should be submitted to the WP3 Universeh team via both the following contacts: *Please mention the Coordinator's name in the title of the document.*

- **Pascal Maussion**, VP International Affairs, Toulouse INP, pascal.maussion@toulouse-inp.fr
(and **Anne-Laure Franc**, Associate Professor, Toulouse INP, anne-laure.franc@laplace.univ-tlse.fr)
- **Adam Walters**, Professor of Physics, Université Toulouse 3, awalters@irap.omp.eu

And to your local contacts for WP3:

AGH	Krzysztof Grabowski, WP3 coordinator, Faculty of Mechanical Engineering and Robotics	kgrabow@agh.edu.pl
HHU	Nicole Dittrich, Coordinator Universeh	Nicole.Dittrich@hhu.de
LTU	Victoria Barabash, Division manager	victoria.barabash@ltu.se
UniLU	Mahulena Hofman, Full professor of the SES Chair in Satellite Communication and Media Law Holger Voos, Automation & Robotics Research Group & Programme Director of the Interdisciplinary Space Master ISM P.J. Blount, Research fellow, Cybersecurity Governance and Regulation at SES / University of Luxembourg	mahulena.hofmann@uni.lu Holger.Voos@uni.lu pjblount@gmail.com

Course proposal is now open and forms should be sent as soon as prepared even if all details are not fully defined. Courses should be ready to be given in the academic year 2022-23.

Further information

Universeh Webinars:

- "What could be a course?" by Université de Toulouse - April, 30th 2021: video available here: What could be a course
- "Digital tools" by Université de Toulouse and Luleå University of Technology – May, 7th 2021: video available here: Digital tools
- "Active learning techniques" by Luleå University of Technology – May, 17th 2021. Video available here: Active learning techniques

Universeh Documents:

- Official website

B. Annexe 2: Course summaries

This annexe includes all the course descriptions available for students.

1. Stratospheric Balloons

This is a project- based course in which students run a regular high-altitude balloon program going through an entire cycle of a space mission. They start by analyzing previous stratospheric balloon missions developed by students. Then in small specialized teams they tackle the various aspects of a space mission: mechanical, thermal, electric architecture; attitude control and navigation (passive), power generation and management, on-board data handling, data telemetry, payload operation and data acquisition, as well as project management. After having chosen one or several science objectives, the students design, build and test (including vacuum and cryogenics) their payload to study the atmosphere or to test a new technology in space. By the end of the first semester, the balloon payload is then being launched from Aire-sur-l'Adour in collaboration with the balloon division of CNES (and/or in Kiruna with SNSA).

The main goal of this course is to create an environment in which students can plan and perform a balloon project mission with a scientific payload and critically select and evaluate relevant scientific and technical information within the subject. After completing the course, the students will be able to define primary and secondary objectives for their mission by writing detailed specifications and an efficient working flow package. Students will be also able to analyze and propose future improvements and developments and identify further knowledge needs and take responsibility for self- knowledge progress. Students will also have experience of writing proposals to the French Space Agency (CNES), and/or Swedish Space Agency SNSA.

2. Introduction to space medicine

This introduction to Spatial Medicine is designed for non-specialists and will offer an introduction to the space environment. It will subsequently provide an insight on space physiology and medicine, considering the impact of space flights on health and the associated adaptations and modifications of the human body (metabolism, bone and muscles, sleep, cells and molecules...). It will also give an overview of the different types of risks for health existing in Space environments and on possible solutions to monitor

and solve a health problem during space flights (use of medication, oral biology...). The different models for ground simulation of spaceflight effects will also be presented. Finally, it will help students to better understand the link between Space, Medicine technology and cognitive sciences. Thanks to an introduction to space applications for health on Earth, the students will be involved in practical cases on how to collect health data in spaceflights and simulation experiments.

The course level and contents will be adapted according to the existing programmes in which it will be integrated (most probably Bachelor last year/Master 1 level) but a scientific background is needed. The idea is to offer this introductory course to future engineers or entrepreneurs who will work on space applications linked to Health and Medicine and who will need a global overview combining basic knowledge of medicine and of the major issues/challenges regarding Health and Space.

3. Cubesat platform: an introduction

The project is an introduction to the management of the satellite platform in terms of communication, electronics (digital and analog), power management, thermal management). It is based on the use of realistic, low-cost models of 2U cubesats, including all the functions of the nanosatellite, including:

- On Board Computer, CPU
- Communication cards
- RF frontend card
- Power management cards
- Sensors
- GPS
- Inertial unit
- Payload cards (camera)
- Solar panels

4. Satellite Communications, Regulation and Business

Nowadays, with the emergence of new space technology, to stay competitive in the space industry, students need to develop an expertise and knowledge in the fields of business and law. This interdisciplinary course will combine technical with law and business aspects of satellite communication systems. Students will submerge themselves into an interdisciplinary work environment and collaborate with other

students from either a law or technical background. They will work together to solve problems in teams, which is also an asset from the societal point of view.

For the technically educated students, the courses are eye-opening in presenting the regulatory and business aspects of space activities. For the law students, the exchange with the technically trained students is enriching as they will cooperate with technical experts in the practice and must at least understand the problems which they are expected to solve. For both groups, the business aspect of satellite communications systems will be new and enlarge their competences. The interdisciplinarity of the course is a simulation of situations in a real employment world.

Our goal is to build the bridges between the different fields to reach a common goal and break the silos of traditional work environments.

5. Ultimate question of life, the universe and everything. Module 1: The buddies in space

Course description for students: The main aim of the course is to broaden the horizons of cognition in terms of understanding life processes, concepts of the presence of life in the Universe and more broadly the scientific approach in general.

