

Amtliche Mitteilungen

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**Examination Regulations
for the European Master on
Embedded Intelligence Nanosystems Engineering –
from Nanoscale Technologies to Ubiquitous Smart
Sensors (EMINENT)
at
the Hellenic Mediterranean University, Greece,
the University of Siegen, Germany,
the Vilnius Gediminas Technical University, Lithuania,
the University of Orléans, France and
the NOVA University Lisbon, Portugal**

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On the basis of § 2(4), § 64(1) and § 77(1) of the Act on Higher Education Institutions of the State of North Rhine-Westphalia (Higher Education Act – [HG]) dated 16 September 2014 (Laws and Regulations [GV.] NRW. p. 547), as last amended by article 2 of the Law of 19 December 2024 (Laws and Regulations [GV.] NRW. p. 1222), the University of Siegen has issued the following subject examination regulations:

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§ 1

Scope of the Examination Regulations

- (1) These Examination Regulations apply to the Erasmus Mundus Master of Science on Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors (EMINENT) at the Hellenic Mediterranean University (HMU), Greece, the University of Siegen (USIEGEN), Germany, NOVA University Lisbon (UNL), Portugal, the Vilnius Gediminas Technical University (VILNIUS TECH), Lithuania and the University of Orléans (UO), France. The Examination Regulations are in line with the EMINENT Partnership Agreement in its current version. They regulate the admission and study of the EMINENT master's degree programme.
- (2) These regulations can be further supplemented by the Examination Regulations or their equivalent in existence at each of the universities, provided these are not in contradiction with national legislation, the EMINENT Partnership Agreement and these Examination Regulations.
- (3) Accordingly, universities shall in principle conduct examinations and assessments in accordance with local policies and procedures and in compliance with national law, but without prejudice to the regulations set out in these Examination Regulations and in accordance with the decisions of the bodies referred to in these Regulations.

§ 2

Objectives of the programme and purpose of the master's examination

- (1) This master's programme aims at providing graduate students with the knowledge, skills, and methods for a career as future-oriented professionals in the field of advanced technologies. Students will gain expertise from the nanoscale to the geometry of intelligent sensing elements to the macroscale of integrated sensing systems for IoT applications. Besides the technical knowledge, it is intended to supply students with important soft skills and international experience as well as with the capability to critically assess complex problems and apply modern and practical methods to solve them.
- (2) The Examination Regulations determine whether the student has achieved the intended learning outcomes and acquired the in-depth knowledge and scientific skills, necessary for practising in her or his aspirational profession.
- (3) Learning Outcomes: Upon successful completion of the EMINENT core educational programme, students will have the knowledge and skills:
 1. to understand and apply fundamental engineering and physical principles of nanotechnology fabrication techniques and functional nanomaterials,
 2. to apply and integrate knowledge in the fields of nanodevices, nanoelectronics, embedded systems and sensorics,
 3. to understand and design control systems, embedded processing, machine learning, signal processing and data communication for intelligent system development,
 4. to develop key soft and research skills for their career advancement such as oral and written communication, active listening, cultural intelligence, team building, intercultural communication, time management, academic writing and reviewing skills,
 5. to evaluate and reason on constraints, such as ethical, regulatory, political, social and economic perspectives, encountered when solving problems embedded intelligent systems,
 6. Students will have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous and to perform a critical analysis of research literature.

The specialisation in each track has the following additional specific learning outcomes:

7. to understand, design, develop and apply knowledge on functional materials for energy harvesting and optoelectronic applications (HMU),
8. to understand, design, develop and apply knowledge on embedded intelligent sensorics and their nanotechnological realisation, particularly for image sensors (USIEGEN),
9. to understand, design, develop and apply knowledge on the use of natural materials for green electronics, intelligent systems and environmental monitoring (UNL),
10. to understand, design, develop and apply knowledge on microsystems, data infrastructures, smart devices and integration technologies for the internet of things (UO),
11. to understand, design, develop and apply knowledge on smart systems and data processing for large data infrastructures (VILNIUS TECH).

§ 3

Joint master's degree

Students that successfully complete the master's degree programme will be awarded the academic degree of a "Master of Science" (M.Sc.). The degree will be awarded jointly by the universities at which the student has been awarded at least 30 ECTS.

§ 4

Administration of the programme

(1) The EMINENT Steering Committee

The EMINENT Steering Committee is responsible for all decisions regarding the execution of the programme. The Steering Committee consists of the academic coordinators at the five partner universities. All academic coordinators must be full or associated professors. The Consortium Coordinator (USIEGEN) provides the chair of the EMINENT Steering Committee who is at the same time the director of the programme.

(2) The EMINENT Examination Committee

The EMINENT Examination Committee is formed for the tasks specified in the examination regulations. It is responsible for organising the examinations and ensuring that the provisions of the examination regulations are met. In particular, the EMINENT Examination Committee is responsible for deciding on appeals against decisions made in examination proceedings. Furthermore, the committee decides on the recognition of previous degrees and the crediting of coursework and examinations. Moreover, the committee is responsible for the evaluation of master thesis proposals: a master thesis can only be carried out after the proposal and the supervisors have been approved by the Examination Committee. The Examination Committee is also responsible for the internal quality assurance of the EMINENT programme. It defines the QA policy and suggests any changes of this policy to the EMINENT Steering Committee, that will make the final decision. Moreover, it supervises the internal quality assurance activities of the programme. Last, the Examination Committee is responsible for determining the ethical acceptability of attitudes, behaviours and projects (e.g., M.Sc. theses' projects), and to issue gender balance and inclusion policies within the EMINENT community and the investigation of fraud cases as well as making proposals for the resulting penalties.

The EMINENT Examination Committee consists of one full or associate professor from each of the five partner universities, two members representing the academic staff (non-professors, but holding a PhD) and two students of the EMINENT programme. The committee is chaired by the professor of the coordinating institution. The academic members of the EMINENT Examination Committee are nominated and elected by the five faculty councils of the faculties offering the modules

for the EMINENT programme. While professors are elected for a period of two years, academic staff will be elected for a period of one year. Re-election is possible. The nomination of academic staff members shall follow a rotation system so that each university elects one academic staff member in two successive years: first year – university A & B, second year – university B & C, third year – university C & D, fourth year – university D & E, fifth year – university E & A and so forth. Elections for the student representatives take place each November. All students enrolled in the EMINENT programme are eligible to vote and to be elected – independently of their semester (written vote, simple majority). Student representatives will be elected for a period of one year. Re-election is possible.

A member who leaves prematurely shall be replaced by re-election. The end of the term of office of the subsequently elected member shall be determined as if she or he had taken office in due time. All decisions within the committee will be made by a simple majority of the votes cast.

If necessary, the Examination Committee may consult other expert advisory members.

(3) The EMINENT Admission Committee

As defined in the EMINENT Partnership Agreement, the EMINENT Admission Committee is responsible for the selection and admission of students. It consists of one delegate from each partner institution. The delegate at the coordinating university represents the chair of the committee. She or he is responsible for the reporting of the outcome of the selection process to the EMINENT Steering Committee and the respective students.

(4) The Administrative Coordinator

The Administrative Coordinator, appointed by the director of the programme, acts as an interface between and advisory member of the Steering Committee (i.e., the decision-making body) and the other committees (i.e., the consulting bodies). The Administrative Coordinator participates in all committee meetings as an advisory member without voting rights. Her or his role is to summarise and present each consulting body's decisions and claims to the Steering Committee. Vice versa, the Administrative Coordinator will inform the consulting bodies on decisions made by the Steering Committee.

§ 5

Admission requirements and barriers to enrolment

(1) Students applying for the EMINENT master's programme are eligible for admission if they fulfil the following minimum requirements:

1. Holding a Bachelor's (B.Sc.) degree in Electrical and Electronic Engineering, Mechanical Engineering, Physics, Material Science, Computer Science or equivalent programmes (Bachelor of Science, Bachelor of Engineering or equivalent) with at least 180 ECTS. The final grade will be translated to the German grading system using the modified Bavarian formula. The translated grade should be at least a 2.7 ("befriedigend+"). The B.Sc. must have been obtained by a nationally recognised university and be recognised by all partner institutions' national legislation.
2. Good command of English language skills: B2 level validated by a certification e.g., TOEFL iBT (minimum score 93) or IELTS Academic (minimum score 6.5 with no individual score under 6). The result of the test should be valid at least 14 days after the application deadline. Candidates that have obtained their bachelor's (or master's) degree in a study course fully taught in the English language in an EU country or in Australia, Canada, Ireland, New Zealand, the United Kingdom, the USA, or Switzerland do not require an English test result. For nationals of countries where English is the only official language, proof of English language skills is also not required.

- (2) Information on the documents to be submitted during the application procedure is made publicly available on the programme website.
- (3) The admission number is specified based on the currently available capacities at the universities hosting the whole cohort of students in the first and second semester. Accordingly, a total number of up to 35 students is expected to be admitted to the programme per year. In case of a higher number of applications from eligible students, applicants will be ranked according to their suitability for the programme (§ 5, 4). All eligible applicants will be invited to take a mandatory online multiple-choice aptitude test. Invitations to this online test are sent out once a month during the application period. The test must be completed within 14 days of the invitation. The – according to their application and their result of the multiple-choice test – best up to 100 candidates will be invited to an online interview with one of the lecturers of the programme. The interview serves to gain an impression of the students' motivation and knowledge level. Afterwards, the lecturer will give a recommendation for either admitting or rejecting the focal candidate. In case more than 35 candidates will be recommended for admission, the ones with the higher score will be admitted. In addition, a reserve list, containing the names of the 15 students that have been placed next according to their total score, is prepared. In case of equal scores of several students, the one(s) with the highest score in education and academic merit will be placed first. If there is still an equal score of several students, female students will preferentially be admitted in order to support the involvement of females in engineering. Moreover, students with handicaps will be preferentially admitted in case of equal scores with their competitors.
- (4) Admission to the master's programme will be based on the interviewers' recommendation and the following criteria:
 1. Education and academic merit (max. 50 points): based on the transcript of records and the degree certificate(s) of the applicant as well as on the result of a short online multiple-choice test (§ 5, 3), the academic merit will be evaluated.
 2. Soft skills, publications and relevant experience (laboratory, or working experience) (max. 20 points),
 3. Recommendation letters (10 points).
- (5) Applications must be submitted latest in March. The exact date of the application deadline will be announced on the EMINENT website at least two months in advance. Applications that are submitted after the application deadline will not be processed.
- (6) Application is also possible if the proof of qualification (bachelor's degree according to § 5, 1) is not yet available at the time of application. In this case, proof of enrolment at the current home university, an official statement from this university stating the expected graduation date, the missing courses, the current performance data and an average grade must be submitted. These documents must not be older than one month at the time of application. The average grade will be considered in the selection process instead of the final grade. If the original language in the document is not English, a certified translation must be submitted as well. The final degree certificate and transcript of academic records must be submitted before August 1st in the respective year to finalise the admission procedure. Otherwise, admission and enrolment in the Master programme will not be granted.
- (7) All applications will first be checked for eligibility (§ 5, 1), followed by an evaluation of all eligible applications according to the admission criteria (§ 5, 4) by the EMINENT Admission Committee. The ranking list, the list of students recommended for admission following the personal interviews, the minutes of the selection meeting as well as a conflict-of-interest statement will be signed by all members of the Admission Committee as well as by the director of the programme (i.e., the chair of the Steering).

- (8) Applicants will be informed whether their application was successful before the end of June. Candidates that have been put on the reserve-list will be informed about their status to ensure that they are prepared for a potential acceptance in case one or several of the selected candidate(s) withdraw(s) from the programme.
- (9) Admitted students will receive a Student Agreement (Annex 2), as well as information regarding the necessary next steps to take to validate their admission. These steps include signing and returning the Student Agreement, applying for visa and signature of the scholarship contract (if applicable). After the student has officially accepted to enrol in the programme, the Consortium Coordinator (USIEGEN) will send her or him all relevant information regarding accommodation, insurance, programme content and structure.
- (10) Students that have not been admitted to the programme may follow an appeal to the selection decision within one week after receiving the notification of their rejection. The response will be prepared by the Admission Committee and must be approved by the Steering Committee. The response to the appeal shall be sent to the enquirer within 14 days after submission of the appeal.

§ 6

Modularisation of the programme, workload and credits

- (1) The master's programme consists of modules and follows a credit points system according to the European Credit Transfer System (ECTS). Modules are thematically and timely determined closed units that can be composed of different teaching and learning methods (lectures, seminars, practical courses etc.).
- (2) After successful completion of a module, the students will be awarded with credit points. The calculation of the credit points is based on the estimated workload of the students. At USIEGEN and UO, one credit point is equivalent to a 30-hour workload. At HMU one credit is equivalent to 26, at UNL one credit point is equivalent to 28 and at VILNIUS TECH to 26.7 hours workload. As a rule, 60 credit points are awarded per academic year.

§ 7

Duration, scope and structure of the study programme

- (1) The standard period of studies is four semesters including master's thesis and master's examinations. To obtain the degree, students must earn a total of 120 ECTS points.
- (2) Students spend their 1st semester at the Hellenic Mediterranean University. Four mandatory and one elective module totalling 30 ECTS must be taken, focusing on the building of the fundamental theoretical and experimental knowledge in the field of nanomaterials and on the application of these materials on sensing devices as well as on building relevant research skills.
- (3) The 2nd semester will be spent at the University of Siegen. Students must take five mandatory modules and one elective module, focused on sensors, sensing devices and embedded systems. The knowledge acquired in the 1st year will be the basis for the specialisation tracks, chosen in the 3rd semester.
- (4) Students spend the 3rd and 4th semester at one of the partner universities, depending on their chosen specialisation (see § 2). During the 3rd semester, students will conduct a mandatory research lab course that can serve as a preparation for the master's project. In addition, elective modules must be taken, so that a total of 30 ECTS is completed in the 3rd semester. The 4th semester is fully dedicated to the master's project. Students should implement their master's project in the topic of their specialisation track.

- (5) If a student earns more than 30 ECTS, i.e., takes more elective modules than required, the elective modules completed with the better grades will be included in the final grade.
- (6) The EMINENT programme requires a minimum of two semesters of mobility during the course of studies. This minimal mobility is ensured as all EMINENT students will spend the first semester in Greece and the second semester in Germany. After the second semester, they may choose to which of the five partner universities they will go. In case a student has her or his permanent residence in Germany or Greece, she or he must visit one of the other three universities within the third and/or fourth semester to cover two semesters of mobility.
- (7) Mandatory and elective modules are listed in the EMINENT Module Handbook (Annex 1).
- (8) Failed coursework and examinations can be retaken as stated in § 12. If a student has to retake an entire course in physical attendance (for example due to too many days of absence), she or he will still be admitted to continue studies as planned. However, she or he must return to the respective university the following year to retake the failed course. In order to avoid prolonging the studies, it is recommended that the student continues her or his studies in parallel with repeating the failed course, e.g., by choosing the specialisation track at the university she or he returns to or by carrying out the master's project at that university. If a student with permanent residence in Germany or Greece has to return to HMU or USIEGEN in the second year of her or his studies, she or he must spend either the third or fourth semester at one of the three other universities in order to fulfil the minimum mobility requirement (§ 7, 6).

§ 8

Coursework

- (1) Modules may stipulate that coursework must be completed as part of courses. Coursework refers to all ungraded course achievements that can be earned by all forms of learning, the presentation of learning content or ungraded testing of acquired knowledge and competences. Coursework serves the purpose of student self-monitoring success and ensures the practice of research-based learning, testing of various text and lecture formats, independent deepening of knowledge and competences acquired in seminars and lectures and, where applicable, the preparation for examinations. Coursework can be delivered in various formats. These can be in particular:
 1. an oral presentation, e.g., about a scientific publication or an experiment conducted during the course,
 2. a written performance, e.g., essay questions,
 3. a practical performance, e.g., the development of an experimental setup, exercises, laboratory practice.
- (2) The format of the coursework for a respective course is specified in the Module Handbook (Annex 1). If several possible forms of delivery are envisaged, the respective lecturer must indicate the format at the latest four weeks after the start of the course.
- (3) If a coursework is a prerequisite to be admitted to an examination within the module, this needs to be specified in the Module Handbook (Annex 1).
- (4) Failed coursework can be retaken without restriction (§ 12). Coursework may be graded, but these grades are not included in the respective module grade.
- (5) Students must register for courses at the university where they will take them. Students are obliged to inform themselves about all dates and deadlines for registration (e.g., examination office, campus management system).
- (6) The students must be informed about the result of their coursework within six weeks after performance/submission.

§ 9

Examinations

- (1) Modules are usually concluded with one examination that is based on the intended learning outcomes defined for the module. Examination performances are graded. This grade is the final module grade and will be included in the calculation of the final grade for the study programme (§ 15, 4).
- (2) Examiners are those teaching in the module. The EMINENT Examination Committee may also appoint other persons as examiners for a module that have at least a master's or equivalent degree in the respective field.
- (3) Examinations can include several examination elements, resulting in an overall examination performance for the respective module (cf. § 15, 4). The individual examination elements and their weighting are given in the EMINENT Module Handbook (Annex 1).
- (4) The announcement of examinations as well as the registration procedure depend on the local regulations of each respective partner university. For example, students have to register via the Campus Management System or responsible facility (e.g., examination office) at the university where they will take the examinations. Students are obliged to inform themselves about the rules, dates and deadlines regarding the registration.
- (5) Students can only register for an exam credit if they are enrolled in the EMINENT master's programme and have achieved the necessary prerequisites (e.g., certain coursework within a module) as defined in the respective module description (Annex 1).
- (6) In case a student does not take an examination within 18 months after having achieved the necessary prerequisites, she or he may be excluded from the programme. Absence intervals according to § 17 or § 18 extend this time limit.
- (7) Examinations can take place in written, oral, practical or combined form. The form of the examination to be taken in each case is specified in the EMINENT Module Handbook (Annex 1). In particular the following formats for an examination are possible:
 1. a written examination, e.g., a written exam (60-120 minutes), a homework assignment (10-20 pages), final exam paper, summary, written term paper (5000 words), report,
 2. an oral examination, e.g., an oral exam (15-60 minutes), Presentation, Seminar presentation (30 minutes),
 3. a practical examination, e.g., a practical performance (30-60 minutes), Lab Course.

Individual forms can also be combined with each other, e.g., a laboratory project with a written final report. If several possible forms of delivery are assigned to an examination, the respective teaching staff will announce the form and scope of the examination no later than four weeks after the start of the course.

- (8) An examination may be taken using the multiple-choice method if the examiner has set the examination herself or himself. If the examination is also taken by students who no longer can retake a failed examination (cf. § 12), the examination should be jointly prepared by two persons authorised to examine. If the examination was not jointly prepared by two persons authorised to examine, the second examiner has her or his own scope for assessment. She or he is not bound to an existing evaluation scheme.
- (9) Oral examinations must be conducted by several examiners or by one examiner in the presence of an expert assessor. The minutes of the oral examination need to be taken and signed by all examiners and, if present, the assessor.

- (10) Students of the EMINENT programme shall be allowed to participate in oral examinations as listeners unless the candidate objects. Participation does not extend to the discussion and announcement of the examination result to the candidate.
- (11) In appropriate cases, examinations may be carried out as group work or as group oral examination at the discretion of the examiner, provided that the individual contribution of each candidate is clearly recognisable and assessable.
- (12) All forms of examinations shall be carried out in English language.
- (13) The student must be informed about the grade for her or his examination performance within six weeks after the examination/submission.

§ 10

Online-examinations

- (1) Coursework and examinations may also take place in electronic form or by electronic communication (online examinations).
- (2) A coursework or examination takes place in electronic communication if
 - 1. the examination result is handwritten, practically or electronically prepared in the sphere of the participant and after completion is transmitted exclusively electronically to the examiner or the examination office for evaluation or
 - 2. the examination is conducted orally by means of video communication.

Coursework or examinations in electronic communication may be conducted in written form (e.g., term papers and open-book examinations), oral form (e.g., oral examinations and lectures), practical form (e.g., laboratory exercises), and combinations of the above. Whether a coursework or an examination is conducted in electronic communication shall be determined and announced by the examiner.