Hard knowledge on the current and historical concepts on the evolution of life, origin of life, methodology of investigating early life processes as well as principles of metabolism, extreme microbial environments, new technology concepts of microbial applications in Space colonization will to be presented.

6. Ultimate question of life, the universe and everything. Module 2: History of astronomy

This is a project-base course in which students put themselves in the position of ancient astronomers and try to develop their own mathematical models in order to predict the position of one of the five planets that can be observed with the naked eye.

The main goal of the course is for students to experiment the scientific method: confronting tough questions, making small but incremental progress and taking advantage of feedback.

The historical field will be the students' playground. The first courses will explain some of the ancients findings on mathematical astronomy such as the neo-babylonians'

zig-zag fonctions and Ptolemy's geometrical models. Then students will choose one planet, one location, and one period of time and will produce their own models and confront them to the real motions of the planet using the Stellarium software.

The range of the historical discussion will go from the middle of the third millennium BP to Einstein's breakthrough in the early twentieth century : the questions of the ancient astronomers may be seen as natural ones, their answers may be seen as cultural ones, but what is really at stake in this course is about the search for understanding what might not be understood and the long term process of mankind trying to figure it out.

7. Medical engineering for space and earth

It's hard to imagine long-lasting manned space missions without personalized healthcare provided onboard, and it is hard to imagine modern space healthcare without engineering and technology. In this course students will get an overview of current trends and challenges in medical technology for space. The course focuses on the technologies which are currently in use and on technologies which might make long-term space-flights possible in the near future. All the aspects are presented both in a general and a specific manner through several practical scenarios.

8. Elastic metamaterials and actuators for space applications

Mechatronic space structures require particular solutions in terms of their efficiency, robustness and precision for equipment which is required to operate for several decades without maintenance. In this context the piezoelectric technology associated with particular material properties can bring multidomain solutions for actuation, mechanical insulation, or energy harvesting. New opportunities in terms of dynamical mechanical response are brought by elastic metamaterials.

Metamaterials are a new class of materials that exhibit extraordinary properties. In the context of dynamics, they can display negative effective mass and/or stiffness, extending the classical design space of engineering materials. Therefore, they can be very attractive for designing high-performance multipurpose devices.

In this course students will learn about applications of elastic metamaterials for various mechatronic space devices, in particular energy harvesters, actuators, sensors and electro-mechanical transformers; and how metamaterials can be designed and used for substantially improving dynamic properties of these systems. Students will have an

opportunity to design a device - from theoretical principles to simulations - prototyping it and performing its physical electro-mechanical testing.

The course is composed of 8 classes in which we present the necessary theoretical and practical background, followed by a 4-class students' project oriented on designing, assembling and testing a prototypical device. Finally, students are involved in an industry-level project supported and supervised by top-class experts from the space sector.

9. Monitoring and economic control of climate change

The course proposed here will focus on the economic impact of weather and the cost associated with climate change. Initially, scientific generalities on meteorology and climate will be described in order to provide students with main concepts and basic knowledge on the subject. A focus on the polar regions, where the impact of climate change is a strong marker of the phenomena, will be provided to highlight the effects of human activities on climate.

Following this, the economical dimension will be addressed and this course will focus essentially on two aspects. The first aspect addressed is the risk management of weather-sensitive activities and the second part will focus on the understanding of the economic aspects of climate change.

The final target is to give students the capacity to understand climate issues, to understand and assess the associated public policies and to take appropriate decisions in their personal and professional activities.

To address these questions, this course consists of lectures given by experts of ENM, Lulea University and Toulouse Business School, active learning and personal projects requiring an answer by students to a problem elaborated by an expert of a socio-economic activities.

10. Snow and ice through the solar system

The course presents phenomena related to ice and snow, in the atmosphere and on the ground. It covers Earth and also other planetary bodies such as Mars, where both water and carbon dioxide ice exist. The course will start with the physical foundations in terms of phase diagrams, equations of state and ice lattice structures and finish with the environmental effects of ice on Earth, and how life, humans and ice interact. 2 practical

projects will consist of field observations of snow and ice, including their structure and properties. Another practical will enable students to compare water and carbon dioxide ice. In a group project the students will put isotope data of terrestrial ice cores into the context of climate change.

The practical project will consist of snow sampling near Kiruna (Swedish Lapland) at a selection of field sites throughout the course, evaporating the water and analysing the refractory residue using AGH laboratories (Poland). Interpretation and analysis in the context of climate change will be provided. The results will be archived across academic years, giving future cohorts of students access to more time-resolved data.

11. Space Innovation, Business & Law

In a fast-growing space environment, there is a crucial need to cross-combine skills and expertise to speed up space project development, be it in terms of technical/technological, business or legal acumen. Time has come to interact and work in a collaborative and comprehensive way and from the outset between all key stakeholders.

This course aims at providing to the participants, whatever their educational or cultural background, not only a "common language" but also an efficient working culture combining technical, legal and business dimensions, enabling them to work more efficiently on the design and development of space-related projects, with a shared mindset.

A key feature of the course is the blend of students of different backgrounds, combined with eye-opening course material; with this configuration, interdisciplinarity is total. The subjects treated will focus on giving the students the opportunity to engage in both the entrepreneurial challenges associated with innovation and start-up marketing; as well as the legal and business issues associated with space economy and intellectual property.