- (3) A coursework or an examination takes place in electronic form if it is conducted exclusively digitally in that the participant enters her or his performance directly into a data processing device (e.g., computer, smartphone, tablet, etc.) and the data is stored outside her or his sphere of influence.
- (4) In the context of online examinations, personal data required for the proper conduct of the online examination, in particular authentication or in the event of suspected cheating, may be processed in accordance with the respective national regulations in conjunction with these regulations.
- (5) Coursework or examinations can be conducted as online examinations if
 - 1. it is a coursework or an examination with oral communication or
 - 2. no supervision of the participants is required during the coursework or examination or
 - 3. the coursework or examination is conducted on the premises of the participating universities with supervisory personnel.

In the case of oral online examinations, the participant must be given the opportunity to take the examination on the premises of the participating universities upon request.

§ 11

Authentication in Online-examination

- (1) For the purpose of carrying out an identification check at the beginning of an online examination or to clearly assign an examination to a participant, the following procedures are possible:

1. for oral online examinations: Matching of a valid identification document and the face of the examinee at the beginning of the audio-video conference by the examiner. In particular, student ID cards and identity cards can be considered as identification documents. Non-relevant data of the identification document (e.g., ID number) can be covered during authentication or taped off beforehand. In the case of group examinations, authentication can be carried out to the exclusion of the other participants if desired.
 2. for all other online examinations: Other appropriate authentication or authentication procedures, e.g., requiring that the exam be submitted for grading by the participant via a university email address or logging in via university-provided platforms.
- (2) Participants who do not identify themselves will be excluded from taking the online exam. Performances that are not submitted via the university email address may be excluded from the evaluation.
- (3) The personal data processed in the course of identification and authentication may not be stored permanently. Technically necessary temporary storage of this data must be deleted immediately.

§ 12

Retaking coursework and examinations

- (1) Passed examinations cannot be retaken for the purpose of improving a grade.
- (2) Examinations and coursework are passed if they have been graded with a 4.0 (converted grade in the German system, cf. § 15, 1), which usually corresponds to 50 % of the maximum number of points to be achieved or better. If an examination consists of several examination elements (cf. § 9, 3 and § 12, 3), the examination is passed if the overall examination is passed after completion of all examination elements.
- (3) Coursework and examinations are not passed if they have been graded worse than 4.0. If an examination consists of several examination elements, the examination is not passed if the overall examination is not passed. In this case, all examination elements of the examination must be retaken.
- (4) Coursework that has not been passed can be retaken without restriction. Examinations can only be repeated twice if they are not passed or are considered as not passed. Repeat examinations for which there is no provision for compensation in the event of a final failure must be assessed by at least two examiners.
- (5) The form of a repeat examination may differ from the form of the original examination. For example, it may be conducted virtually if the student has already left the university at the time of the repeat examination.
- (6) If an examination has been definitively failed, the respective examiner will inform the EMINENT Examination Committee by contacting the local professor, who is member of the committee. The chairperson of the Examination Committee shall inform the candidate with a written notification. The notification shall be accompanied by an information on the student's right to appeal.

§ 13

Master's thesis and master's thesis defence

- (1) The fourth semester is dedicated to the master's project, supervised by a professor at the university where the student is currently staying and a second supervisor that holds at least a master's degree, or equivalent, in engineering. The second supervisor can be from any of the five partner institutions or a representative from a company (associated partners).

- (2) In the master's thesis and the master's thesis defence, the candidate must demonstrate that she or he is able to work independently on the topic chosen in the specialisation phase within a given period of time. In addition, the student must show that she or he is able to adequately document and present her or his results. The master's thesis should be maximum 90 pages long, excluding annexes. Upon successful completion, the candidate will be awarded 30 credit points. The thesis and defence are to be completed in English.
- (3) The topic of the master's thesis and the supervisors can be proposed by the candidate by submitting a written form to the Examination Committee. The supervisors must be approved by the EMINENT Examination Committee. The topic must be approved by the supervisors as well as by the EMINENT Examination Committee. After approval, the candidate must submit her or his thesis within six months.
- (4) The master's thesis and its defence are graded by the two supervisors of the master's thesis. One single grade will be awarded for both the master's thesis and its defence, as the defence is regarded as an integral part of the thesis (cf. § 13, 6). In case of a discrepancy of the grades given by the supervisors, the arithmetic mean of both grades will be formed. In case one supervisor grades the thesis as failed or in case the grades given by the supervisors differ by more than two full grades according to the German grading system (e.g., 1.3 and 3.7), a third examiner will be consulted to evaluate the master's thesis. In this case the arithmetic mean of the three grades will form the final grade.
- (5) The master's thesis can only be set after at least 80 ECTS credit points have been achieved. The EMINENT Examination Committee shall rule on exceptions on request.
- (6) The master's thesis defence is an integral part of the master's thesis. It will last about 45 minutes. In the first 30 minutes, the candidate will present the scientific questions, key stages of the work and her or his results. The second part of the defence is dedicated to a discussion about the thesis and its results. The defence will be carried out in English. It should not exceed a maximum duration of 60 minutes. Students of the EMINENT programme, students of related fields, research staff members shall be allowed to participate in oral examinations as listeners unless the candidate objects. The defence may be carried out in a hybrid format so that external supervisors can attend online. In this case § 11 and § 12 apply accordingly.

§ 14

Acceptance of the master's thesis

- (1) The master's thesis must be submitted in a digital form to the EMINENT Examination Committee within six months after registration to the EMINENT Examination Committee. The student shall be informed about the deadline for submission in written form when registering for her or his master's thesis. In case a master's thesis is submitted after the deadline it will be graded as "failed".
- (2) Upon substantiated request, the deadline of submission may be extended by up to eight weeks. Requests for an extension of the submission deadline must be submitted to the EMINENT Examination Committee before the regular submission deadline. The Examination Committee decides individually whether the request can be accepted. Valid reasons for a postponement of the submission may be physical or mental illness, immutable technical difficulties, taking care of one's children aged 12 years and under, nursing or caring for a direct relative, a spouse or registered civil partner or a first-degree relative by marriage. Upon request, the candidate must present proof of a "valid reasoning" (e.g., in form of a medical certificate).

§ 15

Grading formation

- (1) The results of coursework (if graded), examinations and the master's thesis are given as a local grade, according to the national grading culture of the university where the module or master's thesis takes place.
- (2) Final module grades awarded to students of the EMINENT programme will be transmitted to the administrative personnel at USIEGEN, who will convert the grades to the German grading system using the grade conversion table given below. The converted grades will be registered in the campus management system of USIEGEN.

Grade Conversion Table (passing range)

USIEGEN	HMU	UNL	UO	VILNIUS TECH	Result
4.0					Sufficient
3.7	5	10	10	5	
3.3		11	11		Satisfactory
3.0	6	12	12	6	
2.7	7	13	13	7	
2.3		14			Good
2.0	8	15	14	8	
1.7		16	15		
1.3	9	17	16	9	Excellent
1.0	10	18	17	10	

- (3) In case of a discrepancy in the assessment by two examiners, the grade of an examination performance is calculated from the arithmetic means of both examiners. If one examiner grades an examination as failed, or if the grades awarded by the two examiners differ by more than two full grades, a third examiner will be consulted. In this case, the final grade of the examination will be calculated as the arithmetic means of all three grades. If the final grade is below the pass mark set for the respective university, the examination is failed.
- (4) In case a module includes several examinations (§ 9, 3), the final grade of the module is calculated as the average grade according to the proportional weighting given in the Module Handbook (Annex 1).
- (5) The final overall grade is formed on the basis of the German grading system. For this purpose, the grades for the individual modules are transferred to the German grading system in accordance with § 15, 2. The overall grade is then calculated from the arithmetic mean of the individual grades, which are weighted according to the ECTS credit points on which the respective module is based.
- (6) The grading process of the master's thesis and defence and its reasons must be documented and signed by the examiners, i.e., the two supervisors. The final grade will be calculated as the average of the grades awarded by the supervisors (but see § 12, 2). The grade for the master's thesis is calculated from the grade for the master's thesis itself, with a weighting of 75 % and the grade for the defence, with a weighting of 25%. The student must be informed about the result within ten weeks after submission.

§ 16

Passing and retaking of the master's examination

- (1) In accordance with § 6, the master's examination has been passed when the student has passed all mandatory and enough elective courses (see Annex 1) to obtain 30 ECTS points in the first, second and third semester and completed her or his master's thesis and master's defence at least

with a 4.0 ("sufficient", § 15). In total, the student needs to have obtained 120 ECTS credit points for the completion of the master's programme (§ 7, 1).

- (2) The master's examination consists of the master's thesis and its defence. Each supervisor grades the master's thesis and its defence together, i.e., with one grade for both performances (cf. § 13, 4 and § 13, 6). In case of a fail grade, the candidate is allowed to rewrite the thesis and repeat the defence once. A third attempt is not allowed. If the candidate does not pass the master's examination within two attempts, she or he is considered to have finally failed the master's examination and therewith her or his studies.
- (3) In case of a permanent failure of the master's examination, the student may ask for a transcript listing of all courses and examinations that have been completed, including grades. This list will be handed out to the student once she or he has submitted her or his certificate of removal from the register of students. The transcript must be signed and sealed by the director of the master's programme.

§ 17

Compensation for disadvantages for disabled and chronically ill students

If a candidate provides suitable evidence that she or he is unable to use her or his existing intellectual abilities in the performance of her or his duties due to a chronic or temporary illness or a disability and is therefore unable to complete all or part of the coursework or examination within the specified deadlines, the EMINENT Examination Committee will allow an extension of the processing time for the coursework or examinations. In addition, the form of the coursework or examination may be adapted to the needs of the candidate.

§ 18

Regulations for families, downtimes and protective regulations

- (1) On request of a candidate, the maternity protection periods as specified in the Maternity Protection Act in force shall be taken into account. The maternity protection period shall interrupt all time limits determined for the study course; the duration of maternity leave is not included in the time limit.
- (2) Durations of parental leave shall not be calculated as period of studies. If a candidate is planning to go on parental leave, she or he must inform the EMINENT Examination Committee at least four weeks in advance. In a written statement, she or he must announce the exact dates of the beginning and end of the planned downtime.
- (3) Accordingly, candidates can apply for downtimes if they are nursing or caring for a direct relative or first-degree relative by marriage, a spouse or a registered civil partner. Upon request, the candidate must present proof of a "valid reasoning" (e.g., in form of a medical certificate).

§ 19

Absence, withdrawal, deception and violation of regulations

- (1) A coursework or examination is deemed to have been failed if the candidate misses an examination date or a submission deadline set for the examination performance without a valid reason.
- (2) Valid reasons to miss an examination are, for instance, illness, urgent cases of caring for a direct relative, a spouse or registered civil partner.
- (3) Valid reasons must be submitted to the EMINENT Examination Committee within three days after the missed date. In case of illness of the candidate, a medical certificate stating that she or he is

unable to take the examination needs to be submitted. The Examination Committee decides whether the submitted reason can be accepted. If not, the credit will be graded as failed.

- (4) In case of an attempt to deceive, for example by using prohibited devices or plagiarism, the respective study performance shall be rated as failed. The decision whether cheating has occurred shall be made by the Examination Committee after hearing the candidate concerned. The universities participating in the programme may also provide for further procedures and sanctions in the event of an act of cheating if the act of cheating occurs in the context of a module offered by them or a master's thesis supervised by them. Further details can be found in the corresponding regulations of the respective university.
- (5) If a candidate attempts to influence the result of her or his study or examination performance by interfering with examiners, supervisors or examination bodies, the study or examination performance may be graded as failed.
- (6) The coursework or examination of a candidate who disturbs the orderly process of performance by making the coursework or examination or parts thereof available to other candidates during the preparation of the coursework or examination may be graded as failed.
- (7) In case of multiple or other serious attempts at cheating, the candidate may also be exmatriculated and excluded from the entire degree programme.
- (8) A candidate who disrupts the orderly conduct of an examination may be excluded by the respective examiner or invigilator. In this case, the respective examination is graded as failed. Before the decision is made, the candidate must be given the opportunity to explain herself or himself to the respective examiners. The hearing and the reasons for exclusion must be recorded in the files. In case of an exclusion of the candidate, she or he may request that this decision shall be reviewed by the EMINENT Examination Committee.
- (9) The EMINENT Examination Committee must inform the candidate immediately of any adverse decisions in a written statement. This statement must be approved by the Steering Committee.

§ 20

Master's certificate

- (1) Candidates that have successfully completed the master's programme, will receive a joint official certificate, confirming the award of the master's degree (see § 3). This certificate is printed on paper including the logos of those universities, where the student has earned at least 30 ECTS. The certificate includes the topic and the grade of the master's thesis as well as the overall grade given according to § 15, 5.
- (2) The certificate is signed by the director of the EMINENT programme and the dean of Faculty IV – School of Science and Technology. The date of the certificate shall be the date on which the last examination was performed.
- (3) A duplicate will be stored by the administrators of the coordinating university (USIEGEN).

§ 21

Diploma Supplement and Transcript of Records

- (1) In addition to the joint official certificate, the graduate receives a diploma supplement and a transcript of records.
- (2) The Diploma Supplement contains information on the contents on which the degree is based, the programme structure and the competences acquired with the degree. Moreover, it contains information about the conversion and calculation of grades. It is supplemented by information about the study system of the involved universities.

- (3) The Transcript of Records contains a list of all completed modules including the number of acquired credit points and grades obtained within a course and for each completed module.
- (4) The Diploma Supplement and the Transcript of Records are signed by the chairperson of the EMINENT Examination Committee. A duplicate will be stored by the administrators of the coordinating university (USIEGEN).

§ 22

Access to the examination files

After completion of an examination, master thesis or master defence, candidates can, upon request, gain access to their written examination results and the related reports as well as the examination records. Requests must be addressed to the chairperson of the EMINENT Examination Committee.

§ 23

Invalidity of records and dispossession of the master's degree

- (1) If the requirements for admission to an examination were not fulfilled without the candidate intending to deceive, and if this fact only becomes known after the announcement of the examination result, this defect is remedied by passing the examination. If the candidate has intentionally obtained the admission wrongfully, the EMINENT Examination Committee shall decide on the consequences according to the German national law.
- (2) If the candidate has cheated during an examination and this fact only becomes known after the announcement of the examination result or after the certificate has been issued, EMINENT Examination Committee can adjust the grades for those examination performances subsequently or declare the examination as failed. The invalid certificate has to be returned.
- (3) The degree may be withdrawn if it is subsequently found that it has been acquired by deception or if essential requirements for the award have been erroneously considered to be fulfilled. The decision to withdraw the degree is made by the EMINENT Examination Committee and must be approved by the Steering Committee.
- (4) Before the decision is made, the candidate shall be given the opportunity to give a statement.
- (5) After a duration of five years, a withdrawal of the master's degree cannot be made.

§ 24

Coming into force and publication

These regulations come into force with effect from March 1, 2024. It is published in the Official Announcements of the Consortium Coordinator (USIEGEN). These examination regulations apply to all students who begin their studies in the EMINENT master's programme in or after the winter semester of 2024/2025.

Approved by the legal entities of the University of Siegen, the Hellenic Mediterranean University, the University of Orléans, the NOVA University Lisbon and the Vilnius Gediminas Technical University.

Please note that, in accordance with § 12, 5 of the Higher Education Institutions of the State of North Rhine-Westphalia (Higher Education Act – [HG]), a violation of procedural or formal provisions of the Higher Education Act or the regulations law or other autonomous law of the university can no longer be asserted after one year since this announcement, unless

1. the regulations have not been properly publicised,
2. the rectorate has previously objected to the resolution of the body adopting the regulations,
3. the formal or procedural defect has been notified to the university in advance, stating the violated legal provision and the fact that reveals the defect, or
4. the legal consequence of the exclusion of objection was not pointed out when the regulations were publicly announced.

University of Siegen (Consortium Coordinator), Germany

Siegen, 15 December 2025

the rector

signed

(Univ.-Prof. Dr. Stefanie Reese)

Annexes

Annex 1

HELLENIC MEDITERRANEAN UNIVERSITY
UNIVERSITY OF SIEGEN
UNIVERSITY OF ORLÉANS
VILNIUS GEDIMINAS TECHNICAL UNIVERSITY
NOVA UNIVERSITY LISBON

MODULE MANUAL FOR THE STUDY PROGRAMME

European Master on

**Embedded Intelligence Nanosystems Engineering –
from Nanoscale Technologies to Ubiquitous Smart
Sensors (EMINENT)**

Master of Science (M.Sc.)

Structure of the master's programme

1 st Semester	Fundamentals of Functional Materials: Properties, Fabrication Processes and Characterisation (30 ECTS) Hellenic Mediterranean University (HMU)	ECTS
	Journal Club and Research Skills	7.5
	Chemistry of Materials	7.5
	Graphene and 2D Materials and Devices	7.5
	Winter School – Introduction of Specialisation Tracks	3
	Technology Exploitation	4.5
	Polymer Electronics	4.5
	Condensed Matter for Semiconductor Physics	4.5
2 nd Semester	Fundamentals of Sensors, Devices and Embedded Systems (30 ECTS) University of Siegen (USIEGEN)	ECTS
	Optoelectronics	6
	Semiconductor Electronics	6
	Introduction to Embedded Systems	6
	Microelectronics for EMINENT	3
	Summer School – Preparation for the specialisation tracks	3
	Advanced Semiconductor and Microelectronics	6
	Physics of nanoelectronic devices	6
	Synthetic Aperture Radar	6
	Professional Design Experience Project (PEP)	6
	StartUp Entrepreneurship	6
3 rd Semester	Specialisation in Functional Materials with Optoelectronic Properties (30 ECTS) Hellenic Mediterranean University (HMU)	ECTS
	Research Lab Course: Devices Processing Techniques and Characterisation Methods	7.5
	Energy Devices (Solar Cells and Batteries)	7.5
	Nanomaterials for Energy	7.5
	Skills and Ethics in Science	7.5
	Principles of Lasers	7.5
	Specialisation in Embedded Intelligent Sensorics (30 ECTS) University of Siegen (USIEGEN)	ECTS
	Digital 2D/3D Image Sensing	6
	Research Lab Course: Nanoscience and Nanotechnology for EMINENT	6
	Deep Learning	6
	Microelectronic Sensors	6
	Embedded Control	6
	Nanotechnology	6
	Practical Course Communications Technology	6
	Semiconductor Electronics Design	6
	Specialisation in Natural Materials and Biosensors (30 ECTS) NOVA University Lisbon (UNL)	ECTS
	Biosensors	6
	Paper and cellulosic materials	6
	Soft Skill Course – Entrepreneurship	3
	Research Lab Course	9
	Environmental Monitoring and Big Data	3
	Sensors: Materials and applications	6
	Adv. Programming for Data Science and Engineering	6
	Biomaterials and Biomedicine	3
	Smart Materials and Systems	6
	Molecular Diagnostics	3
	Specialisation in Internet of Things and Robotics (30 ECTS) University of Orléans (UO)	ECTS

3 rd Semester	Processor architectures	3
	Data analytics	5
	Robotics 1	5
	Control 1	5
	Research Lab Course: IoT and data	3
	Full-stack integration	5
	Data transmission	2
	Servers and database	2
	Smartphones	2
	Cybersecurity	2
	Specialisation in Sensor Systems and Data Processing (30 ECTS) Vilnius Gediminas Technical University (VILNIUS TECH)	ECTS
	Intelligent Systems	6
	Microcontrollers of ARM Architecture	9
	Research Lab Course: Internet of Things (with course project)	9
	High Frequency Circuit Design	6
	Data Mining Techniques	6
	Data Centres	6
	Hydropower and Biofuel	6
4 th Semester	M.Sc. Thesis Implementation	ECTS 30

	Mandatory course
	Elective

Module descriptions

1. Hellenic Mediterranean University

Course Title	Condensed Matter for Semiconductor Physics
Module ID	4EMINENT101
Responsible Lecturer	Prof. Dr. George Kavoulakis
University	Hellenic Mediterranean University
Semester	1
Relation to curriculum	Elective
Credit points (ECTS)	4.5
Teaching type	Lecture and exercises
Workload	lecture: 36 h tutorial: 12 h additional individual work of the student/homework time: 69 h total number of estimated working hours: 117 h
Course description	This is an introductory course on condensed-matter physics and of semiconductors. After a very brief review of classical physics, it turns to the basic principles of quantum mechanics. It then examines the consequences of quantum theory, starting with the atoms, turning to the periodic table, to molecules and ending up with solids, paying special attention on various properties of solids.
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • apply the fundamentals of Quantum Physics to the study of the semiconductor materials and devices. • understand and solve problems related to semiconductors and semiconductor based devices. • understand the fundamentals of semiconducting devices such as quantum well, nanowires and quantum dot devices. • simulate semiconductor and superconductor devices.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • An Introduction to Quantum Physics by Stefanos Trachanas, Willey • An Introduction to Solid State Physics by Charles Kittel