12. Space dictionary - Dictionary of Space concepts course

The aim of this course is to contribute to the development of an **illustrated Dictionary of Space Concepts**. This is a **student-driven project** but the dictionary will also be available to the general public. Students will identify important terminologies and concepts for fields relevant to the space sector as part of the **UNIVERSEH** programme (e.g. "space, earth, natural sciences, medicine, humanities"). We will gather terms using

authentic texts, videos, etc., in order to develop definitions, gather & create illustrations, and finally translate terms into the five UNIVERSEH partner languages (German, English, French, Polish, Swedish).

As an integral part of the course, students will hone and further develop their speaking, reading, listening, and writing skills for future use in academic and professional contexts.

13. Machine learning in robotics and edge devices for space exploration

The course provides a wide insight into neural network (NN) algorithms and their hardware implementation. The development of NN applications is typically carried out using GPUs and requires a long calculation time. The course gives participants the ability to accelerate and shorten inferring latency using dedicated hardware with limited resources. Although this idea can be adopted in many different applications from many disciplines, the course demonstrates practical examples from space-related research projects. The main goal is to motivate, illustrate, and experience the impact of Machine Language (ML) and Artificial Intelligence (AI) on the space sector.
Besides the emphasis on creating practical design on the available hardware platforms, the course presents a survey of commercially available (and recently introduced by leading manufacturers) systems for hardware implementation of neural algorithms. A survey of dedicated processors with neural architectures currently being developed is also covered.
Another fascinating subject in the course concerns emerging technologies dedicated to future hardware neuromorphic systems currently in the R&D stage.
The huge innovation potential of ML is strongly emphasised during the course. Practical examples of innovative projects are presented to illustrate the impact of ML and AI in business activity.

14. Course title: Arctic Winter School

Arctic Winter School is an introductory course for students from different academic fields and from all UniversEH partner universities that gives insight into the interdisciplinary fields of Arctic space, environment and culture:

- Environment and society in the changing Arctic. The Arctic Five collaboration.

- Polar atmosphere and its significance for solar-terrestrial interactions, space weather.
- Auroral physics and observations.
- Optical phenomena in the polar regions.
- Snow and ice in different perspectives.
- Arctic climate systems and climate change.
- Nano satellites and balloons for polar research.
- Product innovation for Arctic space.
- Terminology for New Space and polar research, linguistic aspect of intercultural communication.
- Survival in the cold environment.

The first week of the School is taking place at Luleå University of Technology, Kiruna Space Campus and includes lectures and workshops. During the week in Kiruna there will be study visits to Esrange Space Center, the Swedish Institute of Space Physics (IRF) and EISCAT Scientific Association. The week will also include study visits to Abisko Scientific Research Station, LKAB iron ore mine, ICEHOTEL in Jukkasjärvi. There will be both cultural and social activities.

The learning outcomes are assessed through assignments, workshops and project.

15. Critical Outer Space Studies

Our course "**Critical Outer Space Studies: Seminar and Lecture Series**" takes as its cue the increasing prevalence and visibility of both public (NASA, ESA, Artemis Accords) and private (SpaceX Blue Origins, etc.) endeavors that seek to explore, exploit, settle, and own outer space and its celestial bodies. Our course will pay particular attention to how, in recent years, the exploration of outer space has been invigorated via its role as a potential remedy for the challenges of the Anthropocene (via resource extractivism, resettlement, off-world heavy industry, observation of impacts of climate change on a global scale).

Using as a point of departure the notion that outer space is a social construct and as such entangled in terrestrial discourses such as colonialism, capitalism, territoriality, militourism, (among others), this class will engage the complex field of study that is the science and exploration of outer space through a variety of disciplinary lenses—particularly, but not exclusively, from the humanities—such as environmentalism,

posthuman studies, mobility studies, astroethics, critical legal studies, discard studies, and postcolonial studies.

Participating students will have the unique opportunity to engage with the work of leading scholars and scientists in all of these fields through seminar sessions and their discussion of texts, films, reports and other material. The seminars will also prepare the accompanying guest lecture series, which allow the students to directly engage with leading scholars and scientists from diverse disciplinary backgrounds to explore the ethics and cultural discourses that surround the exploration of human space.

The course curriculum includes two field trips to HHU Düsseldorf and Université Toulouse -Jean Jaurès for the first and final sessions of class, respectively, which will be fully funded for enrolled students.

16. Summer school

The main objective of the course is to allow students to acquire knowledge about space resources and mining and create opportunities to gain practical experiences which will help students understand different aspect of space resource exploration against the background of Earth resource exploration.

Lectures will introduce students to different aspects of space exploration, such as geology, sustainable development, and robotics. Students will learn about the geology of various terrestrial bodies and challenges of space exploration. They will also learn about preparing and testing robots used in space missions.

To allow students to see the connections between space geology and space resource exploration and Earth geology and traditional mining, students will take part in educational field trips. The educational trip to the Wieliczka Salt Mine (a UNESCO World Heritage site) is a unique opportunity to see first-hand how the mining industry looked like centuries ago and what it meant to be a miner.

The educational trip to the Racławka Valley and Dubie dolomite mine will help students understand the geological history of planet Earth and learn about different types of rocks and how they were formed first hand.

The school will also be an opportunity to practice communication and collaboration skills in multi-national teams, improve foreign language skills, and brainstorm and reflect on the hard and soft skills of entry-level employees in the space sector. Students will be

encouraged to share and reflect on their experiences of inter-cultural communication and experiences of Krakow and places they will have an opportunity to visit. Krakow the former capital of Poland offers unique opportunities to observe and experience shared European history and traditions in the form of architecture, culture and cuisine.

C. Annexe 3: Academic council minutes

Below are given the minutes of the five academic council meetings which worked on the course selection: September 13, October 5, and December 13, 2021 then January 19 and March 14, 2022.