Course Title	Chemistry of Materials
Module ID	4EMINENT102
Responsible Lecturer	Prof. Dr. Dimitra Vernadou
University	Hellenic Mediterranean University
Semester	1
Relation to curriculum	Mandatory course
Credit points (ECTS)	7.5
Teaching type	Lecture and exercises
Workload	lecture: 36 h tutorial: 12 h additional individual work of the student/homework time: 147 total number of estimated working hours: 195 h
Course description	Knowledge in the state-of-the-art technologies leading to the materials growth with photocatalytic, thermochromic and electrochromic layers for environmental and energy applications. Understanding the relationship between growth parameters-properties-applications for the best choice of materials. Knowledge in the design and chemistry of materials with improved properties.
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • understand the operational mechanisms of photocatalytic, thermochromic and electrochromic materials. • synthesise materials with the aforementioned properties.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • The Physical Chemistry of Materials: Energy and Environmental Applications by Rolando Roque-Malherbe

Course Title	Graphene and 2D Materials and Devices
Module ID	4EMINENT103
Responsible Lecturer	Prof. Dr. Konstantinos Petridis, Dr. George Kakavelakis and Prof. Dr. George Kioseoglou
University	Hellenic Mediterranean University
Semester	1
Relation to curriculum	Mandatory course
Credit points (ECTS)	7.5
Teaching type	Lecture and exercises
Workload	lecture: 36 h tutorial: 12 h additional individual work of the student/homework time: 147 h total number of estimated working hours: 195 h
Course description	Graphene, a single layer of carbon atoms is a honeycomb lattice. Its single layer isolation in 2010 permitted its study and application thanks to wonderful mechanical, physical and optical properties demonstrate. Graphene triggers the evolution and the increasing research & industrial interest to other 2D materials (e.g. transition metal dichalcogenides – TMDs). In this module, an introduction to graphene-based materials and TMDs will be provided: from fabrication to the deposition techniques of these materials. Continuously selected applications in energy harvesting, in electronics and optoelectronics areas, will be presented.
Learning Outcomes	The students will: <ul style="list-style-type: none"> • be able to understand fundamental knowledge of graphene and 2D semiconductor materials. • receive an Introduction to Laboratory techniques of synthesis, deposition and characterisation of graphene & 2D materials – explain how to perform graphene material synthesis experiments. • be aware of graphene and 2D materials applications in energy harvesting, sensing and electronic.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • Scientific Publications (mainly review papers) in the topic • Graphene Fundamentals, Devices, and Applications by Serhii Shafraniuk

Course Title	Winter School – Introduction of Specialisation Tracks
Module ID	4EMINENT104
Responsible Lecturer	Prof. Dr. Konstantinos Petridis, Prof. Dr. Peter Haring Bolívar, Prof. Dr. Luis Pereira, Prof. Dr. Raphaël Canals, Prof. Dr. Sarunas Paulikas
University	Hellenic Mediterranean University
Semester	1
Relation to curriculum	Mandatory course
Credit points (ECTS)	3
Teaching type	Face to Face lectures
Workload	lecture: 26 h additional individual work of the student/homework time: 52 h total number of estimated working hours: 78 h
Course description	During this school, the academic coordinators of each partner university will give a deep introduction to the specialisation tracks that can be chosen in the third semester. These presentations will be accompanied by technological applications these specialization tracks involve. In the afternoon session a workshop in a critical soft and research skill will be organized for the students to practice it, working in groups. One full day will be dedicated to each specialisation track. In addition to the general introduction of the specialisation topic, invited speakers from within and beyond the consortium (within the academia and the market world) will give lectures on the respective topics.
Learning Outcomes	The students will: <ul style="list-style-type: none"> • understand the fundamentals and applications of the specialisation tracks can follow in the forthcoming semesters. • be able to present applications of the various tracks can follow in the forthcoming semester. • be able to demonstrate critical soft & research skills e.g. presentation skills, critical thinking, to collaborate, read a research paper, be able to build bibliographic research.
Assessment method	<ul style="list-style-type: none"> • Final exam paper • Students' Presentations
Literature	<ul style="list-style-type: none"> • The presentation slides of the presenters and the related supporting material

Course Title	Technology Exploitation
Module ID	4EMINENT105
Responsible Lecturer	Dr. Konstantinos Rogdakis and Dr. Lazaros Tzounis
University	Hellenic Mediterranean University
Semester	1
Relation to curriculum	Elective
Credit points (ECTS)	4.5
Teaching type	Lecture and exercises
Workload	lecture: 24 h tutorial: 12 h additional individual work of the student/homework time: 81 h total number of estimated working hours: 117 h
Course description	This module presents a series of strategic frameworks for management and exploitation of innovation and technology in business. The emphasis is on the development of entrepreneurial skills and strategic thinking in managing technologies. The module gives an overview of different market forces, patterns of technological changes, technology drivers, and the business structure and know-how capabilities. Throughout the module, the aim is to acquire a set of analytical tools that are critical for the development of an entrepreneurial technology strategy as an integral part of business strategy. These tools can provide the framework on how to manage technology and innovation, how to respond to market behaviour, competitors, suppliers, and customers. The module would be of particular interest to those interested in managing a business for which technology is likely to play a major role, and to those interested in consulting or venture capital.
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • use terminologies used in the business word. • read and compose a business plan. • communicate technological advances to non-experts. • understand factors that determine the technological advances.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • Scientific Publications (mainly review papers) in the topic

Course Title	Polymer Electronics
Module ID	4EMINENT106
Responsible Lecturer	Prof. Dr. Eletherios Kapetanakis
University	Hellenic Mediterranean University
Semester	1
Relation to curriculum	Elective
Credit points (ECTS)	4.5
Teaching type	Lecture and exercises
Workload	lecture: 24 h tutorial: 12 h additional individual work of the student/homework time: 81 h total number of estimated working hours: 117 h
Course description	Organic semiconductors are the key active components giving the name for the whole field of organic electronics. Typically organic materials (defined molecules or polymers) with delocalised p-system perform as such semiconductors. The p-conjugation and their supra-molecular arrangement determine the materials properties in terms of transport or interaction with external stimuli (e.g. light, pressure, magnetic field). The module will focus first on fundamentals of p-conjugated systems and related electrical and optical properties and methodology to tune HOMO and LUMO levels. The history of polymer metals will be discussed. Related to classical processing approaches, the class discusses polymers and small molecules separately. For both systems examples for structures, their synthesis, properties and applications will be presented, classified by the transport properties (p-type, n-type and ambipolar). As key element the thin film morphology (molecular order) and the principles of thin film formation will be discussed for pure materials, blended systems and covalently linked systems.
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • understand and explain the physical, chemical and electrical properties of organic semiconductors. • understand and explain the operation of organic based devices e.g. organic field effect transistors and organic light emitting devices.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • Polymer Electronics by Mark Geoghegan and George Hadziioannou, Oxford University Press

Course Title	Journal Club and Research Skills
Module ID	4EMINENT107
Responsible Lecturer	Prof.Dr. Konstantinos Petridis
University	Hellenic Mediterranean University
Semester	1
Relation to curriculum	Mandatory course
Credit points (ECTS)	7.5
Teaching type	Lecture and exercises
Workload	lecture: 30 h tutorial: 65 h additional individual work of the student/homework time: 100 h total number of estimated working hours:195 h
Course description	This is a soft skills course that is called to develop students' presentation, problem solving, leadership, and analytical skills whilst encouraging scientific debate and providing the opportunity to broaden scientific knowledge. At each meeting the students will work together and make a presentation about a recent research or a review high impact paper related to the EMINENT topics. In total 8-10 papers should be presented per team. This will be followed by a chaired discussion/debate about the paper. As a part of the course the leading academic should provide the students with tips regarding the following: (a) Introducing yourself, (b) Audience awareness, (c) Explaining a concept, (d) Audience Interaction, (e) Answering audience questions. The leading academic during this module should teach the participants about the research ethics (Belief and Knowledge, Plagiarism & Collusion and Absolute and Relative Truth).
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • use journal article search machines e.g. Scopus, Web of Science, Google Scholar. • read a scientific paper and mine information such as the motivation, the state of the art, the main results and conclusions of a published research work. • present a scientific work. • design the outline of scientific paper.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • Whitesides' Group: Writing a Paper, Advanced Materials, 25 th of August 2004 • How to write and publish a scientific paper by Robert A. Day

Course Title	Research Lab Course: Devices Processing Techniques and Characterisation Methods
Module ID	4EMINENT108
Responsible Lecturer	Dr. Konstantinos Rogdakis
University	Hellenic Mediterranean University
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	7.5
Teaching type	Lecture and exercises
Workload	lecture: 36 h tutorial: 12 h additional individual work of the student/homework time: 147 h total number of estimated working hours: 195 h
Course description	This module provides an introduction to modern processing techniques that research & industrial laboratories follow towards the fabrication of organic & perovskite semiconductor devices. It will cover the whole range of device fabrication processes, from raw materials to the market. Accordingly, among the proposed technologies only those applicable for large-scale manufacturing of organic semiconductor devices will be addressed
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • synthesise and characterise graphene, and perovskite thin films. • construct and characterise (electrical, optical and stability characterisation) graphene and perovskite based solar cells, gas sensing elements. • use roll-to-roll (R2R) and sheet-to-sheet (S2S) printing processes.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • Research Papers

Course Title	Energy Devices (Solar Cells and Batteries)
Module ID	4EMINENT109
Responsible Lecturer	Prof. Dr. E. Kymakis and Prof. Dr. D. Vernadou
University	Hellenic Mediterranean University
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	7.5
Teaching type	Lecture and exercises
Workload	lecture: 36 h tutorial: 12 h additional individual work of the student/homework time: 147 h total number of estimated working hours: 195 h
Course description	The management of energy production and storage is a key Energy Policy in Europe and a requirement for Energy Interventions in Existing Buildings as well as the automotive industry. New constructions must comply to low energy consumption by applying the latest research on materials and devices for Energy Harvesting, Saving and Storage. In addition, the generation of electricity should be contributing to prevent climate change. The main goal is the continuous effort to save Energy, reduce air pollution from internal combustion engines and sustainable development. The subject of this course is the presentation and evaluation of modern efficient technologies aimed at Energy Saving, Storage and Production, providing a variety of concepts.
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • understand and explain the operation of an energy harvesting device. • understand and explain the operational principles of energy storage devices. • fabricate the materials consist the various building blocks of an energy storage device. • fabricate and characterise energy storage devices (batteries and capacitors).
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • Research Papers (mainly Review papers)

Course Title	Nanomaterials for Energy
Module ID	4EMINENT110
Responsible Lecturer	Prof. Dr. Ioannis Remediakis
University	Hellenic Mediterranean University
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	7.5
Teaching type	Lecture and exercises
Workload	lecture: 36 h tutorial: 12 h additional individual work of the student/homework time: 147 h total number of estimated working hours: 195 h
Course description	Fundamental theoretical principles and experimental techniques in the study of surfaces and nanomaterials, with emphasis on energy and environmental applications (sensing). Nowadays, nanotechnology allows the synthesis and characterisation of systems in which the basic units have dimension of a few nanometres. Such systems are in use in electronics (processors), in the chemical industry (catalysts), in medicine (drugs), in optics (quantum dots) and of course in the field of renewable energy sources (photovoltaics).
Learning Outcomes	The students will become familiar with Nanophysics, Nanochemistry and Surface Science; understanding the basic differences between macroscopic and nanophysics and with the basic mechanisms that take place in solar cells, modern batteries and other system energy conversion. The desired learning outcomes are the introduction to Materials Science and specifically to materials extensively used for data storage, sensors, batteries, photovoltaics, along with an introduction to the fields of crystallography, chemical kinetics and physical solid state.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> Scientific Publications (Review papers)

Course Title	Skills and Ethics in Science
Module ID	4EMINENT111
Responsible Lecturer	Prof. Dr. Konstantinos Petridis
University	Hellenic Mediterranean University
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	7.5
Teaching type	Lecture and exercises
Workload	lecture: 36 h tutorial: 12 h additional individual work of the student/homework time: 147 h total number of estimated working hours: 195 h
Course description	Soft skills are a combination of people skills, social skills, communication skills, character or personality traits, attitudes, career attributes, social intelligence and emotional intelligence that enable people to navigate their environment, work well with others, perform well and achieve their goals with complementing hard skills. The Collins English Dictionary defines the term "soft skills" as "desirable qualities for certain forms of employment that do not depend on acquired knowledge: they include common sense, the ability to deal with people, and a positive flexible attitude. Research skills like Bibliographic research, Academic Writing, Poster Presentation, Promotion of your Research, Grant Writing, Interview Tips and Digital Skills are also important to be taught from the final undergraduate year of any discipline. Ethics in science include: a) standards of methods and process that address research design, procedures, data analysis, interpretation, and reporting; b) standards of topics and findings that address the use of human and animal subjects in research; and c) publication cheating.
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • provide an overview of the most wanted soft skills the labour market requires. • apply the presented soft & research skills in her daily academic and research life. • cope successfully in an interview process. • analyse a complex problem into smaller units. • present, negotiate and convince of her claims. • write, submit and evaluate her work. • communicate digitally and face to face communication. • come back from fall back. • adapt in any new professional or social environment.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • Scientific Publications • Handbook for Research Skill Development by the University of Adelaide (Australia) • The Ethics of Science: An Introduction by David B. Resnik

Course Title	Principles of Lasers
Module ID	4EMINENT112
Responsible Lecturer	Prof. Dr. Konstantinos Petridis and Prof. Dr. Nektarios Papadogiannis
University	Hellenic Mediterranean University
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	7.5
Teaching type	Lecture and exercises
Workload	lecture: 36 h tutorial: 12 h additional individual work of the student/homework time: 147 h total number of estimated working hours: 195 h
Course description	This module will present the fundamentals of laser devices. The module will start with the Einstein equations, provide the conditions to have lasing and the characteristics of this lasing radiation. An introduction to the generation of laser pulses will be provided with the introduction of the mode locking and Q-Switching techniques. Finally, the most common met laser systems in an undergraduate and postgraduate laboratories will be presented. Such systems are: diode lasers, He-Neon Lasers, Ti:Sapphire Lasers, Nd:YAG laser systems.
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • understand and explain the fundamental processes describing light-matter interactions. • understand and explain the operational principles of a stimulated emission device. • understand and explain the continuous and pulsed laser operation. • realise and understand the use of lasers towards the modification of electrical, physical and chemical properties of nanomaterials.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	Will be announced within the first lecture. <ul style="list-style-type: none"> • LASERS by Siegman • Principles of Lasers by Orazio Svelto

Course Title	Master Thesis
Module ID	4EMINENT001
Responsible Lecturer	All professors of the department
University	Hellenic Mediterranean University
Semester	4
Relation to curriculum	Mandatory
Credit points (ECTS)	30
Teaching type	Individual projects
Workload	independent work: 800 h
Course description	<p>For the work on the master's project, candidates will use the knowledge and skills received during the first 3 semesters of Master studies. During the master's project, candidates need the following key qualifications:</p> <ul style="list-style-type: none"> • Most assignments involve extensive system development work; the related planning/organizational skills are required. • The ability to use literature resources and other sources to collect and structure material on the given topic. • The ability to read and understand demanding original English professional literature. • The ability to draft a lecture on a non-trivial scientific topic in front of a specialist audience (i.e. also to design it didactically correctly) and to present it using standard media. • The ability to write texts of approx. 60-120 pages, usually to explain the corresponding scientific content.
Learning Outcomes	The candidate will independently work on a problem in her or his field of study using scientific methods within a specified period of time.
Assessment method	The Master's thesis is evaluated by the supervisors. Evaluation is based on the complexity of the project, quality of the technical report, value of the research, created applications and models, presentation and defence of the thesis.
Literature	The literature is specified individually according to a specific problematic task.

2. University of Siegen

Course Title	Optoelectronics
Module ID	4ETMA203
Responsible Lecturer	Prof. Dr. Peter Haring Bolívar
University	University of Siegen
Semester	2
Relation to curriculum	Mandatory course
Credit points (ECTS)	6
Teaching type	Lecture and exercises
Workload	lecture: 30 h exercises: 30 h additional individual work of the student/homework time: 120 h total number of estimated working hours:180 h
Course description	<p>Content ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ul style="list-style-type: none"> • Introduction, Literature (K,U) • Principles: understanding light-matter interaction, comparing quantum mechanical descriptions to classical mechanics (K,U) • Optical absorption: classifying optical absorption processes, describing transition rates (K,U) • Optical emission: classifying optical emission processes, describing transition rates (K,U) • Principles semiconductor lasers (K,U) • Modes in semiconductor lasers (K,U) • Electro-optic modulators in bulk (K,U) • Optical modulators (K,U) • Principles of photoconductivity (K,U) • Photodiodes (K,U) • Nonlinear optics (K,U) • Photonic switching and computing (K,U) • Optical storage (K,U) • Optoelectronics in communication technology (K,U) <p>Methods ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ul style="list-style-type: none"> • Describing optoelectronic processes in semiconductor devices (AP, AN) • Modelling active photonic components (AP, AN) <p>Evaluation ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ul style="list-style-type: none"> • Understanding the function of optical components and their intrinsic limitations (AN,E) • Having a general view of the modern challenges in optoelectronics and being able to assess them (AN,E).
Learning Outcomes	The Module "Optoelectronics" provides a detailed insight into the functionality of optical components, enabling the ability to assess, model and realize devices and systems. Theoretic concepts are illustrated by application-relevant examples, providing a deeper understanding of the subject and the skillset to survey and comprehend current challenges in optoelectronics
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	<p>Will be announced within the first lecture.</p> <ul style="list-style-type: none"> • K.J. Ebeling, Integrated Optoelectronics, Springer Verlag, 1993. • B.E.A. Saleh, M.C. Teich: Fundamentals of Photonics. John Wiley and Sons, Berlin, New York (USA), 1991.

Course Title	Semiconductor Electronics
Module ID	4ETMA301
Responsible Lecturer	Prof. Dr. Peter Haring Bolívar
University	University of Siegen
Semester	2
Relation to curriculum	Mandatory course
Credit points (ECTS)	6
Teaching type	Lecture, exercises and laboratory practice
Workload	lecture: 30 h exercises: 15 h laboratory practice 15 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>This is an advanced course in Solid-State Physics that introduces students to the models and principles which determine the fundamental operation of semiconductors, and on the ways to modify and control the electronic conduction within advanced semiconductor materials, nanostructures and devices.</p> <p>Content ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ol style="list-style-type: none"> 1. Solid-State Semiconductor Physics: Wave-Particle Duality (K, U) <ul style="list-style-type: none"> • Schrödinger-Equation • Kronig/Penney Model • Derivation of Energy Bands in Solids 2. Charge Carrier Concentration: Thermal Equilibrium (K, U) <ul style="list-style-type: none"> • Density of States • Fermi-statistics 3. Intrinsic Conduction and Doping in Semiconductors: Thermal Equilibrium (K, U) <ul style="list-style-type: none"> • Fermi-energy • Volume potential 4. The Semiconductor at Non-Equilibrium (K, U) <ul style="list-style-type: none"> • Fundamental Semiconductor Equations • Continuity (Generation/Recombination) • Poisson Equation • Diffusion- and Field-induced Currents • Quasi-Fermi Energy 5. pn-junction at low-currents (K, U) <ul style="list-style-type: none"> • Shockley Assumptions • Derivation: IV-Characteristics • Break-down Voltage • Shockley/Read/Hall-Recombination Theory (SRH) 6. MOSFET&JFET(K, U) <ul style="list-style-type: none"> • IV-Characteristics • MOS capacitors • Theory of MOSFET transistors • Simulation models <p>Methods ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ul style="list-style-type: none"> • Calculation, Development and Optimisation of Modern Semiconductor Devices Based on Lecture-mediated Knowledge (U, AP, AN) • Semiconductor Measurement and Characterisation Techniques (AP, AN)
Learning Outcomes	<ul style="list-style-type: none"> • In Semiconductor Electronics, elementary physical processes in semiconductor materials are discussed and important device characteristics are derived. The exercises comprise application specific device calculations that validate and support the device theory gained in the lectures.