Academic Council minutes – 13.09.21, 15:00-16:30.

Attendees

Sophie SIXOU (UT), Hélène GENTILS (UT), Claude MARANGES (UT), Rafał Dańko (AGH), Mats Näsström (LTU), François RULIER (UT, student representative), Victor CEBOTARI (Uni.Lu), Linnea Hofverberg (LTU, student representative), Manon Veyret (UT), Nicole Dittrich (UDUS), Stefan Marschall (UDUS), Pascal MAUSSION (UT)

Excused

Agata ZWOLAK (AGH, student representative), Catherine LEGLU (Uni.lu), Adam WALTERS (UT)

Discussions

1. **Validation of UNIVERSEH courses**

- ***Satellite Communications, Regulation and Business – 5* course*** (see document attached for details)

Some of the languages proposed (Czeck and Russian) – are based in the languages spoken by the students, but the lectures will be given in English, and the module will also include lectures and projects. In the framework of these projects, interactions between students and between students and professors will happen in the various languages.

The course is mainly project-based (30 teaching hours and 75 hours' student project work), in order to encourage active learning techniques. Student project work will be supervised by professors.

2022 will be an experimental year for UNIVERSEH, being the first year when the courses will be delivered. For this test year, we will select the students (12 students in Uni.lu and 12 students in UT (Toulouse INP)). After the experimental year, we hope to open the selection of students to incoming students.

Validation of the courses will happen during the presentation of the student's projects (if possible during in-person visits) in front of an international jury composed of teachers from Luxembourg and Toulouse. Students project teams would be composed of students from both Uni.lu and Toulouse INP.

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Thales Alenia Space will provide specific question for the students.

The course is approved with 5 stars. No specific recommendations are formulated.

- ***Cubesat platform: an introduction – 3* course*** (see document attached for details)

There are two themes but integrated into one project.

Business or entrepreneurship aspects could be included in the future development of the course, and therefore the multidisciplinary star could be applied for.

The multilingualism star would be more complex to implement, although in future developments, we are planning for possible mobility and exchanges between the students, but it is not the main goal.

Welcoming students from other universities would be very difficult, so for the first test year, we will limit it to students from LTU and Toulouse INP and depending how things happen, the course could be opened to other students.

The personal workload of students would be around 50hours, but it is not written down in the course proposal.

The course is approved with 3 stars. The recommendation is to complete the information regarding the expected workload for students (and in all future courses).

- ***Stratospheric balloon - student projects – 3* course*** (see document attached for details)

English will be the main language, support will also be provided in French and Swedish, so there is a potential to develop this multilingualism approach in the future.

The professors involved are from engineering background, and there are plans to involve other disciplines (eg. involvement of an incubator), but discussions are not advanced enough to apply for the multidisciplinary star yet.

The course is approved with 3 stars. Recommendation is to further the work on the multidisciplinary aspect of the course to reach the 4* course.

Summary of the courses approved:

Course name	Active learning techniques	Digital content	Inter-disciplinary	Multilingual	Cooperation with another UNIVERSEH partner
#1. Satellite Communications, Regulation and Business	X	X	X	X	X
#2. Cubesat platform: an introduction	X	X			X
#3. Stratospheric balloon - student projects	X	X			X

For information, in the table available on GWS, Academic Council members can see the courses in preparation, that will be submitted for approval during the next meetings.

There is a lack of courses at bachelor level compared to courses at Master's level. The general feeling in WP3 was that the cooperation was harder to set at the bachelor level. There is also a lack of programmes focusing on PhDs.

HHU asked for cooperation on a course on water management in space vehicles to propose a course with UT.

All courses should ultimately integrate minimum 2 partners, and co-construction of the courses is essential.

The personal workload should be mentioned in all templates.

Any course can be submitted again to apply for a new star.

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Before Year 3 starts, any change in the template of the course should be sent to the Academic Council for an update of all documents (even if no validation is necessary) – until end of July 2022

2. A.O.B.

Next meetings:

- October 5th – in Toulouse – 14:00-16:00 please make sure you register here before the 19th of September.
- December 13th 2021, virtually – 09:00-10:30

Actions

UT to check how many hours of students' time 1ECTS credit should involve and compared it with the proposed workload of the approved courses.

- A student is supposed to work 1500 to 1800 hours during one academic year, to validate 60 ECTS.
- Then, **one ECTS credit represents 25 to 30 hours of study** (including class attendance).
- **UNIVERSEH courses, 3 ECTS : 75 to 90 hours**
    - If 30 hours lectures, then 45 to 60 hours of personal work.

HHU to check the best contact person for the proposed course on water management in space vehicles.

ALL to send any update regarding courses already approved.

Academic Council minutes – 05.10.2021, 14:00-15:30.

Université Fédérale de Toulouse Midi Pyrénées

Attendees

Sophie SIXOU (UT), Rafał DANKO (AGH), Catherine LEGLU (Uni.Lu), Jonny JOHANSSON (LTU), Benjamin IRKENS (HHU), François RULIER (UT, student representative), Victor CEBOTARI (Uni.Lu), Linnea HOFVERBERG (LTU, student representative), Agata ZWOLAK (AGH, student representative), Adam WALTERS (UT, WP3)

Excused

Claude MARANGES (UT), Stefan MARSCHALL (UDUS), Mats NÄSSTRÖM (LTU), Hélène GENTILS (UT),

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1. Validation of UNIVERSEH courses #4

COURSE #4:
Title: Introduction to Space Medicine
Partners: UT.TLSE-UT3/MEDES & AGH & LTU
Bachelor/ 1st year Master
5 star rating: 4* course
Active learning techniques / Digital content / Interdisciplinarity/ European Multilingualism

Mobility

No mobility will be needed, as all courses will be provided in an asynchronous format. The practical cases will be performed, using virtual laboratory only.