	<ul style="list-style-type: none"> • In the laboratory, students can transfer theoretical assumptions to practical measurements of different semiconductor materials and devices. Moreover, students learn how to present their measurement results in an adequate, scientific manner.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	<ul style="list-style-type: none"> • Simon Min Sze; Physics of Semiconductor Devices; Third Edition; John Wiley & Sons, New York; 2006; ISBN-10: 0-471-14323-5. • Michael Shur; Physics of semiconductor devices; Prentice Hall, Englewood Cliffs, New Jersey; 1990 mit Übungsaufgaben. • Juin J. Liou; Advanced semiconductor device physics and modeling; Artech House, Boston; 1994 mit Übungsaufgaben; ISBN 0890066965. • Edward H. Nicollian, John R. Brews; MOS (Metal Oxide Semiconductor) Physics and Technology; John Wiley & Sons, New York; 1982; ISBN 0471085006. • David J. Griffiths, Introduction to Electrodynamics; Third Edition; Prentice Hall, Englewood Cliffs, New Jersey; 1998; ISBN 0-13-805326-X. • Richard H. Bube; Electrons in Solids; An Introductory Survey; Third Edition; Academic Press, San Diego; 1992; nicht lieferbar. • Andrew S. Grove, Physics and Technology of Semiconductor Devices; John Wiley & Sons, New York, 1967; ISBN 0-471-32998-3. • Albrecht Möschwitzer, Klaus Lunze; Halbleiterelektronik; Lehrbuch; 8. Auflage; Hüthig-Verlag, Heidelberg 1988.

Course Title	Introduction to Embedded Systems
Module ID	4INFBA022/2
Responsible Lecturer	Prof. Dr. Roman Obermaisser
University	University of Siegen
Semester	2
Relation to curriculum	Mandatory course
Credit points (ECTS)	6
Teaching type	Lecture and exercises
Workload	lecture: 30 h exercises: 30 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>The variety and number of embedded systems have grown significantly during the last years. This segment has become by far the most important one in the computer market with applications such as consumer electronics, industrial control and transportation systems. Transportation systems such as automotive electronics are of particular interest, because of stringent timing and dependability requirements that act as technology catalysts. The embedded system market is expected to grow significantly during the next decade and it is expected that many embedded systems will be connected to the Internet and form cyber physical systems.</p> <p>This module includes system aspects of distributed embedded real-time systems, central requirements (e.g., determinism, reliability, composability) and methods for supporting them.</p> <p>Coping with contradicting system requirements (e.g., flexibility vs. composability, open system vs. temporal guarantees) and competence for using the most appropriate design principles and methods. Information about new developments (IoT) and basic knowledge.</p> <p>Theoretical knowledge is complemented by case studies and system architectures from different domains (e.g., automotive, avionics). Lab offers practical experience (e.g., programming of embedded systems with microcontrollers, scheduling, timing analysis).</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Context and requirements of embedded real-time systems • Modelling of embedded real-time systems • Global time and temporal relations • Reliability • Real-time communication • Real-time operating systems • Real-time Scheduling • Interaction with the environment • Design of embedded systems • Validation • Internet of things • Examples of system architectures
Learning Outcomes	<p>The students:</p> <ul style="list-style-type: none"> • learn about different paradigms and design principles for embedded systems. • can describe requirements, paradigms, concepts, platforms and models of embedded systems. • can explain nonfunctional requirements of embedded systems. • can describe and apply concepts and methods for real time and fault tolerance. • will become familiar with different components and design principles to apply them in concrete problem scenarios.

	<ul style="list-style-type: none"> • can evaluate different development approaches (e.g., time-triggered, and event-triggered control) und map them to application scenarios. • can evaluate platform technologies such as communication protocols, processors and operating systems with respect to their suitability for real-time, safety and reliability requirements.
Assessment method	<ul style="list-style-type: none"> • Preliminary examination performance (course work): exercises • Written exam (2 hours) – 100% of the grade. <p>Credit points are awarded when the preliminary examination performance and the final examination are passed</p>
Literature	<ul style="list-style-type: none"> • E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, LeeSeshia.org, 2011. • Peter Marwedel. Embedded System Design, Embedded Systems Foundations of Cyber-Physical Systems. 2nd Edition. 2011. • L. Gomes, J.M. Fernandes. Behavioral Modeling for Embedded Systems and Technologies: Applications for Design and Implementation. Information Science Reference. 2009. • P.J. Mosterman. Model-Based Design for Embedded Systems. CRC Press. 2010.

Course Title	Microelectronics for EMINENT
Module ID	4EMINENT204
Responsible Lecturer	Prof. Dr. Peter Haring Bolívar
University	University of Siegen
Semester	2
Relation to curriculum	Mandatory course
Credit points (ECTS)	3
Teaching type	Lecture, exercises and laboratory practice
Workload	lecture: 30 h exercises: 15 h laboratory practice: 15 h additional individual work of the student/homework time: 30 h total number of estimated working hours: 90 h
Course description	<p>In Microelectronics the students gain fundamental and advanced knowledge in the fields of the most relevant microelectronic devices such as diodes and transistors, and giving insight into their electronic behaviour, circuit integration principles and technological fabrication processes.</p> <p>Content ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ol style="list-style-type: none"> 1. Fundamental transistor parameters and behaviour (K, U) <ul style="list-style-type: none"> • Input-/Output-/Transfer Characteristics • Introduction to BJT, MESFET, HEMT • h-Parameter • S-Parameter 2. Transistor Building-Blocks (K, U) <ul style="list-style-type: none"> • Current-/Voltage Sources (circuits and applications) • Current Mirror (circuits and applications) 3. Darlington and Cascode Amplifier Circuits (K, U) 4. Differential Amplifiers (K, U) <ul style="list-style-type: none"> • Benchmarking (Common-Mode Rejection Ratio, Bandwidth, Gain-bandwidth product, Input-/Output Resistance/Capacitance, Voltage-/Current Gain...) (K, U) • Emitter-coupled Differential Amplifier • Base-coupled Differential Amplifier 5. Power Amplifiers (K, U) 6. Operational Amplifier (K, U) <ul style="list-style-type: none"> • Circuit (K, U, AP, AN) • Technology and Fabrication (K, U, AN) • Applications (K, U, AP) <p>Methods ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ul style="list-style-type: none"> • Measuring, Analysing, and Extracting of Transistor- and Circuit- Key Figures of Merit (FOM) (AP, AN) • Developing, Building and Characterising Operational Amplifier Circuits (AP, AN) <p>Evaluation ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ul style="list-style-type: none"> • Detailed Analysis of Different Transistor Types and Technologies (AN, E) • Analysing, Extracting and Calculating Characteristic FOM of Operational Amplifiers and Operational-Amplifier-based Circuits (AN, E) • Optimising Transistors and Circuits with respect to a specific parameter (AN, E) • State-of-the-Art Transistor Technologies (U, AN, E)

Learning Outcomes	<ul style="list-style-type: none"> • The students learn how integrated circuits are assembled and passive components can be integrated on a microchip. • The students learn how transistor-based building blocks can be combined to realise complex circuits. Using the example of an operational amplifier circuit, students learn how it works and how it can be designed, optimised and fabricated technologically. Transistor and operational amplifier benchmarks are presented and will be measured, analysed and evaluated in the laboratory. The lecture qualifies the students to develop and design integrated and discrete circuits for a wide variety of applications.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	<ul style="list-style-type: none"> • E. Böhmer; Elemente der angewandten Elektronik; Vieweg Verlag. • U. Tietze, C. Schenk, E. Gamm, Halbleiter-Schaltungstechnik, Springer Vieweg, 2019.

Course Title	Summer School – Preparation for the specialisation tracks
Module ID	4EMINENT205
Responsible Lecturer	Prof. Dr. Haring Bolívar, Prof. Dr. Konstantinos Petridis, Prof. Dr. Luis Pereira, Prof. Dr. Raphaël Canals, Prof. Dr. Sarunas Paulikas
University	University of Siegen
Semester	2
Relation to curriculum	Mandatory course
Credit points (ECTS)	3
Teaching type	Face-to-face lectures
Workload	lecture: 40 h additional individual work of the student/homework time: 50 h total number of estimated working hours: 90 h
Course description	The scope of the summer school is to facilitate students' transition from the 2nd to the 3rd semester. In preparation to the school, each student will develop an individual research statement which summarises their individual perception of current challenges and the potential of their planned field of specialisation in general, and what they individually intend to contribute to the field. The school will provide general keynote lectures and general methodological training (scientific work, ethics) in morning sessions. During afternoon sessions, students will be separated in five groups according to their chosen specialisation. Each group will receive topical lessons by representatives of the universities offering the respective specialisation track, in order to homogenise the individual knowledge base of each student and provide fundamental methodological expertise. Guest lecturers from industry will be invited to give lectures in order to provide hands-on experience of challenges and expectations in the field. In addition, fourth-semester students from each specialisation track will be invited to the school to present their master's projects to their peers and to the new student generation.
Learning Outcomes	The students will: <ul style="list-style-type: none"> • have a deep understanding of the underlying theoretical and experimental challenges of their specialisation track. • understand and be able to apply fundamental methodologies of the specialisation field. • be able to contextualise and discuss current developments in the field of their specialisation track. • be able to analyse future trends and demands in academic and industrial research & development in the field of their specialisation track. • be able to write an analytic statement of a research field. • understand the expectations and perspective of a master thesis, and gain overview of potential master thesis topics, also in conjunction with industrial partners.
Assessment method	Oral Examination (2/3) and individual assessment of the individual research field summary (1/3)
Literature	Will be announced.

Course Title	Advanced Semiconductor and Microelectronics
Module ID	4ETMA352
Responsible Lecturer	Prof. Dr. Bhaskar Choubey
University	University of Siegen
Semester	2
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Laboratory practice
Workload	laboratory practice: 60 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>The “Advanced Semiconductor and Microelectronics (ASME)” course deals with various current developments on the field of microelectronics. It is intended to be specially addressing issues that are not covered in the “Semiconductor Electronics and Analog Circuits” course. The ASME course is divided into two areas:</p> <ul style="list-style-type: none"> • laboratory practice with accompanying preparation and • follow-up work or lectures with accompanying seminars and exercises. <p>The content of the lecture ASM is not fixed, but changes with each new lecture in order to reflect the most actual developments in the field. Possible topics are e.g. advanced CMOS design with FinFETs, simulation models, integrated optical and power devices, memristors, sensors, neuromorphic circuits, advanced integrated sensors.</p>
Learning Outcomes	<ul style="list-style-type: none"> • Students analyse microelectronics and semiconductor systems at a research-level. This can contain advanced CMOS design with FinFETs, simulation models, integrated optics and power devices, memristors, sensors, neuromorphic circuits and data converters. • The students learn how to use the simulation software in advance. • They will also take on the preparation and delivery of a presentation following the coursework. The course gives them experience in professional teamwork, knowledge transfer, impact, presentation skills and problem-solving. • The students will also acquire an advanced understanding of analog CMOS design. Knowledge and skills will enable the students to obtain advanced positions in industry and research institutions.
Assessment method	<ul style="list-style-type: none"> • Preliminary examination perform (coursework): laboratory practice • Examination: presentation (30 minutes) – 100% of the grade
Literature	<p>Will be announced.</p> <p>Notes provided in the course.</p>

Course Title	Physics of nanoelectronic devices
Module ID	4NANOMA3
Responsible Lecturer	Jun. Prof. Dr. Peter Modregger
University	University of Siegen
Semester	2
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture and exercises
Workload	lecture: 30 h exercises: 30 h additional individual work of the student/homework time: 120 h total number of estimated working hours:180 h
Course description	The course provides a detailed physics-oriented introduction into the fundamental working principles and advantages of nanoscale technologies: <ul style="list-style-type: none"> • crystal structure of solids, • elastic properties, • phonons, • electronic band structure of solids, • band structure of direct and indirect semiconductors, • pn-junction, • electronic devices as MOSFETs, • solid state magnetism and magnetic devices, • electronic band structure on the nanoscale, • application in nano electronics.
Learning Outcomes	The students will: <ul style="list-style-type: none"> • know the concepts and methods of solid-state physics and nanophysics. • be able to understand concepts and operation of nanoelectronic devices. • be able to think in terms of abstract concepts, recognition of complex problems, application of advanced knowledge and skills in inter- and trans-disciplinary discussion of complex issues, debating and discussing in English.
Assessment method	Preliminary examination performance (course work): successful processing of exercises is prerequisite for the final examination. Final written exam (100% of the grade) – or oral examination (100% of the grade)
Literature	<ul style="list-style-type: none"> • Kittel, Solid State Physics, Simon M. Sze, Physics of Semiconductor Devices, 3rd ed., Wiley-Interscience.

Course Title	Synthetic Aperture Radar
Module ID	4ETMA251
Responsible Lecturer	Prof. Dr. I. Ihrke
University	University of Siegen
Semester	2
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture and exercises
Workload	lecture: 30 h exercises: 30 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>Imaging radar techniques have established themselves in recent years as an indispensable imaging technique in remote sensing of the Earth, especially in the field of environmental observation.</p> <p>The lecture explains the effects and principles that lead to obtaining a high-resolution image with radar waves.</p> <p>These include: The electromagnetic wave and its propagation in free space, radiation via antennas, radar equation, backscatter properties, description of the acquisition geometry, etc.</p> <p>Additional content:</p> <ul style="list-style-type: none"> • Basics of radar signal processing, • Structure of a radar sensor, • Doppler effect, • Scanning and ambiguities, • Description and properties of different transmit waveforms, • Application of optimal filters for pulse compression, • Multi-dimensional location-variant signal processing (processors) for focusing SAR data, • Complexity of bistatic SAR signal processing with respect to geometric modeling and synchronisation, • Image analysis and 3D reconstruction. <p>The lecture is accompanied by programming work.</p>
Learning Outcomes	<ul style="list-style-type: none"> • Students learn how to use the principle of synthetic aperture to improve the geometric resolving power of a sensor and thus how to use radar sensors for image acquisition. To this end, the fundamentals of radar signal processing are first taught and then the special properties of this method are discussed. The influences of waveform, wavelength, antenna, acquisition geometry and the properties of the scene on the acquired radar image are presented and explained to the students. • Students apply the learned knowledge by means of simulations and processing of real.
Assessment method	Final oral exam (20-40min) – 100% of the grade
Literature	<ul style="list-style-type: none"> • Habilitationsschrift: Alberto Moreira: „Radar mit synthetischer Apertur. Grundlagen und Signalverarbeitung“. • Christopher Oliver „Understanding Synthetic Aperture Radar Images“. • Skolnik, Merrill, I.: „Introduction to Radar Systems“. • Ulaby, Fawwaz: „Microwave Radar and Radiometric Remote Sensing“. • Charles V. J. Jakowatz: „Spotlight-Mode Synthetic Aperture Radar: A Signal Processing Approach“.

Course Title	Professional Design Experience Project (PEP)
Module ID	4EMINENT209
Responsible Lecturer	Prof. Dr.-Ing Peter Haring Bolívar
University	University of Siegen
Semester	2
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture/workshops and small group tutorials
Workload	total number of estimated working hours: 180 h Details are given in the course description below.
Course description	<p>The core principle behind the PEP-projects as a learning experience is for the student to undertake a design and development practice, reflect on it and then critically analyse this experience.</p> <p>Lecture/workshops and small group tutorials will be provided at key points of the process in order to support the individual experiences of the students and provide time for developing reflection and analysis. These sessions will introduce and support students' work on their assessed reports and presentation. The structure of the programme includes (with information on the average time effort, taking into account 1 ECTS as a 30h total effort):</p> <ul style="list-style-type: none"> • General introductory lectures (3 x 2 hours (+1 self-work) = 9 h) teaching weeks 1,2,3 on general programme presentation, SCRUM methodology, and writing skills and tools training, • Coaching with host group/industrial external partner (7 x 2 hours (+1 preparation) = 21 h) every 2nd week to continually assess, discuss and reflect the project goals, approach and progress, • PEP: Self-study/group work/placement 100 hours by arrangement over the semester between the student and coaching group., • PEP-Project presentation preparation and written summary of the project (30 h), • PEP-Seminar and Final Project Presentation (5 x 2 hours (+2 preparation) = 20 h) teaching weeks 12-14 ensuring cross-fertilisation between all groups and overall presentation of the developments to external and project partners.
Learning Outcomes	<p>The students are able to familiarise themselves with an engineering-related problem in a defined period of time and to work out a solution with the given tools, as well as to use the knowledge they have already acquired from their studies. A special aspect here is that the students working in small teams can freely choose from a range of industry- and application-inspired problems according to their inclination and focus of study. The teams are individually coached by experts from all groups and external industrial partners involved in the programme following modern SCRUM development methodologies.</p> <p>The students get introduced in real-world development practises. Students acquire the ability to coordinate teamwork, conceive and achieve realistic development targets, apply theoretical knowledge to practical use and structure complex development tasks. Furthermore, they are able to learn to assess and make use of globally available knowledge for their specific development task and skills in interdisciplinary and international teamwork across Europe.</p>
Assessment method	Written report and final presentation of the developed project (1 hour) – 100% of the grade
Literature	<p>Will be announced within the first lecture.</p> <ul style="list-style-type: none"> • B.E.A. Saleh, M.C. Teich: Fundamentals of Photonics. John Wiley and Sons, Berlin, New York (USA), 1991.

Course Title	StartUp Entrepreneurship
Module ID	4INFMA103
Responsible Lecturer	Prof. Dr. Roman Obermaisser, Prof. Dr. Kristof Van Laerhoven
University	University of Siegen
Semester	2
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture and exercises
Workload	lecture: 30 h exercises: 30 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>This course is intended for all students who have ever thought about starting their own company or actually plan to do so.</p> <p>Also, students with an idea who already or not yet know how to market their product will find this course very useful. It will be shown how easy it is to start a business nowadays. The university gives founders the support they need. Within the framework of a cross-faculty university-wide association of institutions, interested students are provided with simple tools for a business start-up. These include working out a business plan, preparing pitches and how to get funding and support before, during and after the startup.</p> <p>Students learn exciting stories of founders and start-ups around the university and if they are further interested after the course, they can apply for the incubator program "One Small Step". Here they can set the course for their career as a company founder.</p> <p>The topics of the course are:</p> <ul style="list-style-type: none"> • Business Idea/Innovation, • Business Model/Team, • Market and Competitor Analysis, • Start-up Ecosystem in Siegen, • Financing Options/The Proposal, • Prototyping/Incubator, • IP/forms of enterprise/corporate law, • The perfect pitch.
Learning Outcomes	<p>The students:</p> <ul style="list-style-type: none"> • learn skills, analysis techniques and presentation to start up a business. • Know how to Successfully edit and create: <ul style="list-style-type: none"> - Business Model Canvas, - Business plan, - Business pitches.
Assessment method	Seminar presentation (30 min, 50%) with written term paper (5000 words, 50%)
Literature	Will be announced.

Course Title	Digital 2D/3D Image Sensing
Module ID	4ETMA356
Responsible Lecturer	Prof. Dr. P. Haring Bolívar
University	University of Siegen
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	6
Teaching type	Seminar, laboratory practice
Workload	seminar: 30 h laboratory practice: 30 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>The seminar "Digital 2D/3D Imaging" addresses the conception and production methods of modern micro-systems for two- and three-dimensional image acquisition. The components of this type of "All-Solid-State" camera system are presented and the influences of the individual components on system performance are derived. Such a camera micro system is the combination of sensor technology, illumination, optics and signal processing. Current Examples and Application will be presented.</p> <p>Content ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ol style="list-style-type: none"> 1. Machine Vision (K, U) <ul style="list-style-type: none"> • Industrial image processing • Image Formation 2. Digital Imaging (K, U) <ul style="list-style-type: none"> • Signal processing • Digital images: discretisation, digitisation, digital descriptions, storing 3. Solid-State Image Sensing (K, U) <ul style="list-style-type: none"> • CCD • CMOS APS 4. 3D – Imaging (K, U) <ul style="list-style-type: none"> • Introduction • Triangulation • Interferometry • Time-Of-Flight (ToF) • PMD – functional principle 5. 3D – Cameras (K, U) <ul style="list-style-type: none"> • Introduction • Range resolution • Device optimisation 6. Fields of application (K, U) <p>Methods ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ul style="list-style-type: none"> • Calculation and determination of resolution/resolution limits (AP, AN) • Calculation and determination of distance information (AP, AN) <p>Evaluation ("K" Knowledge; "U" Understanding; "AP" Applying; "AN" Analysing; "E" Evaluation):</p> <ul style="list-style-type: none"> • Detailed understanding of the approaches and procedures of 2D and 3D imaging (AN, E) • Knowledge of the functionality of essential imaging techniques (AN, E) General view on modern challenges of 2D/3D imaging (AN, E)
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • learn how to capture and process a 2D and 3D image. • understand how an image acquisition system operates.

Assessment method	<ul style="list-style-type: none"> • Preliminary examination performance (course work): laboratory practice • Final oral exam (20 – 40 minutes) – 100% of the grade
Literature	<ul style="list-style-type: none"> • Bernd Buxbaum: Optical time-of-flight distance measurement and CDMA based on PMD technology mittels phasenvariabler PN-Modulation. Shaker Verlag, Aachen 2002, ISBN 978-3-8265-9805-0. • Wei Tai: Investigations of 3D-PMD cameras with special regard to optical optimisation. Shaker Verlag, Aachen 2001, ISBN 978-3-8265-8789-4.

Course Title	Research Lab Course: Nanoscience and Nanotechnology for EMINENT
Module ID	4EMINENT212
Responsible Lecturer	Prof. Dr. Peter Haring Bolivar
University	University of Siegen
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	6
Teaching type	Laboratory practice
Workload	work laboratory: 90 h seminar: 30 h individual work of the student/homework: 60 h total number of estimated working hours: 180 h
Course description	Literature search, elaboration of measurement/synthesis/technological strategies, involvement in current research topics, lab reports and critical evaluation of results.
Learning Outcomes	Students apply scientific strategies of the chosen research topic. Students are able to design and perform experiments based on literature search on their own.
Assessment method	Graded Report and Presentation (100 %)
Literature	Relevant literature will be distributed in the course.

Course Title	Deep Learning
Module ID	4INFMA204
Responsible Lecturer	Prof. Michael Möller
University	University of Siegen
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture and exercise
Workload	lecture: 30 h exercises: 30 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>This module will give an introduction to deep learning, describe common building blocks in the network architectures, introduce optimisation algorithms for their training, and discuss strategies that improve the generalisation.</p> <ul style="list-style-type: none"> • Supervised machine learning as an interpolation problem • Fully connected layers, rectified linear units, sigmoids, softmax • Gradient descent for nested functions: Chain rule and backpropagation • SGD on large data sets, acceleration via momentum and ADAM • Capacity, overfitting and underfitting • Training, testing, and validation data sets • Improving generalisation: data augmentation, dropout, early stopping • Working with images: Convolutions and pooling layers. Computing derivatives and adjoint linear operators • Training: Data preprocessing, weight initialisation schemes, batch normalisation • Applications and state-of-the-art architectures for image classification, segmentation, and denoising • Architecture designs: Encoder-decoder idea, unrolled algorithms, skip connections + residual learning, recurrent neural networks • Hands-on practical experience by implementing gradient descent on a fully connected network in NumPy. Introduction to PyTorch for training complex models on GPUs
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • understand the basic concepts of deep learning. • be able to analyse the chain rule for nested functions with several variables and implement the gradient descent algorithm for simple networks from scratch. • be familiarised with a deep learning framework and can implement architectures for regression and classification problems on their own. • be familiarised with different design patterns for the architecture of neural networks and can explain crucial steps for the successful training and generalisation of neural networks.
Assessment method	<ul style="list-style-type: none"> • Preliminary examination performance (course work): Reaching 50% of the points on the exercises/homework is mandatory for being admitted to the written exam. • Final written exam (1,5 hours) – 100% of the grade. <p>Credit points are awarded when the preliminary examination performance and the final examination are passed.</p>
Literature	<ul style="list-style-type: none"> • "Deep Learning" by Ian Goodfellow, Yoshua Bengio and Aaron Courville (available at http://www.deeplearningbook.org/). • Introduction to Python, e.g. at https://github.com/jrjohansson/scientific-python-lectures. • Coursera course "Machine Learning" by Andrew Ng.

Course Title	Microelectronic Sensors
Module ID	4ETMA350
Responsible Lecturer	Prof. Dr. Bhaskar Choubey
University	University of Siegen
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture, exercises, and laboratory practice
Workload	lecture: 30 h exercises: 15 h laboratory practice: 15 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>The course is dedicated to the integration of physical sensors with microelectronic circuits. At first, the students will understand the concepts of physical measurements as well as various sources of error. They will be able to analyse and distinguish different types of sensors for the same physical phenomenon. They will also learn advanced circuit concepts for interfacing with these sensors. Finally, they will analyse advanced concepts of at least two different sensor systems. The first area will be optical sensors, specifically CMOS image sensors and their various circuits and applications. The second one is microelectromechanical sensors, including concepts of mechanical and chemical sensing and their integration into microelectronic circuits.</p> <ul style="list-style-type: none"> • Physical quantities and their measurement • Measurement errors and concepts of sensitivity/accuracy/resolution/accuracy/bias/random error/calibration standards/interference/noise • Optical sensors – CCD and CMOS image sensors • Microelectromechanical sensors – types, manufacturing processes, simulation and design, check • Sensor interface circuits and their physical implementations
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • be able to analyse and distinguish different types of sensors for the same physical phenomenon. • learn advanced circuit concepts for interfacing with these sensors. • analyse advanced concepts of at least two different sensor systems.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	<p>Will be announced within the first lecture.</p> <ul style="list-style-type: none"> • Böhm, M.: Microelectronics; Script.

Course Title	Embedded Control
Module ID	4INFBA100
Responsible Lecturer	Prof. Dr. Roman Obermaisser
University	University of Siegen
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture and exercise
Workload	lecture: 30 h exercises: 30 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>The purposes of the course are to become acquainted with application fields of embedded control systems, understand models and working methods to develop embedded control systems and comprehend the interplay of software and hardware with the physical environment.</p> <p>Syllabus:</p> <ol style="list-style-type: none"> 1. Modelling and Mathematical Descriptions of Dynamic Systems <ul style="list-style-type: none"> • Discrete Dynamics • Hybrid Systems • Composition of State Machines • Concurrent Models of Computation 2. Design of Embedded Control Systems <ul style="list-style-type: none"> • Embedded Processors • Memory Architectures • Input and Output • Multitasking • Scheduling 3. Analysis and Verification <ul style="list-style-type: none"> • Invariants and Temporal Logic • Equivalence, Refinement, Simulations • Reachability Analysis and Model Checking • Quantitative Analysis 4. State-of-the-Art Tools for Embedded Controller Development <ul style="list-style-type: none"> • Scilab/Xcos
Learning Outcomes	<p>The students:</p> <ul style="list-style-type: none"> • become acquainted with application fields of embedded control systems. • understand working methods to develop embedded control systems. • understand models of embedded control systems and comprehend the interplay of software and hardware with the physical environment. • work with state-of-the-art development tools (e.g., Scilab/Xcos). • gain knowledge and understand the functionality of these development tools. • perform a practical experiment in the lab.
Assessment method	<ul style="list-style-type: none"> • Preliminary examination performance (course work): successful processing of exercises is prerequisite for the final examination. • Final written exam (2 hours) – 100% of the grade. <p>Credit points are awarded when the preliminary examination performance and the final examination are passed</p>
Literature	<ul style="list-style-type: none"> • E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, LeeSeshia.org, 2011. • Peter Marwedel. Embedded System Design, Embedded Systems Foundations of Cyber-Physical Systems. 2nd Edition. 2011. • L. Gomes, J.M. Fernandes. Behavioral Modeling for Embedded Systems and Technologies: Applications for Design and Implementation. Information Science Reference. 2009.

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| | <ul style="list-style-type: none">• P.J. Mosterman. Model-Based Design for Embedded Systems. CRC Press. 2010. |
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Course Title	Nanotechnology
Module ID	4ETMA358
Responsible Lecturer	Prof. Dr.-Ing. Peter Haring Bolívar
University	University of Siegen
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Laboratory practice
Workload	lecture: 30 h exercise: 15 h laboratory practice: 15 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>Nanotechnology is an advanced course on the technological, physical and chemical methods used in modern semiconductor nanoelectronics fabrication. This subject will bring the students more towards the development of chips, will bring out the detailed analysis how actual fabrication works and what all processes and methods are involved in the development of a chip design from scratch. Along with theoretical teaching of each such aspect, students will have the opportunity to perform laboratory sessions, where students will explore and work in the environment of clean room. Development of nano level, fabrication of FET devices and careful measurement and characterisation of fabricated devices are some of the domains, students will work on. The theoretical teaching will include complete study of modern processes with all necessary understanding of the advanced fabrication processes.</p> <p>Detailed laboratory in clean room to get practical experience on the technological, physical and chemical methods for the production of semiconductor-based, nanoelectronic components. The experiments concentrate on a series (10) 3-4 h experimental lab work. At the end a fully functional device is fabricated. Outcome device varies and is e.g., an amorphous Silicon thin film solar cell, or a graphene-based field-effect transistor.</p>
Learning Outcomes	<p>The students are able to:</p> <ul style="list-style-type: none"> • describe technological processes for the production of nano and microelectronic components and circuits. • compare them with alternative production methods. • realise specific component performance parameters with the help of learned knowledge about unique and targeted selection of technological processes. • classify advantages and disadvantages of technological processes such as • combine manufacturing processes, thus to develop complicated process chains for functional components and circuits (e.g., for transistors, solar cells, optoelectronic components ...)
Assessment method	<ul style="list-style-type: none"> • Preliminary examination performance (course work): successful processing of Lab Reports is prerequisite for the final examination. • Final written exam (2 hours) – 100% of the grade. <p>Credit points are awarded when the preliminary examination performance and the final examination are passed.</p>
Literature	<ul style="list-style-type: none"> • Plummer, Deal and Griffin, Silicon VLSI Technology: Fundamentals, Practice and Modeling. • Simon M. Sze, VLSI Technology, McGraw-Hill. • Hilleringmann, Silizium-Halbleitertechnologie: Grundlagen mikroelektronischer Integrationstechnik, Vieweg + Teubner. • Widmann, Mader, Technologie hochintegrierter Schaltung, Springer Verlag. • Madou, Marc: Fundamentals of Microfabrication. • Sze, Simon M.: Physics of Semiconductor Devices.

Course Title	Practical Course Communications Technology
Module ID	4ETMA206
Responsible Lecturer	Prof. Dr. C. Ruland
University	University of Siegen
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Laboratory practice
Workload	laboratory practice: 60 h individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	This is an additional lab module providing a hands-on practical training in diverse areas of telecommunications, in laboratories at different institutes, in order to provide a broad overview of photonic, wireless and coding technologies and using advanced methods for characterising telecommunication components and systems of communication technology.
Learning Outcomes	<ul style="list-style-type: none"> • Practical understanding of components of Communication Technology • Basic practical experience with modern communication systems • Experience with various measurement techniques of communication technology
Assessment method	Laboratory practical course – coursework All experiments must be completed, written laboratory lab reports must be prepared and submitted and presented final.
Literature	<ul style="list-style-type: none"> • M. Bossert, M. Breitbach: Digitale Netze. Verlag B.G. Teubner, Stuttgart, 1999. • F. Kaderali: Digitale Kommunikationstechnik I und II. Verlag Vieweg, Braunschweig, 1991. • J.-R. Ohm, H.D. Lüke: Signalübertragung, Springer-Verlag, Berlin, 2002. • B.E.A. Saleh, M.C. Teich: Fundamentals of Photonics. John Wiley and Sons, Berlin, New York (USA), 1991. • E. Voges, K. Petermann (Hrsg.): Optische Kommunikationstechnik. Springer Verlag, Berlin, 2002. H.-G. Unger: Optische Nachrichtentechnik, Teil I, 3. Auflage. Hüthig Buch Verlag Heidelberg, 1992. H.-G. Unger: Optische Nachrichtentechnik, Teil II, 2. Auflage. Hüthig Buch Verlag Heidelberg, 1993. • B. Walke: Datenkommunikation I und II: Verteilte Systeme, ISO/OSI-Architekturmodell u. Bitübertragungsschicht. Hüthig Verlag, Heidelberg, 1987.

Course Title	Semiconductor Electronics Design
Module ID	4ETMA300
Responsible Lecturer	Prof. Dr. Bhaskar Choubey
University	University of Siegen
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture and laboratory practical course
Workload	lecture: 30 h laboratory: 30 h additional individual work of the student/homework time: 120 h total number of estimated working hours: 180 h
Course description	<p>This course looks at the elementary design processes in the microelectronics industry. Students are first taught lecture-based courses followed by advanced learning of software tools.</p> <p>It consists of:</p> <ul style="list-style-type: none"> • Design approaches – top-down, bottom-up, divide and conquer, structured design, object-oriented design, • Fabrication techniques for VLSI, • Materials – microelectronic properties, • Analog and digital modules of integrated electronic systems, • Modelling and simulation methods including SPICE, • Practical knowledge in an advanced design tool leading to a complete system design with communication, analog and digital components. <p>In this course, the students will acquire working knowledge of computer-based modelling, simulation and testing tools used in electronics design and will understand manufacturing processes and supply chain of electronic components needed in design. Students will be taught properties of materials used in integrated systems and will understand building blocks of integrated electronic systems. The course will emphasise on problem definition, design conceptualisation, modelling, approximation techniques, optimisation and prototyping in the context in microelectronic systems.</p>
Learning Outcomes	<p>The students:</p> <ul style="list-style-type: none"> • understand the design principles that are used in electronic systems. • know the fundamentals in computer-aided modelling, simulation and test equipment, which are used in electronic design. • are familiar with the design process and the supply chain of the electronic components that are necessary for the construction. • understand the modules of integrated electronic systems, and the building blocks of integrated electronic systems. • strengthen their skills in problem solving, design conception, modelling, approximation techniques, optimisation and prototyping in the context of micro-electronic systems.
Assessment method	<ul style="list-style-type: none"> • Preliminary examination performance (course work): laboratory practical course • Final written exam (2 hours) – 100% of the grade. <p>Credit points are awarded when the preliminary examination performance and the final examination are passed.</p>
Literature	<p>Will be announced in the first lecture.</p> <ul style="list-style-type: none"> • Böhm, M.: Semiconductor Electronics; Script.

Course Title	Master Thesis
Module ID	4EMINENT002
Responsible Lecturer	All professors of the department
University	University of Siegen
Semester	4
Relation to curriculum	Mandatory
Credit points (ECTS)	30
Teaching type	Individual or group projects
Workload	independent work: 900 h
Course description	<p>For the work on the master's project, candidates will use the knowledge and skills received during the first three semesters of Master studies. During the master's project, candidates need the following key qualifications:</p> <ul style="list-style-type: none"> • Most assignments involve extensive system development work; the related planning/organisational skills are required. • the ability to use literature resources and other sources to collect and structure material on the given topic. • the ability to read and understand demanding original English professional literature. • the ability to draft a lecture on a non-trivial scientific topic in front of a specialist audience (i.e., also to design it didactically correctly) and to present it using standard media. • the ability to write texts of approx. 60-120 pages, usually to explain the corresponding scientific content.
Learning Outcomes	The candidate will independently work on a problem in her or his field of study using scientific methods within a specified period of time.
Assessment method	The Master's thesis is evaluated by the supervisors. Evaluation is based on the complexity of the project, quality of the technical report, value of the research, created applications and models, presentation and defence of the thesis.
Literature	Individually specified for each thesis.

7. NOVA University Lisbon

PL = Labs classes, TP = Theoretical classes with practical exercise, TL = Pure theoretical lectures,
OT = Orientação Tutorial (Tutorial Supervision)

Course Title	Biosensors
Module ID	5324/4EMINENT301
Responsible Lecturer	Hugo Manuel Brito Águas
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	6
Teaching type	Lecture, exercises and laboratory practice
Workload	TP: 21 h PL: 35 h OT: 6 h total number of working hours: 168 h
Course description	<p>This module is designed to transmit to the students the knowledge on transduction mechanism, most suitable transducers and detection mechanism for a specific biological sample. The focus is on innovation, showing the state of the art adopting a technological approach as well on micro fabrications and lab on chip systems, supported by a strong laboratory immersion. This module will provide to the students concepts behind the design and fabrication of biosensors. It is the objective to introduce the students to the new sensoric technologies associated with biotechnology and microelectronics.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Introduction to biosensors • Bioreceptors and bioaffinity • Transduction systems • Physical properties of biological samples • Temperature, pressure, force and displacement, piezoelectric transduction systems • Microelectronic instruments • Optical transduction systems: fiber optics, evanescent waves, Surface Plasmon Resonance • Electrochemical transduction systems: amperometric and potentiometric sensors. Surface immobilisation. Supports for immobilisation. Sol-gel, membranes, silica and polymeric supports • Calorimetric sensors, Immunosensors • Enzymatic sensors, micro-organisms based sensors, DNA sensors • Development of immunosensors to detect IgG/ELISA, instrumentation and data processing • Building of prototypes • Interdigital electrodes and electronic-nose, microfabrication, microfabricated systems • Integrated systems, MEMS, Lab-in-a-chip, instruments for the human health • Instruments for applications in biotechnology • Instruments for the monitoring of the environment, Biochips
Learning Outcomes	<p>The students will be able to:</p> <ul style="list-style-type: none"> • understand the physical, chemical, and biological variables capable of being monitored in a biological process. • identify the various transduction systems available. • be able to master the main processes involved in the microfabrication. • to propose a sensorial system capable of detecting a biological agent by mean of physical, chemical and biological means involving microelectronics.
Assessment method	Students can opt between two written tests or an exam. The average of the tests

	<p>or exam must be above 9.5/20 (50% of the final grade). 40% of the final grade are given by a written project and the evaluation of this project includes the written document, presentation and discussion.</p> <p>The practical lab classes are mandatory to be approved and there is a 5 questions quiz for each lab that the students answer on-line. This accounts for 10% of the final grade.</p>
Literature	<ul style="list-style-type: none"> • Handbook of Biosensors and Biochips, 2 Volume Set, Robert S. Marks (Editor), Christopher R. Lowe (Editor), David C. Cullen (Editor), Howard H. Weetall (Editor), Isao Karube (Editor), (2008) Wiley. • Handbook of Modern Sensors: Physics, Designs, and Applications, Jacob Fraden, 3rd ed, (2004) Springer Sensor Technology Handbook, Jon S. Wilson (Editor), (2005) Elsevier. • Biosensors (Practical Approach S.) Jon Cooper, Tony Cass, 2nd Ed. (2004) Oxford University Press John L. Vossen, Werner Kern, Thin Film Process II, Academic Press, 1991. • Cantilever transducers as a platform for chemical and biological sensors; Review of Scientific Instruments, Vol 75, n° 7, (2004). • BioMEMS: state-of-the-art in detection, opportunities and prospects; Rashid Bashir; Advanced Drug Delivery Reviews 56 (2004) 1565– 1586; (online na sciencedirect). • Microfabrication Techniques for Chemical/Biosensors ; Proceedings of the IEEE, Vol. 91, n° 6, (2003).