Balance of the partner cooperation

The course is mainly based on teaching from Toulouse partners (23h), for this Introduction course. AGH, MEDES and LTU will be in charge of the practical cases (7h), using virtual laboratory. This first course, initiated by UT (UT3 and MEDES), has been the basis to build a long-term strong collaboration. The clear plan for the tripartite team (UT, AGH and LTU) is to create other Spatial Medicine courses, with a higher input of AGL and LTU, and a lower one from UT.

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Languages

Many languages will be obviously used in each UniverseH course by small groups of students and/or teachers, from the same nationality and/or university (their native or usual language). Nonetheless, multilingualism will be defined as mentioned in the Guidelines document as "teaching in two different languages **with a significant use of each**". The mention of various languages scarcely used could be omitted, to avoid any confusion.

Public and perspectives

The public may be either Bachelor last year students (AGH, and maybe LTU) or Master 1 student (UT-ISAE Supaero), with a scientific background. A long-term ambitious, but very interesting perspective may be to create a semester program on space medicine for engineers.

The information regarding the requirement of a solid scientific background (bottom of page 9) has to be outlined for the students. The **prerequisite for the incoming students should be clearly stated in all course templates.**

Conclusion:

The course is approved with the 4 stars proposed. The recommendation is to complete the information regarding the prerequisite for incoming students (and in all future courses), and to highlight it in the document.

Summary of the courses approved:

Course name	Active learning techniques	Digital content	Inter-disciplinary	Multilingual	Cooperation with another UNIVERSEH partner
#1. Satellite Communications, Regulation and Business	X	X	X	X	X
#2. Cubesat platform: an introduction	X	X			X
#3. Stratospheric balloon - student projects	X	X			X

#4. Introduction to space Medicine	X	X	X		X

z

Discussions

Issues and future goals for WP3

- WP3 should be able to propose enough courses (target of minimum of 10 courses of 3 ECTS each for 2022-23) with a wide set of areas, including both general Bachelor and more specialized Master. **A structure is now needed**, to fill in all the empty cases.

- **The missing courses should be identified, with the specific domain to fill:**
  - Humanities, sociology, from UT-UT2, Uni. Lu, HHU for example

- **All partner universities should be involved**
  - The courses identified above should be proposed in priority by the partners who have not been too involved yet
  - Dusseldorf: Literature possible, but a human resource problem exists as people have interest but no time. There is also a problem in knowing how to reward time spent by teaching staff preparing courses while respecting administrative procedures.
  - The solution could include adapting, improving and sharing existing courses

2. A.O.B.

Next meetings:

- December 13th 2021, 9 am, by Zoom
- Agenda:
  - Next courses validation (Goal : another 6 courses of 3 ECTS)
  - Subsequent validations: course approval by written procedure
  - 2022 Academic Council planning

The next meeting will mainly focus on the validation of new courses. Partners are welcome to suggest additional agenda item.

Actions

UT – to send minutes and all WP3 documents to be presented (next courses proposal)

WP3 – summary of the missing courses in the specific domains/area.

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Academic Council – 13.12.2021, 9:30 – 10:45.

Attendees

Catherine LEGLU (UniL), Claude MARANGES (UT), Mathilde MARCEL (UT), Stefan MARSCHALL (HHU), Mats NÄSSTRÖM (LTU), François RULIER (Student representative UT), Sophie SIXOU (UT), Adam WALTERS (WP3, UT), Agata ZWOLAK (student representative AGH), Linnea HOFVEBERG (student representative LTU),.

Excused

Rafal DANKO (AGH).

Discussions

- Preliminary remarks

The course offer is highly promising but in order to fulfil the required and ambitious characteristics in the creation of courses, some questions need to be better addressed.

- Prerequisites need to be made clearer in the template, as well as learning outcomes. These would ensure an effective recruitment of students.
- In particular, the English-level prerequisite should be harmonized: all partners agree to set a B2 entry level for each class, with a possibility to recommend a higher level for master-level classes.
- The overall evaluation and grading system should be harmonized between partners. The Academic council will take up this issue, after leaders from WP3 provide propositions.
- If tests are in the mother tong for Bachelor students, this may be a problem for international recruitments with students having 3, 4 or 5 different nationalities. English may be better for all, Bachelor and Master, students.
- It is stressed that the multilingualism star should be only given when the courses are given with at least 2 languages for all students (see available help-guide for more details), It is not a problem to have an excellent course with “only” 3 or 4 stars. Missing stars can also be worked on later.

- Attention has to be paid to harmonising the teaching periods, presented either as Semester (1 or 2) or as Fall/Winter/Spring/Summer according to the universities.
- Specific terms such as a “Jigsaw classroom”, “Stellarium”, “Ireal”, should be explained briefly.
- Student-written dictionaries should be further discussed by the Academic Council. The idea of asking students to create dictionaries (which can be found in several courses, not just the Dictionary course #14 below), is questionable.

The templates are written to prepare the start of course design, and are made to be included in an existing curriculum. Descriptions need to be in general less rhetoric, and more scientific rigor would appeal to students. Once validated and course-content created, the templates should be specifically adapted to answer students’ questions and expectations.