Course Title	Paper and cellulosic materials
Module ID	7452/4EMINENT302
Responsible Lecturer	Maria Helena Godinho/Luis Pereira
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	6
Teaching type	Lecture, exercises and laboratory practice
Workload	TP: 21 h PL: 35 h OT: 6 h total number of working hours: 168 h
Course description	<p>Cellulose has a unique role among polymeric materials: It is biocompatible and biomimetic polymer and studying it requires interdisciplinary skills.</p> <p>This module is recommended for students who want to deepen their learning in the characteristics of cellulose and its derivatives and their impact on industrial sectors on the development of new functional materials.</p> <p>The module starts by addressing fundamental aspects about the structure of cellulose, its chemical modifications, and its major applications.</p> <p>The central scientific objective is to consolidate and extend students' knowledge in the field of polymeric materials by introducing an old natural material which is a potential source of new materials with exceptional mechanical, optical and electrical properties.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Introduction: Natural polymers. Major natural polymers; Cellulose: Constitution and Structure: structural analysis. crystalline structure. Amorphous cellulose • Lignocellulosic composites: Wood, Cork, Cotton. Paper manufacture • Cellulose Derivatives: Classification of cellulose derivatives • Modification reactions of cellulose • Crosslinking reactions. Graft derived cellulose • Preparation of films and fibers and their characterisation • Cellulose Derivatives interaction/Solvent: rheological characterisation. Water-soluble cellulose derivatives. Gel point • Cellulose Liquid Crystalline Polymers: Classification. Optical properties of chiral nematic phase theory for the chiral nematic phase • Thermotropic mesophases • Rheological properties of thermotropic and lyotropic phases • Cellulosic composites: Preparation of mixtures and micro composites • Films and fibers preparation • Applications of Cellulose and Its Derivatives as Biocompatible Materials
Learning Outcomes	<p>The students get a vision of cellulose as a material of the future in terms of technological applications.</p> <p>Then students learn about the applications of cellulose to paper and composites. Finally, a new view is given on the applicability of cellulosic materials in their areas of photonics, energy and electronics.</p>
Assessment method	Two tests or exam together a written report on the lab work. The final grade is given based on the weighted average of tests/exam with written work and lab work presentation made by the students.
Literature	<ul style="list-style-type: none"> • P.J. Flory "Principles of Polymer Chemistry", Cornell University Press, Ithaca, N.Y. (1953). • R.D. Gilbert, Cellulosic Polymers, Blends and Composites, Hanser, Munich (1994). • W. Hamad, Cellulosic Materials, Kluwer Academic Publishers, London (2001).

	<ul style="list-style-type: none"> • P.A. Williams, Cellulosic pulps, fibres and materials, Woodhead Publishing Ltd, Cambridge (2000) N.-S. Hon, N. Shiraishi, Wood and Cellulosic Chemistry, Marcel Dekker, N.Y. (2000). • Articles to be distributed during the lecture classes.
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Course Title	Soft Skill Course – Entrepreneurship
Module ID	1210/4EMINENT303
Responsible Lecturer	António Carlos Bárbara Grilo
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	3
Teaching type	Seminars; team work; mentoring
Workload	TP: 48 h total: 84 h
Course description	<p>This soft skill course is focusing on providing to the study an immersion in an entrepreneurship experience, combining lectures, seminars, contact with industry and investors. Some specific topics to be addressed are:</p> <ul style="list-style-type: none"> • The beginning: needs, opportunities and challenges, • Definition of the idea and development of the solution, • Value Proposition and Business Model, • Market Analysis and Marketing Plan, • Elevator-pitch, • Study of Financial Flows, • Development plan, • Implementation and Financing.
Learning Outcomes	<p>This curricular unit aims to make students aware of the importance of an entrepreneurial attitude, innovation and experimentation, as well as the development of social skills and entrepreneurship techniques for innovative and technological projects. This course proposes to motivate and prepare students to undertake innovative projects in companies or to develop technology-based startups.</p> <p>This is done by acquiring basic knowledges in market search/analysis, IP search, development of business cases/plans and seeking for investments to finance their ideas. This is made with “virtual” cases, but all ideas are presented to be evaluated by experts from different areas, and the three best ones received a prize and the opportunity to process with a “real” development of their idea</p>
Assessment method	<p>Based on the principles of multidisciplinary, classes will integrate students from different degrees with a view to promoting the integration of knowledge derived from various scientific areas and will involve professors and "mentors" with diverse backgrounds in the fields of engineering, science, management and business.</p> <p>The assessment comprises the presentation and defence of the idea in an elevator pitch and the respective report (carried out in a group of 4-5 elements). The presentation will contribute 50% and the report 50% towards the final grade.</p>
Literature	<p>Paul Burns, (2010), "Entrepreneurship and Small Business: Start-up, Growth and Maturity", Palgrave Macmillan, 3rd Ed.</p> <p>Shriberg, A. & Shriberg (2010), "Practicing Leadership: Principles and Applications", John Wiley & Sons, 4th Ed., USA.</p> <p>Spinelli, S. & Rob Adams (2012). "New Venture Creation: Entrepreneurship for the 21st Century". McGraw-Hill Higher Education; 9 Ed.</p> <p>Thomas H. Byers, Richard C. Dorf, Andrew Nelson (2010) "Technology Ventures: From Idea to Enterprise", 3rd Ed., McGraw-Hill Higher Education.</p>

Course Title	Research Lab Course
Module ID	10603/4EMINENT304
Responsible Lecturer	José Augusto Legatheaux Martins, Pedro Abílio Duarte de Medeiros
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	9
Teaching type	The solution of the concrete research problem, under the supervision of the proponent of the theme, will allow students to be exposed to research problems, as well as a preliminary contact with the research methods in the area. The specific problem and the methods to be applied are those indicated in the research proposal carried out by the mentor of the topic selected by the student.
Workload	lab: 80 h
Course description	This curricular unit allows students to have a first contact with the practice of scientific research. Its main objective is to give them the opportunity to apply the previously acquired knowledge to solve specific problems. The research lab course consists of the development of a small project around one of the topics addressed in the modules the student will have in the semester. It consists in a deep immersion in a research project running at UNL.
Learning Outcomes	The student will gain autonomy in performing literature reviews, lab practices, presentations and reports, exploring the critical thinking. The activity will be linked to the modules offered at UNL with a strong engagement in the research labs activities. By the end, the students must be able to: <ul style="list-style-type: none"> • Presentation of the problem, • Make a state-of-the-art presentation, • Select tools and methods to use in solving the problem, • Propose a work plan.
Assessment method	The evaluation is based in a written report and a presentation.
Literature	Literature to be provided by the mentor depending on the scientific topic to be addressed.

Course Title	Environmental Monitoring and Big Data
Module ID	12676/4EMINENT305
Responsible Lecturer	Francisco Manuel Freire Cardoso Ferreira
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	3
Teaching type	Lecture and exercises
Workload	TP: 56 h total number of working hours: 168 h
Course description	<p>This module allows for an understanding of the different conceptual strands on data acquisition, processing, and interpretation in the framework of environmental monitoring design and for decision-support purposes for different environmental engineering areas. All this is supported by the use of data services available on the market, allowing for the interpretation of case studies that ensure critical thinking about their value for decision making in the context of environmental engineering practice.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Environmental system analysis integrated approach. • Identification of the characteristics and key variables associated to environmental systems, such as in air, soil use, cities, and ecosystems. • Definition of monitoring strategies and sampling procedures of environmental systems and the respective quality assurance/quality control procedures. • Data acquisition techniques by monitoring equipment, sensors, drones, and Earth observation satellites. • Knowledge of data services and their access and gathering procedures. • Selected statistics for data analysis (review and application of methods associated with both univariate and multivariate analysis). • Automatic learning tools. • Data visualisation fundamentals and examples, with practical hands-on approach using state of the art visualisation tools. • Development of monitoring plans, supported with case studies examples.
Learning Outcomes	<p>The students will be able to:</p> <ul style="list-style-type: none"> • understand, within the environmental engineering area, the appropriate temporal and spatial scales to provide solutions to problems in domains such as air, soil use, and cities, enabling the design of strategies for their monitoring, from data acquisition, data service access, data processing and interpretation of big data. • evaluate different monitoring means to be used under a particular problem-solving objective, from standard monitoring equipment and stations to sensors, drones and Earth observation satellites. • access environmental global data services and develop skills to get to use them. • handle and process environmental big data through public and/or tailor-made tools. • Introduction to scientific visualisation techniques, including for large amount of data. • understand the importance of data in environmental engineering as a fundamental support for informed decisions with add-value recognised by the market.
Assessment method	<p>Two tests (25% weighting of each towards the final grade) and several group works (weighting 50% of the final grade).</p> <p>It is necessary that the average of the tests and the average of assignments is in both cases equal to or higher than 9.5.</p>
Literature	<ul style="list-style-type: none"> • Acevedo, M. F., 2012. Data Analysis and Statistics for Geography, Environmental Science, and Engineering, CRC Press, 557 pp.

	<ul style="list-style-type: none"> • Berthouex, P. M. and L.C. Brown, 1994. Statistics for Environmental Engineers, Lewis Publishers, Boca Raton, 335 pp. • Davis, J.C., 2002. Statistics and Data Analysis in Geology, 3rd edition, John Wiley & Sons, New York. • Gilbert, R.O., 1994. Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York. • Hereden, R.A., 1998. Ecological Numeracy: Quantitative Analysis of Environmental Issues, John Wiley & Sons Inc., New York, 331 pp. • Kumar, L. & Mutanga, O. (Eds) 2019. Google Earth Engine Applications, MDPI DOI 10.3390/books978-3-03897-885-5.Lillesand T.M., Kiefer R.W., J. Chipman (2015) Remote Sensing and Image Interpretation 7th Edition, John Wiley & Sons, ISBN: 978-1-118-34328-9. 736 Pages. • Moreira, J., Carvalho, A. and Horvath, T., 2018. A General Introduction to Data Analytics. John Wiley & Sons.
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Course Title	Biomaterials and Biomedicine
Module ID	4EMINENT307
Responsible Lecturer	Paula Isabel Pereira Soares
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	3
Teaching type	Lectures and lab
Workload	TP: 24 h PL: 24 h tutorial: 2 h autonomous study: 42 h total number of working hours: 86 h
Course description	<p>The main learning objective is directed towards raising awareness and providing general knowledge on Nanomedicine and its innovation driven impact in biomedicine.</p> <p>Specific goals are to develop critical thinking and reasoning on nanoscale events and their impact on medical applications, such as (but not limited to) diagnostics, research in biomedicine (tools and novel approaches), therapeutics (drug delivery, nanoformulations, molecular actuators), tissue regeneration and precision medicine.</p> <p>Syllabus:</p> <ol style="list-style-type: none"> 1. Nanotechnology and biologic systems <ol style="list-style-type: none"> a. Scale effects and properties of nanomaterials b. Characterization of nanomaterials in a biology context c. Nanosystem-cell/nanosystems-organism interaction d. Pharmacology of nanodrugs 2. Nanoparticles in biomedicine <ol style="list-style-type: none"> a. Metal NPs, polymers, lipidic, VLPs b. Nanovectors for drug delivery/gene therapy c. Controlled release mechanisms in nanodrugs d. Imaging via nanoplatforms e. Nanodiagnostics 3. Multifunctional NPs for therapeutics <ol style="list-style-type: none"> a. Molecular Targeting b. EPR c. Multimodal: PTT, PAT, PDT, etc and applications thereof d. Nanoteheranostics 4. DNA nanotechnology – self-assembly and origami 5. Lab-on-chip/organ-on-chip 6. Nanotoxicology in humans
Learning Outcomes	<p>Short focused lectures on the key topics from syllabus, followed by discussion of selected papers on those themes – this ensures in depth discussion and reasoning on the matters. The short focused monographies, together with oral presentations, allow to correlate and critical discuss the apprehended concepts within the broader framework of nanomedicine. These steps should allow the development of critical reasoning on the fundamental aspects of Nanomedicine, oral and written presentation of scientific works, open discussion and team work – all fundamental in contemporary education.</p> <p>Teaching methodologies (including evaluation):</p> <ul style="list-style-type: none"> • Lectures/lab work/discussion for presentation of topics and discussion of case studies. • Paper presentation and discussion (teamwork). • Monography and oral presentation of particular theme. • Assessment: Presentation and discussion of selected papers.; monography on selected theme with subsequent oral presentation and discussion.
Assessment method	Presentation and discussion of selected papers; monography/lab work on selected

	theme with subsequent oral presentation and discussion
Literature	<ul style="list-style-type: none"> • Handbook of Nanoparticles (M. Aliofkhazraei Ed.), Springer. ISBN 978-3-319-15337-7. • Nanomedicine (Seifalian A., Mel A., and Kalaskar D. M. Ed.), One Central Press (OCP), UK. • Nano-Oncologicals: New targeting and delivery approaches, Advances in Delivery Science and Technology (M.J. Alonso and M. Garcia-Fuentes Ed), Springer; Controlled Release Society – Springer- ISBN: 978-3-319-08084-0.

Course Title	Smart Materials and Systems
Module ID	4EMINENT308
Responsible Lecturer	Rui Alberto Garção Barreira do Nascimento Igreja
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lectures and lab
Workload	TP: 28 h PL: 42 h OT: 14 h autonomous work: 74 h total number of working hours: 168 h
Course description	<p>The discipline of Smart Materials and Systems is an introduction to how materials response to certain stimuli can be well understood by modelling properties that couple electrical properties and other properties such as mechanical, optical and rheological properties.</p> <p>Module 1:</p> <ul style="list-style-type: none"> - Introduction to the concept of smart materials and systems - Physical properties most relevant to sensory systems and actuators. Advantages and disadvantages of different combinations of the characteristics of sensors and actuators. Intelligent material classes. Electroactive Materials (piezoelectric, piezoresistive) - Physical properties of piezoelectric materials. Piezoelectric crystals. Polymers and piezoelectric ceramics. Mathematical representation of the electromechanical coupling in piezoelectric materials. Harvesting energy. Piezo actuators and sensors. Piezo-resistive, electro-restrictive and magnetostrictive materials. <p>Module 2:</p> <ul style="list-style-type: none"> - Chromogenic, electrochromic, photochromic and halochromic materials. Categories of electrochromic materials. Conductive polymers, organic and inorganic materials. WO₃ transition metal oxides. Applications Thermochromism and materials. Windows and smart roofs. Preparation methods and characterization techniques. <p>Module 3</p> <ul style="list-style-type: none"> - Shape memory effect. Superelasticity. Classes of metal alloys with shape memory. Alloys with ferromagnetic memory. Physical properties depending on the structural state. Damping. Actuation force. Design and dimensioning of systems based on alloys with shape memory. <p>Module 4</p> <ul style="list-style-type: none"> - Electrorheological fluids - Electro and magneto rheological fluids. Basic concepts of rheology: Newtonian and non-Newtonian fluids, viscosity and viscoelasticity, differences in normal stresses, flow curves and viscosity. Particular case of electrorheological (ER) and magnetoreological (MR) fluids: composition of ER and MR fluids and effects of electric and magnetic fields on their viscosity. <p>Each module will have practical demonstration classes. After the set of demonstration classes students must choose a theme to carry out a mini project</p>
Learning Outcomes	Concept of smart materials and systems. Most relevant physical properties for sensory systems and actuators. Classes of smart materials: piezoelectric materials, chromogenic materials, shape memory materials, biomimetic materials, electrorheological fluids. Advantages and disadvantages of different combinations of the characteristics of sensors and actuators. Characterization of smart materials. Implementation of engineering solutions using materials and intelligent systems. Adequate selection of materials and smart depending on the application. Design and dimensioning of smart systems.

Assessment method	<p>For the continuous evaluation is compulsory to answer tests/assignments, one for each module, and the presence at the practical/lab classes.</p> <p>The final mark is computed by weighting the mark of each module according to the weeks taken in each module.</p>
Literature	<ul style="list-style-type: none"> • K. Ohtsuka, C.M. Wayman, "Shape memory materials", Cambridge University Press, 2002. MV Gandhi and BS Thompson, "Smart materials and structures", Chapman & Hall, London, 1992. ISBN 0-412-37010-7. • DM Addington and DL Schodek, "Smart materials and technologies for the architecture and design professions", Architectural Press (Elsevier Science), Oxford, 2005. ISBN 0-7506-6225-5. • V Srinivasan and DM McFarland, "Smart structures: analysis and design", Cambridge University Press, Cambridge, 2000. ISBN 0-521-65977-9. • Electroceramics AJ Moulson and JM Herbert Chapman and Hall. • Smart materials and structures, MV Gandhi and BS Thompson, Chapman and Hall.

Course Title	Sensors: Materials and applications
Module ID	7460/4EMINENT306
Responsible Lecturer	Rui Alberto Garção Nascimento Igreja
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture, exercises and laboratory practical classes
Workload	TP: 21 h PL: 35 h OT: 6 h total number of working hours: 168 h
Course description	<p>The general objective of the module is to make available to the students the concepts that are in the origin, development, and manufacture of sensors, as well as the properties of materials used to make them. Moreover, the module also addresses the technologies associated with the measurements of physical and chemical properties in both lab and industrial environments.</p> <p>Syllabus:</p> <ol style="list-style-type: none"> 1. Sensors and signals. Physical principles of measurement. 2. Temperature sensors – Resistance temperature sensors (RTDs). The thermistor. Thermocouples; Temperature measurements with semiconductors and integrated circuits. Radiant sensors; pyroelectric detectors; pyroelectric effect; methods and materials; pyrometers. 3. Strain and stress sensors – Resistance-type strain gages. The stress gage. Linear variable differential transformer. 4. Force, torque and pressure measurements – Load cells; Torque measurements; torque cells. Pressure measurements. 5. Displacement, velocity, and acceleration measurements – Optical measurements methods; LVDT; Seismic transducers. Accelerometer; piezoelectric-type accelerometers. 6. Fluid flow measurements – insertion-type transducers; pitot tube; Hot-wire and hot-film anemometers. Drag-force velocity transducers. Venturi meters. 7. Chemical Sensors and multisensors systems – Transducers for chemical sensing; Multisensor systems.
Learning Outcomes	The students start by having an introduction to sensors and their main features, being able to understand the main physical principles used in sensors and transducers as well as materials used. Then the students are supposed to understand in detail the transduction mechanisms and the characteristics of the sensors. It includes the most important types of chemical sensors as well as systems with multi-sensors. The knowledge about these topics is supposed to be demonstrated on both a theoretical and laboratory level.
Assessment method	Set of tests or exam and reports of the laboratory work. The final grade is given based on the weighted average of tests/exam with practical work.
Literature	<ul style="list-style-type: none"> • Instrumentation for Engineering Measurements, James Dally, Wiley. • Les Capteurs en Instrumentation Industrielle, Georges Asch, Dunod. • Measurement Systems Applications and Design, Ernest O. Doebelin, McGraw-Hill. Instrumentação Industrial, Gustavo da Silva, Escola Superior de Tecnologia de Setúbal. AIP Handbook of Modern Sensors, Jacob Fraden, AIP Series in Modern Instrumentation. • The Measurement, Instrumentation and Sensors Handbook, ed John g Webster, IEEE Press. • Sensors Update – Wiley – VCH. Revistas: Sensors and Actuators A and B, Elsevier. Sensors (IEEE).

Course Title	Adv. Programming for Data Science and Engineering
Module ID	12529/4EMINENT307
Responsible Lecturer	Carlos Augusto Isaac Piló Viegas Damásio
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture and exercises
Workload	TP: 28 h PL: 28 h total number of working hours: 168 h
Course description	<p>The main objective of the module is to provide science and engineering students the knowledge and skills necessary to develop programmes that enable her or him to perform data processing, using a pedagogical translational approach adequate to the target population.</p> <p>Syllabus:</p> <ol style="list-style-type: none"> 1. Introduction to Programming for Data Analysis: <ul style="list-style-type: none"> • Data Science • CRISP Methodology 2. Software structuring and organisation: <ul style="list-style-type: none"> • Modules, Classes, and API Usage • Functional data processing (map, flatmap, reduce, etc. operators) • Programme deployment models (e.g. libraries, Jupyter Notebooks) 3. Data processing and querying: <ul style="list-style-type: none"> • Spatio-temporal and complex data. Methods for data access • Relational Data Interrogation Language: SQL. Projections, selections, joins and aggregations • Manipulation of data series and tabular data 4. Data Visualisation: <ul style="list-style-type: none"> • Fundamentals of interactive data visualisation • Main data visualisation tools for exploratory data analysis • Using python libraries for data visualisation and small interactive dash-board design 5. Scalability and Cloud Services: <ul style="list-style-type: none"> • Challenges and approaches • Parallel computing frameworks (e.g. Spark)
Learning Outcomes	<p>By the end of this course the students with prior programming skills will have acquired knowledge, skills and competences that will allow them to:</p> <ul style="list-style-type: none"> • understand the role of interaction and know the main interaction techniques. • be able to express computations using an imperative model or functional operators. • understand and be able to develop processing and processing activities for raw experimental or sensor data for supporting data analysis. • understand the challenges associated with processing large amounts of data. • understand the basic principles and algorithms of machine learning. • know and be able to express computations on complex and spatiotemporal data. • know and choose the data views that best fit data analyses.
Assessment method	Practical work (50%) and 2 tests (each 25%).
Literature	<ul style="list-style-type: none"> • Database System Concepts, 7th Edition (essencialmente capítulos 2,3 e 4) Abraham Silberschatz, Henry F. Korth and S. Sudarshan McGraw Hill, 2019. • Anand Balachandran Pillai, Software Architecture with Python, Packt Publishing, 2017. • Interactive Data Visualization: Foundations, Techniques, and Applications, Second Edition. Matthew O. Ward, Georges Grinstein, Daniel Keim, 2015, ISBN 9781482257373.