1. Validation of UNIVERSEH courses

Course #5: Ultimate Question of Life, the Universe, and Everything

Module 1: The buddies in space – partners: AGH & UT3, 80/20% - Bachelor or Master

– 5 stars: active learning techniques, digital content, interdisciplinary, multilingualism, European.

Comments/recommendations: **Validated with 5 stars**

- The languages mentioned in “documents in Greek, Arabic, Latin, Polish and others” to be questioned – will the students be able to handle all these diverse languages. Recommended that the class be limited to the consortium native languages.

- Disjoint use of French and Polish languages may exclude other students of the consortium. Efforts have to be made for real multilingualism (see help guide).

- More details are needed regarding the overall course, pre-requisites, learning outcomes and descriptions of how the course will be evaluated.

Course #6: Ultimate Question of Life, the Universe, and Everything

Module 2: History of Anatomy – partners: UT3 & AGH, 80/20% - Bachelor or Master

– 5 stars: active learning techniques, digital content, interdisciplinary, multilingualism, European.

Comments/recommendations: **Validated with 5 stars**

- Disjoint use of French and Polish languages may exclude other students of the consortium. Efforts have to be made for real multilingualism (see help guide).

Course #7: Introduction to Space Tourism

Partners: UT3 & LTU – 80%/20% - Master or Doctorate

– 4 stars: active learning techniques, digital content, interdisciplinary, European.

Comments: **May be validated in January with 4 stars**

- The main point of concern is the missing information about which students are targetted. Student skills/profiles (prerequisites) should be identified clearly to be sure this course can be attractive.

- More details needed regarding the overall course description and the scientific focus are needed:

Unclear statements about the purpose of this course and its academic/scientific relevance. We think that the description needs to be rewritten. For example: Why would this topic need to be taught at a university, in particular from this non-scientific perspective? There is no mention of environmental aspects, or of the general economic merits of space tourism

Course #8 Medical Engineering for Space and Earth (after Course #4 Introduction to Space Medicine)

Partners: AGH & UT3/MEDES & LTU - 70/20/10% - Master or Bachelor

– 4 stars: active learning techniques, digital content, interdisciplinary, European.

Comments/recommendations: **Validated with 4 stars**

- The content and learning outcomes, appear overly ambitious for a 3 (ECTS) credit course and should be more focused.

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Course #10 Elastic metamaterials and actuators for space applications

Partners: AGH & INP – 50/50% - Master 2 or Ph.D.

- 3 stars: active learning techniques, digital content, European.

Comments/recommendations: **Validated with 3 stars (not multilingualism)**

- The Multilingualism star is not validated at this stage: teaching in English, French and Polish raises questions about co-requisites: does the student need to have a good level of each language? The idea of the tandem teachers has to be clarified.

- The target profile of students is vague and needs to be improved. It will be fine for the first experimental year but thought should be given for future enlargement.

Course #11 Monitoring and economic control of climate change

Partners: INP & TBS & LTU – 50/35/15% - Master 2 – 4 stars: active learning techniques, digital content, interdisciplinary, European.

Comments: **Will be discussed in January**

- More focus is needed regarding the overall course description.

- The term “Jupyter notebooks” should be clarified and a more precise explanation given of how they will be used.

- This course will be evaluated again in January.

Course #12 Snow and Ice throughout the Solar System

Partners: LTU & AGH – 60/40% - Master

– 4 stars: active learning techniques, digital content, interdisciplinary, European.

Comments/recommendations: **Validated with 4 stars**

- Details are needed regarding the overall evaluation process, and should be mentioned in a specific section (to harmonize for all courses). They should not uniquely concern the Multilingualism part.

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Course #13 Space Innovation, Business and Law

Partners: ISAE & TBS & UNI.LU.

- 4 stars: active learning techniques, digital content, interdisciplinary, European.

This course is a collaboration between WP3 and WP5.

Comments/recommendations: **Validated with 4 stars**

- The target of 50 plus than 60 participants in 2023 appears overly ambitious. The exact contribution of the 60 Space Hack participants should be clarified. More information is needed about the recruitment of students.

Course #14 Dictionary of Space Concepts course

Partners: UDUS & AGH – 60/40% - Bachelor or Master. 4 stars: active learning techniques, digital content, interdisciplinary, European.

Comments: **Will be discussed in January**

- This course needs to be discussed furthermore by all members of the Academic Council.

- The interdisciplinary characteristic needs to be clarified, as well as the overall relevance of the course. The gain for students is not clear. See general comment above.

Decisions

Courses #5, #6, #8, #10, #12, #13 are validated with comments.

Course #7 : will be evaluated again in January, with the information required

Courses #11 and #14 are still to be discussed by the Academic Council in January.

Next actions

- UT - to send minutes and all WP3 documents to be presented (next course proposal)

- UT- All partners to agree on a meeting date in early January, a doodle will be sent.

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- WP3 - AW to summarize the evaluation systems of the alliance to initiate an attempt to harmonise the evaluation of UNIVERSEH courses.

- AC (with WP3 support) - Summary of how the new courses fit into the matrix of academic fields and space sectors. Do they contribute to reinforcing the weaker boxes? (from Oct. 5h AC).

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Academic Council – 19.01.2022, 14:30 – 16h.

Attendees

Rafal DANKO (AGH), Linnea HOFVEBERG (student representative LTU), Catherine LEGLU (UniL), Mathilde MARCEL (UT), Stefan MARSCHALL (HHU), Mats NÄSSTRÖM (LTU), François RULIER (Student representative UT), Sophie SIXOU (UT), Adam WALTERS (WP3, UT), Agata ZWOLAK (student representative AGH),

Excused

Claude MARANGES (UT).