	<ul style="list-style-type: none"> • Moreira, João, Andre Carvalho, and Tomás Horvath. A General Introduction to Data Analytics. John Wiley & Sons, 2018.
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Course Title	Molecular Diagnostics
Module ID	10915/4EMINENT308
Responsible Lecturer	Maria Alexandra Nuncio de Carvalho Ramos Fernandes
University	NOVA University Lisbon
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	3
Teaching type	Lectures, laboratory practice
Workload	TP: 14 h PL: 18 h S: 1 h OT: 3 h total number of working hours: 84 h
Course description	<p>The main objective of this Module is to explore the more recent and innovative advances in the context of human disease diagnostics. It is intended that students understand all the steps from biological sample collection, nucleic acid extraction, the techniques used for amplification and/or detection and how to deal with results.</p> <p>Theoretical:</p> <p>Molecular Diagnostics</p> <ol style="list-style-type: none"> Genetic Test <ul style="list-style-type: none"> Prenatal Diagnosis Molecular Cytogenetics Biological samples: harvesting and processing. Molecular Biology Laboratory Molecular Biology Techniques in Diagnostics Strategies in Genetic Diagnostics New Technologies for Genetic Diagnosis Applications <p>Lab:</p> <p>Fusion transcripts detection in CML</p>
Learning Outcomes	It is intended that students understand all the steps from biological sample collection, nucleic acid extraction, the techniques used for amplification and/or detection and how to deal with results. Moreover, it is intended that the students understand the advantages and disadvantages of the different methodologies and the advances of nanotechnology for point-of-care. An objective of this module is the development of critical analysis, especially in what concerns laboratory results, fostering attitudes that enable students to explore, in autonomy, more advanced or more particular themes of the Molecular Diagnosis.
Assessment method	Theoretical Exam – 60% of the final grade Laboratorial classes report – 40%
Literature	<ul style="list-style-type: none"> Principles and Applications of Molecular Diagnostics. Nader Rifai, Andrea Rita Horvath and Carl T. Wittwer. Elsevier. 2018. Textbook of Clinical Chemistry and Molecular Diagnostics. Nader Rifai. Saunders. 2017. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications Lela Buckingham, Maribeth L. Flaws F.A Davis Company, 2011. Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory. Wayne W. Grody, Robert M. Nakamura, Frederick L. Kiechle, Charles Strom, Academic Press, 2010. Molecular Diagnostics: For the Clinical Laboratorial. William B. Coleman, Gregory J. Tsongalis. Humana Press, 2006. Fundamentals of Molecular Diagnostics, David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Sauders, Elsevier, 2007.

Course Title	Master Thesis
Module ID	/4EMINENT003
Responsible Lecturer	All professors of the department
University	NOVA University Lisbon
Semester	4
Relation to curriculum	Mandatory
Credit points (ECTS)	30
Teaching type	Individual or group projects
Workload	independent work: 800 h
Course description	<p>For the work on the master's project, candidates will use the knowledge and skills received during the first three semesters of Master studies. During the master's project, candidates need the following key qualifications:</p> <ul style="list-style-type: none"> • Most assignments involve extensive system development work; the related planning/organisational skills are required. • The ability to use literature resources and other sources to collect and structure material on the given topic. • The ability to read and understand demanding original English professional literature. • The ability to draft a lecture on a non-trivial scientific topic in front of a specialist audience (i.e., also to design it didactically correctly) and to present it using standard media. • The ability to write texts of approx. 60-120 pages, usually to explain the corresponding scientific content.
Learning Outcomes	The candidate will independently work on a problem in her or his field of study using scientific methods within a specified period of time.
Assessment method	The Master's thesis is evaluated by the supervisors. Evaluation is based on the complexity of the project, quality of the technical report, value of the research, created applications and models, presentation and public defence of the thesis.
Literature	The literature is specified individually according to a specific topic.

8. University of Orléans

Course Title	Processor architectures
Module ID	IoT0/4EMINENT401
Responsible Lecturer	Prof. Dr. Raphael Canals, A. Rimlinger (industrial staff: Arrow Electronics)
University	University of Orléans
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	3
Teaching type	Lecture, Laboratory works, Case study
Workload	lecture: 10 h TP: 18 h additional individual work of the student/homework time: 62 h total number of estimated working hours: 90 h
Course description	<p>The Internet of Things (IoT) entry point, often considered as the third evolution of the Internet, is a set of architectures that allow communicating systems to generate data, capture the environment and then automatically transfer it to the Internet.</p> <p>This course introduces the basic hardware and software bricks to design the acquisition system (sensor) according to the application needs defined in the specifications, including embedded system architecture, functioning of a microcontroller-based system, advantages of integration, programming, etc.</p> <ul style="list-style-type: none"> • Embedded system architecture • Functioning of a microcontroller-based system <p>Syllabus:</p> <ol style="list-style-type: none"> 1. Processor system architectures <ul style="list-style-type: none"> • Different processor families • Architecture of a processor board • Programme memory, data memory and input/output devices 2. Microcontroller architectures <ul style="list-style-type: none"> • Microcontroller architecture • ARM processor architecture: RISC architecture, operation, pipeline, operating modes • Interruption: role, asynchronism, management, multitasking • Timers, meters and PWM • Development tools and environments • Understanding of the high-level language to machine code compilation chain
Learning Outcomes	<p>Students will be able to:</p> <ul style="list-style-type: none"> • understand how a processor architecture works. • choose a hardware architecture. • understand the advantages of integration: consumption, dimensions, reliability, etc. • realise the acquisition of a sensor data. • manage asynchronous events.
Assessment method	Writing or oral exam; Homeworks; Report and defense of laboratory works.
Literature	<ul style="list-style-type: none"> • Rimlinger, Alain, " Overview of embedded architectures", 2021. • Canals, Raphael, "Microcontroller systems", 2022.

Course Title	Data analytics
Module ID	IoT1/4EMINENT402
Responsible Lecturer	Prof. Dr. Frédéric Ros (equally director of the Metropolitan incubator), Prof. Dr. Philippe Ravier
University	University of Orléans
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	5
Teaching type	Lectures, Laboratory works, Case study
Workload	lecture: 17.5 h tutorial: 7.5 h TP: 25 h additional individual work of the student/homework time: 100 h total number of estimated working hours: 150 h
Course description	<p>In any system, signals are acquired using analog or digital sensors. Thanks to signal processing, these signals must be processed to detect, elaborate and interpret these signals carrying information.</p> <p>The exploitation of all this information stored in our database requires the use of tools for analysis to extract useful information for the user: this is where the added value of the IoT is positioned. This course introduces some statistical data analysis tools as well as tools for pre-processing data and extracting characteristic attributes from the data, with a complement to understand the principles and to use basic classification methods such as SVM and neural networks.</p> <ol style="list-style-type: none"> 1. Introduction to signal processing <ul style="list-style-type: none"> • Signals and systems • Classification of signals and systems • Linear systems • Frequential representations of signals and systems • Sampling and quantification • Filter design 2. Analysis tools <ul style="list-style-type: none"> • Linear and logistic regression • Principal Component Analysis (PCA) • Factor analyses 3. Time series 4. Data mining and visualisation <ul style="list-style-type: none"> • R language (introduction) and descriptive graphs • Practicum in multimedia data analysis (images and audio) using R and/or Python 5. Data pre-processing and attribute extraction <ul style="list-style-type: none"> • Some data denoising techniques • Characteristic attributes: audio and image examples • Attribute selection 6. Classification methods <ul style="list-style-type: none"> • SVM Method • Classification by neural networks • Introduction to Deep Learning.
Learning Outcomes	<p>Students will be able to:</p> <ul style="list-style-type: none"> • master the mathematical tools for characterisation and manipulation of noise and signals. • use statistical data analysis tools such as linear or logistic regression, PCA and factor analysis. • use data visualisation or representation tools in MATLAB or R languages. • use tools for pre-processing data and extracting characteristic attributes from the data.

	<ul style="list-style-type: none"> understand the principles and use basic classification methods such as SVM and neural networks.
Assessment method	Writing or oral exam; Homeworks; Report and defence of laboratory works.
Literature	<ul style="list-style-type: none"> Ros, Frédéric, "Data mining and AI", 2021. Ravier, Philippe, "Signal processing", 2020.

Course Title	Robotics 1
Module ID	4EMINENT403
Responsible Lecturer	Prof. Dr. Pierre Vieyres, A. Fonte, L. Nouaille, C. Novales, S. Miossec, G. Poisson
University	University of Orléans
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	5
Teaching type	Lecture and exercise, laboratory practise
Workload	TP: 52 h additional individual work of the student/homework time: 100 h total number of estimated working hours: 152 h
Course description	<p>This course will introduce major steps of robotics:</p> <ul style="list-style-type: none"> • Design strategy and principles of 3D CAD modelling • Mechanical robot design: transmission of movement and power. Mechanisms adapted for robotics handling and mobile. Integration of the electric, pneumatic, or hydraulic actuator. gripping devices, assembly, and handling effectors; proprioceptive and external sensors • General introduction to robotics: anatomy and technology; industrial classification. Design and modelling of robotic serial manipulators: Spherical robots, scara and dedicated structures. Denavit-Hartenberg notation. Direct and Inverse Kinematic Modelling. Jacobian matrix. Industrial applications of robotics: Introduction to cooperative robotics, teleoperation • Design and modelling of wheeled mobile platforms; Formalism of Campion for the development of direct and inverse kinematic models. Degrees of mobility, path planning and motorisation of wheeled robots <p>Advanced courses will be developed within the following syllabus:</p> <ul style="list-style-type: none"> • Computer aided design • Transmission and mechanical design • Modelling and identification of robots • Modelling of mobile robotic systems
Learning Outcomes	<p>Students will be able to:</p> <ul style="list-style-type: none"> • identify and configure the articulated mechanical system in relation to the robotic task. • identify and adapt peri-robotic systems to equip the articulated mechanical system. • address a complex mechatronic system using the basic concepts of articulated robots and associated automation elements. • develop a model, analyse, and control the movements of a robotic manipulator. • design a mobile robotics platform.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	<p>Will be announced within the first lecture.</p> <ul style="list-style-type: none"> • Phillip J. McKerrow. Introduction to robotics, Ed. Addison Wesley Publishing Company, 1991. • John J. Craig. Introduction to robotics mechanics and control, 2nd Ed. Addison Wesley Publishing Company, 1989. • Modeling Identification and Control of Robots, W. Khalil, E. Dombre CRC Press, 2002 - 480 pages. • Handbook of robotics, Bruno Siciliano, Oussama Khatib, 2nd edition Springer.

Course Title	Control 1
Module ID	4EMINENT404
Responsible Lecturer	Prof. Dr. Dominique Nelson-Gruel
Responsible academic staff	D. Nelson-Gruel, N. Ramdani, M. Fruchard, D. Aubry, Y. Becis
University	University of Orléans
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	5
Teaching type	Lecture and exercise, Simulation tools
Workload	TP: 52 h additional individual work of the student/homework time: 100 h total number of estimated working hours: 152 h
Course description	<p>When a reliable model of a system has been validated, in addition to using it in a control strategy, it is often necessary to use this model in order to monitor the dynamic operation of the system. This active diagnostic approach aims to detect the presence of defects (sensors, actuators) in order to generate alerts or reconfigure the steering of the system. This course therefore presents the basic methods and principles of diagnosis, the focus will be on the algorithmic surveillance based on residues of observations derived from an estimation of the state of the system by observers or filters. An introduction to non-linear phenomena is presented including multiple equilibrium points, boundary cycles, entry-dependent stability, bifurcations. This will cover also: Control of non-linear systems, Exact linearisation and link with a platitude control, Control by sliding modes.</p> <p>Advanced courses will be given on:</p> <ul style="list-style-type: none"> • Diagnosis and observers, • Advanced control.
Learning Outcomes	<p>The students will be able to:</p> <ul style="list-style-type: none"> • implement a model-based diagnostic strategy. • synthesise estimators: adequate observers or filters. • analyse the stability and convergence of these estimators. • generate and analyse observations residues. • detect and isolate system faults, actuators or sensors. • be aware of the non-linear problems encountered in automatic systems and for the control of robotic system. • give some basic methods of analysis and control of non-linear systems.
Assessment method	Final written exam (2 hours) – 100% of the grade
Literature	<p>Will be announced within the first lecture.</p> <ul style="list-style-type: none"> • Isidori. Nonlinear Control Systems. Springer, New York, 3rd edition, 1995. • H. K. Khalil. Nonlinear Systems. Prentice Hall, Englewood Cliffs, NJ, 1996.

Course Title	Research Lab Course: IoT and data
Module ID	4EMINENT405
Responsible Lecturer	Prof. Dr. Raphaël Canals, D. Nelson-Gruel, P. Vieyres, R. Weber
University	University of Orléans
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	3
Teaching type	Lecture, Lab and Project
Workload	PL: 20 h additional individual work of the student/homework time: 70 h total number of estimated working hours: 90 h
Course description	The teaching referring to the Research Lab Course will allow to develop an IoT solution to meet an application specification. It will then be necessary to study all or part of the value chain of the solution and to implement it, from the installation of the sensor(s) to the data exploitation and visualisation of the results.
Learning Outcomes	The students will be able to: <ul style="list-style-type: none"> • understand the complete value chain of an IoT solution. • construct all or part of an IoT system in accordance with a mechanical structure. • analyse each part of the system. • exploit the acquired data and interpret them in order to provide the user with a graphic representation of the phenomena to be studied.
Assessment method	Lab Course (100 %)
Literature	Relevant literature will be distributed in the course.

Course Title	Full-stack Integration
Module ID	POLIoT15/4EMINENT406
Responsible Lecturer	Prof. Dr. Jean-Yves Cadorel (equally industrial staff: 3ZA engineering), R Beaudenon (industrial staff: IBM), N. Ramdani
University	University of Orléans
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	5
Teaching type	Lectures; Laboratory works; Case study
Workload	lecture: 7.5 h tutorial: 7.5 h TP: 25 h additional individual work of the student/homework time: 110 h total number of estimated working hours: 150 h
Course description	<p>This course focuses initially on technologies involved in end-to-end IoT solutions and protocols for local & global connectivity. Then the architecture and concept of different cloud models are presented (IaaS, PaaS, SaaS, cloud virtualisation, cloud storage, data management). Finally, the decisive factors for the user interaction in the context of IoT are introduced. A concrete practical exercise permits to design the architecture and technologies needed to implement IoT devices and to create an application by utilising cloud platforms.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Device hardware: IoT objects (sensors, actuators, smartphones, gateways) • Device software: Embedded/firmware programming, edge operating systems and applications • Communications: Models, data exchange formats, protocols (MQTT, CoAP, HTTP REST, etc.) • Cloud Platform & Middleware Programming • Delivery models – IaaS, PaaS, SaaS, cloud platform; micro-services using Docker • Security and regulations • IoT security standard: identity, authentication, authorisation, confidentiality, integrity, availability, lifecycle management (OTA upgrades) • GDPR, ePrivacy regulation, privacy by design. Practical cryptography for the Internet of Things • Scalability and Management (devices, applications, network) • IoT interoperability and scalability • Integration with IT & other systems • Open data management & API. Aggregations <p>Laboratory:</p> <ul style="list-style-type: none"> • Case studies: Smart homes/buildings, smart cities, smart industry, smart medical care. Human activity recognition. Air quality analysis, industrial internet (IIoT)
Learning Outcomes	<p>Students will have:</p> <ul style="list-style-type: none"> • knowledge and understanding of: <ul style="list-style-type: none"> – technologies involved in end-to-end IoT solutions. Protocols for local & global connectivity. – the architecture and concept of different cloud models: IaaS, PaaS, SaaS, cloud virtualisation, cloud storage, data management. – the decisive factors for the user interaction in the context of the Internet of Things (IoT). • practical skills. They will be able to: <ul style="list-style-type: none"> – design the architecture and technologies needed to implement IoT devices. – design usable functional prototypes of interactive systems.

	– create application by utilising cloud platforms.
Assessment method	Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group work/paper.
Literature	<ul style="list-style-type: none"> • Cadorel, Jean-Yves, "Full-stack integration", 2021. • Beaudenon, Rémy, "Implementation of server-based applications and visualisation of data-results for the client", 2021. • Ramdani, Nacim, "IoT and robotics: case studies", 2022.

Course Title	Data transmission
Module ID	POLIoT07/4EMINENT407
Responsible Lecturer	Prof. Dr. Rodolphe Weber, C. Alayrac (industrial staff: CRESITT Industrie)
University	University of Orléans
Semester	3
Relation to curriculum	Elective course
Credit points (ECTS)	2
Teaching type	Lecture, Laboratory works, Case study
Workload	lecture: 15 h TP: 5 h additional individual work of the student/homework time: 40 h total number of estimated working hours: 60 h
Course description	<p>The main objectives of this module are to present digital communications and to be able to choose a wired or wireless transmission protocol depending on the constraints, to understand the architecture of a digital radio transmission system and the basics of antenna design and antenna impedance adaptation.</p> <ul style="list-style-type: none"> • Digital communication • Wired and wireless communications <p>Syllabus:</p> <ol style="list-style-type: none"> 1. Communicating systems <ul style="list-style-type: none"> • Different types of serial link, implementation 2. Introduction to digital communication <ul style="list-style-type: none"> • The overall architecture and associated parameters (source, channel, bandwidth, data rate, signal to noise ratio, bit error rate) • Linear and non-linear digital modulations and associated parameters (inter symbol interferences, spectral efficiency, pulse shaping, bit error rate, Eb/No) • Software defined radio (SDR) architecture and et associated tools (eye diagram, constellation, carrier and symbol synchronisation) • Demultiplexing techniques OFDM, FDMA, TDMA, CDMA • Implementation on a SDR GnuRadio demonstration board 3. RF considerations <ul style="list-style-type: none"> • Antenna characteristics (gain, directivity, VSWR, ...) • Antenna design and antenna adaptation issues • The certification procedure for IoT systems • Measurement tools for antenna and EMC studies <p>Link budget</p> <p>Standard wired communication protocol</p> <ul style="list-style-type: none"> • RS232, RS485, Profibus, Profinet, Modbus, Ethernet, CPL, ... <p>Standard radio communication protocol</p> <ul style="list-style-type: none"> • Short range (WPAN, WLAN): BT, BLE, Wi-Fi, ZigBee, Thread, Z-Wave, RFID, NFC, EnOcean, Ant+ • Long range (WWAN, LPWAN): ZigBee-NAN, WirelessHART, Wi-SUN, 4G/5G, LTE-M, Sigfox, Lora, 6LoWPan, NB-IoT, Telensa ... • Standardisation, industrial alliances
Learning Outcomes	<p>Students will be able to:</p> <ul style="list-style-type: none"> • implement a serial communication. • choose a wired or radio transmission protocol depending on the constraints (data rate, latency, power consumption, transmission range, bit error rate, regulations and standards, EMC etc.). • understand the architecture of a digital radio transmission system. • understand the basics of antenna design and antenna impedance adaptation. • assess a link budget. • know the certification procedure for IoT systems.

Assessment method	Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group project/work/paper.
Literature	<ul style="list-style-type: none"> • Weber, Rodolphe, "Data transmission for IoT", 2021.

Course Title	Servers and database
Module ID	POLIoT10/4EMINENT408
Responsible Lecturer	Prof. Dr. Matthieu Exbrayat, I. Todinca
University	University of Orléans
Semester	3
Relation to curriculum	Elective course
Credit points (ECTS)	2
Teaching type	Lectures, Laboratory works, Individual projects, Case study
Workload	lecture: 7.5 h TP: 12.5 h additional individual work of the student/homework time: 40 h total number of estimated working hours: 60 h
Course description	<p>When the acquired data are received at the server level, they must be stored in databases whose model is to be defined according to the need. Beforehand, it is necessary to set up this server as well as all the software services that will allow the implementation of the functionalities useful to the application framework.</p> <p>This course gives major steps in setting up a server, the related services, the management of data, including: Servers and software services, SQL and NoSQL databases.</p> <p>Syllabus:</p> <ol style="list-style-type: none"> 1. Servers and services <ul style="list-style-type: none"> • http protocols – REST architectures • Client/Server • Address an API design framework • Introduction to REST Web Services – Design, request and authentication • API testing tools • Notions about microservices 2. Relational database <ul style="list-style-type: none"> • Relational model and properties • SQL language: <ul style="list-style-type: none"> - Creation of a database - Update in a database - Query (simple queries, aggregates, etc.) • Security concept in relational databases 3. NoSQL database <ul style="list-style-type: none"> • The different typologies of NoSQL databases: <ul style="list-style-type: none"> - Key/value - Columns - Document - Graph • The Map/Reduce programming model • Query languages associated with the different typologies (SPARQL, etc.)
Learning Outcomes	<p>Students will be able to:</p> <ul style="list-style-type: none"> • design and implement a REST web service to collect and transmit data in connection with an existing relational or NoSQL database. • propose a client/server architecture with possibly several services to answer a problem. • test and secure this API. • implement a Python framework to develop this type of service. • understand the relational database model. • update and query a relational SQL database. • understand the different types of NoSQL databases. • update and query a NoSQL database. • choose a database model. • design the architecture of a database.