Discussions

- Summary of 13.12.21 Academic Council meeting

Validated courses:

- #5 & #6 Ultimate Question of Life, the Universe, and Everything (2 modules),
- #8 Medical Engineering for Space and Earth (after Course #4 Introduction to Space Medicine),
- #10 Elastic metamaterials and actuators for space applications,
- #12 Snow and Ice throughout the Solar System
- #13 Space Innovation, Business and Law.

Courses to be further discussed: #7 Introduction to Space Tourism, #11 Monitoring and economic control of climate change and #14 Dictionary of Space Concepts course

1. Validation of UNIVERSEH courses

Course #7: Introduction to Space Tourism

Partners: UT3 & LTU – 80%/20% - Master or Doctorate

– 4 stars: active learning techniques, digital content, interdisciplinary, European.

Comments: **Removed by the PI, too busy to make the course**

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Course #11 Monitoring and economic control of climate change

Partners: INP & TBS & LTU – 50/35/15% - Master 2 – 4 stars requested: active learning techniques, digital content, interdisciplinary, European.

Comments: **Validated with 3 stars (not the European one)**

- Regarding the previous remark made by the Council that the information given was not clear and precise enough, the new version is much more detailed and overall satisfactory. These improvements have been much appreciated.

- 15% of LTU participation is quite low. Below 20% of participation of a partner, the European star is not likely to be fulfilled. However, the Academic Council encourages LTU to get involved up to 20% to meet the criterion. In this case the star could be validated later.

- The Five-star document should be updated with this mention of minimum 20% requirement for the European star. For some specific cases (e.g. 80/10/10 for 3 partners), the 20% minimum involvement criterion remains at the discretion of the Academic Council.

Course #14 Dictionary of Space Concepts course

Partners: UDUS & AGH – 60/40% - Bachelor or Master. 4 stars: active learning techniques, digital content, interdisciplinary, European.

Comments: **Revised version to be submitted beginning of March**

- The Dictionary is initially a UNIVERSEH project requirement for WP2 meant to be developed by specialists. The idea of this course is to involve students who must gain new academic skills in this way.

- The terms of what is expected from students in this course need to be redefined so as to be clearer. Students should be supervised and their scope of participation clearly defined. Various pedagogical approaches should be considered to maximise the structure of the course: case studies, projects, etc. The overall direction of the course and its outcomes for students need to be made clearer.

- The course has to be more attractive for students:

. Explain that it is part of a group (WP2) working already at minimum 80%, potentially 100%, and what the product will be, independently of the student participation.

. Emphasize the project mode for students: work more on the collaborative aspects, be sure students have a real input, besides translation, with media

aspects for example (associate/create links, examples, videos associated to the words, …)

- The number of students is quite ambitious compared to the foreseen number of teachers, and considering that each student will need to be guided carefully.

- The B2 English entry level will require supervision.

- Be aware that other courses introduce the participation to “Dictionaries” (e.g. courses #15, #16): this should be discussed and clarified in order that the students understand if it is related to the same project or not.

- The Academic Council is nevertheless enthusiastic about this ambitious course, as long as it is built solidly enough, with clear achievements for the students, so as to be very beneficial for them. The members look forward to receive the updated version.

Course #15 Machine learning in robotics and edge devices for space exploration

Partners: AGH & LTU 54/41/5% (Slovenia) - Bachelor B3 & Future: more advanced version, Master, Ph.D. – 4 stars requested: active learning techniques, digital content, interdisciplinary, European.

Comments/recommendations: Validated with 3 stars (not the Interdisciplinary one)

- A 5% participation is not a real collaboration, there is no point to mention it, except if more developed. Percentages are approximate and 41% should be rounded to 40%

- The digital content part is too detailed in the template that should consider real specialized techniques: e.g. connecting to Eduroam is not considered as a pedagogical digital tool, so no need to mention it.

- The multilingualism star is not convincing, as stated in the template, as English will be the main language.

- The dictionary mentioned does not refer to #14 Dictionary of Space concepts and appears disconnected from other aspects of the UniverseH Space Dictionary. This has to be clarified.

- Interdisciplinarity cannot rely on one or a few courses presenting examples of applications. The Academic Council does not grant the interdisciplinarity star. The Academic Council recommends that that this first course is presented as general aspects of Machine learning and then, more advanced courses may be developed in the future to focus on the applications in different areas.

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Course #16 Arctic Winter Schools

Partners: LTU, UT.TLSE-INP, UT.TLSE-UT2J, AGH - Every year. (2022: Feb. 28th-March 5th 2022) in Kiruna + 2 weeks at home universities - Bachelor (B1-3) and Master (M1-2) - 4 stars: active learning techniques, digital content, interdisciplinary, European.

This course is a collaboration between WP3 and WP5.

Comments/recommendations:

No decision taken, waiting for WP3 and WP3 discussions

- The February 2022 Arctic Winter School is cancelled due to Covid-related restrictions. The Academic Councils thinks it may be more beneficial to wait for another template of the Summer School in Krakow to make a decision. Discussions within WP3 and with WP2 have to be finalized for the whole annual organization, budget…

- The 7,5 ECTS prerequisite refers to LTU practices of validating one course, this has to be clarified in order to be understood by all.

- The dictionary mentioned referring to #14 Dictionary of Space course, has to be clarified with the Course #14 and for the students.

2. The evolution of the matrix along with the new courses

Academic Fields & Space Segments represented in validated courses

	Our Earth and space	Sustainable Space (e.g. earth orbit)	Space Settlement and resources	Space Exploration & discovery
Science & Engineering	7,4	2,3	2,0	4,4
Economy, Business, Finance	3,7	1,6	0,3	0,0
Medicine & Health	1,7	0,0	0,5	0,9
Social & Human Sciences	3,1	1,8	0,8	1,0
Art & Cultural Studies	0,5	0,3	0,3	0,3
Innovation & Patents, Entrepreneurship	3,3	1,1	0,8	1,2
Total	19,7	7,1	4,5	7,8

Colour coding from intial analysis
Figures show new additions

Nb of ECTS / Course	3
Nb of course	13
Total ECTS	39,0

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For the next wave of course design, WP3 should try as far as it is reasonable to fill the missing spots, as it is a UNIVERSEH engagement. However, the courses must remain coherent and consistent from a pedagogical and curriculum perspective.

Before the next wave of course design, collecting feedback from students would be very helpful.

3. Issues and future goals for WP3

At the moment, around 4 templates are in preparation.

Summary of next steps

The Academic Council will meet again in March 2022. Please fill the doodle with your availabilities.

The evaluation systems in the alliance will be on the agenda of the next meeting.

The 5-star evaluation document should be amended with the 20% of cooperation required for the European star.

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Academic Council – 14.03.22, 14:00-15:30.

Zoom

Attendees

Rafal DANKO, Nicole DITTRICH, Anne-Laure FRANC, Linnea HOFVERBERG, Catherine LEGLU, Mathilde MARCEL, Adam WALTERS, Mats NÄSSTRÖM, Axelle VANHECKE, Emmanuel ZENOU, Agata ZWOLAK.

Excused

Stefan MARSCHALL, Sophie SIXOU.

1. Validation of courses

Course #18 Summer School on Space Resources and Mining

Partners: AGH & LTU & LUX & HHU – 70%/15%/5%-10% - Bachelor or Master

Comments: **validated with 3 stars: active learning techniques, digital content, interdisciplinary.**

The "active learning techniques" and "digital content" stars are validated with no difficulty. Even if the course has not applied for the "digital content" star, the presence of digital quizzes validates the star.

Regarding interdisciplinarity, the star is awarded but it is important to ensure that interdisciplinary aspects (at least two lines in the matrix 3.1) are effectively included in a significant way in the program. The course description in the template needs to be subsequently updated and completed to highlight the interdisciplinary aspects.

For the stars not awarded on the basis of information in the template it is possible to come back and ask for the star at a later date if these aspects are subsequently developed.

Regarding multilingualism, some efforts need to be made in the next years to validate the star.

Regarding cooperation with other partners, the "European" star is not granted as the criterion of 20% of involvement of another partner is not met. More

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involvement is expected in the coming years. There is a possibility to invite at least one professor from a partner University, or find a way to encourage Professors from the alliance to meet.

Course #16 Arctic Winter School

Partners: LTU, UT.TLSE-INP, UT.TLSE-UT2J, - Bachelor (B1-3) and Master (M1-2).

Comments: **validated with 3 stars: active learning techniques, digital content, interdisciplinary.**

The “active learning techniques”, “digital content” and “interdisciplinary” stars are validated with no difficulty.

Regarding multilingualism and the cooperation with the other partners, similar comments as for Course #18.

Course #14 Dictionary of Space Concepts Course

Partners: HHU & AGH – 60%/40% - All students.

Comments: **validated with 4 stars: active learning techniques, digital content, multilingual, European.**

The Academic Council appreciates a lot of effort has been made since the last meeting. However, the course description still needs to be improved. Even if the course is validated by the Academic Council today, the template needs to be updated as details of the course are worked out.

The “active learning techniques”, “digital content”, and “multilingualism” stars are validated with no difficulty. Regarding the “European” star, more information should be mentioned regarding the cooperation between the two partners.

Regarding the “interdisciplinary” star, the teaching team is not yet shown to be interdisciplinary, the content needs to be more detailed and the template would need to be updated to show that interdisciplinary expertise is effectively available.

Course #17 Critical Space Studies: Introductory Seminar and Lecture Series

Partners: UT2J & HHU – 50%/50% - All students.

Comments: **validated with 4 stars: active learning techniques, digital content, interdisciplinary, European.**

The "active learning techniques", "interdisciplinary" and "European" stars are validated with no difficulty.

Insufficient information is given on the digital content star since a lot of the items cited moodle, zoom, webex are becoming standard and more is expected for this star. However, it is understood that this aspect will be further developed during course creation. The star is given but the template should be subsequently updated with more information on digital tools used.

Sufficient information is not yet given on the multilingual aspects that could be developed in future for example for the second year of the course.

2. Evaluation systems in the alliance

Cf. A suggested marking equivalences table attached. It needs to be validated by each partner.

http://egracons.eu is a possible harmonization system to be adopted by partners. This system is the result of a project funded by the European Commission DG EAC through the Lifelong Learning Programme. (Note added after the meeting – this would require partners to provide statistics on the % number of students receiving each marking range)

To be further discussed, the Academic Council waits for feedback from partners.

3. Issues and future goals for WP3

The next step is to start to work on programs. The present idea is to develop UNIVERSEH semesters focussed on topics related to space that can be combined with existing courses in the partners so as to create joint programs. Each partner needs to discuss internally possible semesters when their students would be able to carry out mobility as part of their studies as well as programs in which they would be interested, their topics and broad curricula.

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The role of the Academic Council is to be rethought regarding this next step. Each representative of the Academic Council will be in contact with their University to discuss possibilities of semesters and programs. Then, a brainstorming session could be organised in Krakow on May 31st.

Next meeting: May 31st, in Krakow (Poland).

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