Assessment method	Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group project/work/paper.
Literature	<ul style="list-style-type: none"> • Exbrayat, Matthieu, "Servers and services", 2021. • Todinca, Ioan, "Databases for IoT", 2022.

Course Title	Smartphones
Module ID	POLIoT10/4EMINENT409
Responsible Lecturer	Prof. Dr. Aladine Chetouani
University	University of Orléans
Semester	3
Relation to curriculum	Elective course
Credit points (ECTS)	2
Teaching type	Lectures and Laboratory works
Workload	lecture: 5 h TP: 15 h additional individual work of the student/homework time: 40 h total number of estimated working hours: 60 h
Course description	<p>Smartphones can be considered today as connected objects in themselves. Indeed, they integrate various types of sensors allowing to acquire numerous data which can be processed by in-situ processors before transmitting this information to other systems. In addition, they offer a graphical interface that facilitates their use and data entry. This course presents these objects and how to programme them.</p> <p>Syllabus:</p> <ol style="list-style-type: none"> 1. Java <ul style="list-style-type: none"> • Introduction to JAVA (Android) programming • Programme Development 2. Android <ul style="list-style-type: none"> • Interface management (design and XML) • Basic "Hello Word" application • Multi-activity application • Control management • Transfer of information • Use of sensors • Communication 3. Complements <ul style="list-style-type: none"> • Cross-platform • PWA (Progressive Web Apps): nomadic continuous access to information without reliable connection
Learning Outcomes	<p>Students will be able to:</p> <ul style="list-style-type: none"> • develop applications on Android. • manage the packaging of activities. • communicate between activities and transmit data. • use the different existing data sensors (accelero-meter, gyroscope, camera, audio, GPS, etc.). • use communication channels (Bluetooth, Wi-Fi). • transmit data between smartphones.
Assessment method	Report and defence of laboratory works.
Literature	<ul style="list-style-type: none"> • Chetouani, Aladine, "Smartphones and tablets", 2022.

Course Title	Cybersecurity
Module ID	4EMINENT410
Responsible Lecturer	Prof. Dr. Raphaël Canals, Laurent Moulin (industrial staff: Spartan conseil), Benjamin N'guyen (external Prof. Dr.: INSA-CVL), Laurent Bobelin (external Prof. Dr.: INSA-CVL)
University	University of Orléans
Semester	3
Relation to curriculum	Elective course
Credit points (ECTS)	2
Teaching type	Lectures and Laboratory works
Workload	lecture: 5 h TP: 15 h additional individual work of the student/homework time: 40 h total number of estimated working hours: 60 h
Course description	<p>Moving towards the Industry of the Future or Agriculture 4.0 inevitably leads to the consideration of cybersecurity notions. Indeed, connecting electronic systems exposes them to risks that were previously unknown to many companies. This course provides an awareness of the subject of cybersecurity and allows a first level of measurement of the risks to which a connected electronic system and therefore a company is exposed.</p> <ol style="list-style-type: none"> 1. Introduction <ul style="list-style-type: none"> • What is cybersecurity? • Information technology • Hacker motivation and strategy 2. Networks, protocols and infrastructure <ul style="list-style-type: none"> • The cyber-physical industry area • Impacts of network technologies on infrastructures 3. Implementation strategy <ul style="list-style-type: none"> • Respecting simple rules • Key points to secure • Cybersecure by design 4. Attack surface <ul style="list-style-type: none"> • Sources of threats • Attack vectors • IIoT: a "revolution" for hackers 5. Good practices <ul style="list-style-type: none"> • Risk management, analysis and processing • Risk reduction • Managing and governing cybersecurity 6. Risk management <ul style="list-style-type: none"> • Protection means • Identifying risks • Assessing and treating risk
Learning Outcomes	<p>The students will be able to:</p> <ul style="list-style-type: none"> • understand the current issues, processes and methods of cybersecurity for electronic systems that are becoming hyperconnected. • evaluate and control the cyber risk specific to companies.
Assessment method	Final written exam (1 hour) (50%) + Lab report (50%)
Literature	Relevant literature will be distributed in the course.

Course Title	Master thesis
Module ID	4EMINENT004
Responsible Lecturer	All professors of the department
University	University of Orléans
Semester	4
Relation to curriculum	Mandatory
Credit points (ECTS)	30
Teaching type	Individual or group project
Workload	independent work: 800 h
Course description	<p>For the work on the master's project, candidates will use the knowledge and skills received during the first three semesters of Master studies. During the master's project, candidates need the following key qualifications:</p> <ul style="list-style-type: none"> • Most assignments involve extensive system development work; the related planning/organisational skills are required. • The ability to use literature resources and other sources to collect and structure material on the given topic. • The ability to read and understand demanding original English professional literature. • The ability to draft a lecture on a non-trivial scientific topic in front of a specialist audience (i.e., also to design it didactically correctly) and to present it using standard media. • The ability to write texts of approx. 60-120 pages, usually to explain the corresponding scientific content.
Learning Outcomes	The candidate will independently work on a problem in her or his field of study using scientific methods within a specified period of time.
Assessment method	The Master's thesis is evaluated by a supervisor assigned to monitor the work and a defence committee. Evaluation is based on complexity of the project, quality of the technical report, value of the research, created applications and models, presentation and defence of the thesis.
Literature	The literature is specified individually according to a specific problematic task.

9. Vilnius Gediminas Technical University

Course Title	Intelligent Systems
Module ID	ELESM17105/4EMINENT501
Responsible Lecturer	Prof. Dr. Arturas Serackis
University	Vilnius Gediminas Technical University
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	6
Teaching type	Lecture; Laboratory works; Individual or group projects; Case study
Workload	theory lectures: 28 h Laboratory works: 15 h consultations: 2 h independent work: 115 h total number of working hours 160 h
Course description	<p>This subject provides knowledge and ability to creatively apply the fundamentals of the natural science and mathematics, thoroughly knowledge and understanding of the electronics engineering study field principles that correspond to the study programme and be able to apply them for solving new engineering problems.</p> <p>Ability to identify, locate and evaluate the data needed for required engineering tasks by using databases and other sources of information.</p> <p>Understand in theory the technology of intelligent systems and be able to apply the acquired knowledge to solve various type signal processing tasks.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Introduction. Artificial Neural Networks • Artificial Neural Networks. Multi-Layer Perceptron Network • Artificial Neural Networks. Radial Basis Function Networks • Artificial Neural Networks. Support Vector Machines • Artificial Neural Networks. Kohonen Network • Optimisation. Evolutionary Computations • Knowledge Systems • Rule-based Systems • Uncertainty. Fuzzy Logic • Intelligent Agents • Hybrid Systems • Application of the Intelligent Systems
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • acquire knowledge about intelligent systems, their composition and working principles based on artificial neural networks, evolutionary algorithms or fuzzy logic, is acquired. • be able to simulate with Matlab intelligent systems or their parts and learn the application of intelligent systems to process and analyse sounds, images or other signals of technical nature.
Assessment method	<p>Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group project/work/paper.</p> <p>Final mark FM evaluation formula: $FM = IE \times 0.1 + FE \times 0.6 + 1/4 \times (L1 + L2 + L3 + L4) \times 0.1 + R \times 0.1 + 1/2 \times (N1 + N2) \times 0.1,$ here: IE – evaluation of the intermediate exam; FE – evaluation of the final exam; L – total evaluation of the laboratory; N – evaluation of the group or individual homework; R – evaluation of the Report. Evaluation formula of the group or individual homework N: $N = N1 \times 0.2 + N2 \times 0.6 + N3 \times 0.2,$ here: N1 – evaluation of the analysis methodology and hardware selection; N2 –</p>

	evaluation of amount and quality of analysis performed, results received; N3 – evaluation of the conclusions.
Literature	<ul style="list-style-type: none"> • Haykin, Simon S. 2009. Neural networks and learning machines. 3rd ed. Pearson Education, 2009. 934 p. • Hopgood, A. A., 2000. Intelligent systems for engineers and scientists//CRC Press LLC.

Course Title	Microcontrollers of ARM Architecture
Module ID	ELKRM17306/4EMINENT502
Responsible Lecturer	Prof. Dr. Algirdas Baškys
University	Vilnius Gediminas Technical University
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	9
Teaching type	Lecture; Laboratory works; Individual or group projects; Case study
Workload	theory lectures: 28 h laboratory works: 30 h consultations: 2 h independent work: 180 h total number of working hours: 240 h
Course description	<p>The subject provides knowledge and critical assessment of the latest achievements in the study field of the electronics engineering. Ability to plan and carry out analytical, modelling and experimental studies by applying new problem-solving methods and critically evaluate their results and draw conclusions. Ability to apply their knowledge and understanding to see the standard and non-standard computer systems and embedded systems engineering problems, clearly formulate and practically solve them by applying theoretical models and innovative research methods, including mathematical analysis, computational modelling and experimental research methods.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Introduction to Internet of Things Embedded Systems based on the high performance. Microcontrollers • ARM microcontroller architecture 1: Memory, Protection Unit, CPU, Registers • ARM microcontroller architecture 2: Stacks, Instruction set, Timers • ARM microcontroller architecture 1: Power modes, Floating Point Unit • ARM embedded software development 1: Standards, Barrier usage scenarios, Determinism • ARM embedded software development 2: Fault tolerance, Code generation, Image generation • ARM embedded software development 3: Real Time Operational Systems (RTOS) • ARM embedded software optimisation. ARM embedded software debug: • System startup: what happens when a processor starts. Implementation of Cortex-M series processors
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • acquire general knowledge about the ARM microcontrollers purpose, classification, architecture, functional blocks and programming are obtained in the ARM architecture microcontrollers course. • be able to analyse the specific representative of ARM microcontrollers family in details. • know about the microcontroller features, hardware and software used for the editing and debugging of programmes. • have the theoretical and practical skills of development of programmes for the ARM microcontrollers.
Assessment method	<p>Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group project/work/paper.</p> <p>Formula for calculating the final grade G: $G = 0,4 E + 0,2 KL + 0,1 N1 + 0,1 N2 + 0,2 L$, where: E – grade of final exam; KL – grade of intermediate examination; N1 ir N2 – grades of first and second homework; L – grade of laboratory works.</p>
Literature	<ul style="list-style-type: none"> • Yiu, Joseph, "The Definitive Guide to the ARM Cortex-M0", 1st edition, Newnes, 2011.

	<ul style="list-style-type: none"> • Yiu, Joseph, "The Definitive Guide to the ARM Cortex-M3 and Cortex-M4 Processors", 3rd edition, Newnes, 2013. • Martin, Trevor, "The Designer's Guide to the Cortex-M Processor Family: A Tutorial.
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Course Title	Research Lab Course: Internet of Things (with course project)
Module ID	ELKRM17309/4EMINENT503
Responsible Lecturer	Prof. Dr. Darius Guršnys
University	Vilnius Gediminas Technical University
Semester	3
Relation to curriculum	Mandatory course
Credit points (ECTS)	9
Teaching type	Lecture; Laboratory works; Individual or group projects; Case study
Workload	theory lectures: 42 h laboratory works: 15 h consultations: 3 h independent work: 180 h total number of working hours: 240 h
Course description	<p>Subject is focused on Internet of Things (IoT) technologies, hardware and software solutions for standalone internet connected devices. Module content includes: IoT architecture, communication protocols, cloud platforms, IoT data processing and visualisation, IoT security. Requires scientific investigation and experimentation. Elevates ability to combine theoretical and practical elements, to apply information technologies, to assess and analyse literature and data.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Introduction to the subject • IoT architecture • IoT hardware • IoT software • IoT communication protocols • IoT data protocols • Programming of IoT devices • IoT security • IoT cloud platforms • IoT data processing and visualisation
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • be able to plan and carry out analytical, modelling and experimental studies of the internet of things by applying new problem-solving methods and critically evaluate received data. • be able to make engineering decisions when faced with multiple, uncertain and inaccurately defined engineering problems that corresponds to the internet of things. • be able to effectively work independently and in a team, be the leader of the team, will have very good knowledge on project management and business aspects, and will be able to know how to communicate with the engineering community. • know the organising principles and requirements of engineering activities related to the internet of things, will be able to assess the engineering activities in a sense of workplace safety, environmental, ethical, and commercial aspects.
Assessment method	<p>Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group project/work/paper.</p> <p>Formula for calculating the final grade G: $G = 0,5 E + 0,1 N1 + 0,1 N2 + 0,2 K + 0,1 L$, here: E – grade of final exam; K – grade of colloquium; N1 and N2 – grade of first and second homework; L – cumulative grade of laboratory works.</p>
Literature	<ul style="list-style-type: none"> • Waher, P. Learning Internet of Things. Packt Publishing. 2015. 242 p. • Buyya, R.; Dastjerdi, A., V. Internet of Things: Principles and Paradigms. Morgan Kaufmann. 2016. 378 p.

	<ul style="list-style-type: none">• Monk, S. Raspberry Pi Cookbook: Software and Hardware Problems and Solutions. 2nd edition. O'Reilly Media. 2016. 510 p.
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Course Title	High Frequency Circuit Design
Module ID	ELKRM17307/4EMINENT504
Responsible Lecturer	Prof. Dr. Vaidotas Barzdėnas
University	Vilnius Gediminas Technical University
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture; Laboratory works; Individual or group projects; Case study
Workload	theory lectures: 28 h laboratory works: 15 h consultations: 2 h independent work: 115 h total number of working hours: 160 h
Course description	<p>The course of the High-Frequency Circuit Design delivers knowledge of the impedance importance for RF circuits design, analysed LC resonances, matching and distributed circuits, Smith charts using to solve tasks, analysed RF filters and transistor amplifiers design, provides design features of a printed circuit boards for radio frequency circuits.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Introduction • Review of AC Analysis and Network Simulation • LC Resonance and Matching Networks • Distributed Circuits • The Smith Chart • Matrix Analysis • Electromagnetic Fields and Waves • Filter Design • Transistor Amplifier Design • Design Features of a Printed Circuit Boards for Radio Frequency Circuits
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • know and critical assess the latest achievements in the electronics engineering that correspond to the high frequency circuits design subject. • be able to make engineering decisions when faced with multiple, uncertain and inaccurately defined engineering problems that corresponds to the high frequency circuits design subject. • based on the knowledge of the high frequency circuits design subject, will be able to merge knowledge from different study fields, properly choose engineering equipment and software, will be able to deal with multiple engineering problems.
Assessment method	<p>Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group project/work/paper.</p> <p>An expression for an evaluation of a final mark G: $G = 0,4 \times E + 0,3 \times TE + 0,2 \times P + 0,1 \times N$, here: E – mark of session exam; TE – mark of midterm exam; P – total mark of practical works; N – mark of group homework.</p> <p>An expression for an evaluation of the practical works P: $P = (PDG1 + PDG2) / 2$ here: PDG1 – the first defence of practical works; PDG2 – the second defence of practical works. An expression for an evaluation of the homework's N: $N = (N1 + N2 + N3) / 3$ here: N1 – the first homework; N2 – the second homework; N3 – the third homework.</p> <p>Note: E, K, P and N grades must not less than 5.</p>
Literature	<ul style="list-style-type: none"> • C. Bowick. RF circuits design. Newnes, 2014, 176 psl.

	<ul style="list-style-type: none"> • Joseph F. White. High Frequency Techniques: An Introduction to RF and Microwave Design and Computer Simulation. 2016 John Wiley & Sons, 528 psl. • Razavi, Behzad. RF microelectronics. 2012. Pearson, 2012, 932 p. • Sobot, Robert. Wireless communication electronics: introduction to RF circuits and design techniques. http://link.springer.com/book/10.1007%2F978-1-4614-1117-8.
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Course Title	Data Mining Techniques
Module ID	ELKRM17308/4EMINENT505
Responsible Lecturer	Prof. Dr. Nerijus Paulauskas
University	Vilnius Gediminas Technical University
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture; Laboratory works; Individual or group projects; Case study
Workload	theory lectures: 28 h laboratory works: 28 h consultations: 2 h independent work: 115 h total number of working hours: 160 h
Course description	<p>Subject is focused on modern data mining techniques and their application to find previously unknown and potentially useful information analysing big data sets. Module content includes: data pre-processing and exploratory data analysis, classification methods (nearest neighbour's method, naive Bayes classifier and decision trees), regression analysis, data clustering and evaluation of model performance.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Introduction to the subject. Common knowledge • Data preprocessing • Exploratory data analysis • Data classification methods. Distance metrics • Classification using nearest neighbours • Classification using naive Bayes • Prediction methods. Regression analysis • Decision trees • Cluster analysis. Clustering with k-means • Evaluating model performance • Enhancing model performance
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • know and critical assess the latest achievements in the electronics engineering that correspond to the data mining techniques. • be able to make engineering decisions when faced with multiple, uncertain and inaccurately defined engineering problems that corresponds to the data mining techniques. • based on the knowledge of the data mining techniques, will be able to merge knowledge from different study fields, properly choose engineering equipment and software, will be able to deal with multiple engineering problems.
Assessment method	<p>Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group project/work/paper.</p> <p>Assessments methods of students' formula: Formula for calculating the final grade G: $G = 0,4 E + 0,05 N1 + 0,05 N2 + 0,05 N3 + 0,25 TE + 0,2 P$, here: E – grade of final exam; TE – grade of midterm exam (colloquium); N1, N2 and N3 – grade of first, second and third group homework; P – cumulative grade of practical works.</p>
Literature	<ul style="list-style-type: none"> • Larose D. T., Larose C. D. Data Mining and Predictive Analytics. Wiley, 2nd Edition. 2015. 824 p. • Lantz B. Machine Learning with R. 2nd Edition, Packt Publishing. 2015. 454 p. • Zumel N., Mount J. Practical Data Science with R. Manning Publications, 2014. 416 p.

Course Title	Data Centres
Module ID	ELKRM17303/4EMINENT506
Responsible Lecturer	Liudas Duoba
University	Vilnius Gediminas Technical University
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture; Laboratory works; Individual or group projects; Case study
Workload	theory lectures: 28 h laboratory works: 15 h consultations: 2 h independent work: 115 h total number of working hours: 160 h
Course description	<p>Subject is focused on modern data centres, their architecture. The module includes fundamental knowledge of data centres and cloud computing. During the lecture will be discussed about data networks, data storage systems, data centres and cloud platform architecture, data centre security, data traffic engineering, resource management, types of data centres. Below are listed some, but not all, of the core technology to be discussed during lectures: VXLAN, MLAG, ECMP, LPG, OpenStack, KVM, VMware Hyper-Z, Docker, OpenVZ, NAS, and SAN. It will examine modern operating data centre best practices.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Introduction to Data Centres • Structure of Data Centres • Data Centres Networks • Virtualization Technologies • Management of Data Centres • Data Centres Security • Operation of Data Centres
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • know and critical assess the latest achievements in the electronics engineering that correspond to the data centres. • be able to apply knowledge that corresponds to the data centres subject, to develop new, innovative engineering ideas in solving non-standard computer engineering design problems. • Based on the knowledge of data centres, will be able to merge knowledge from different study fields, properly choose engineering equipment and software, will be able to deal with multiple engineering problems.
Assessment method	<p>Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group project/work/paper.</p> <p>Assessments methods of students' formula: Formula for calculating the final grade G: $G = ND1 \times 0,2 + ND2 \times 0,2 + SE \times 0,4 + L \times 0,2$; where: ND_i – nth homework grade; SE – final exam grade; L – cumulative laboratory grade. Formula for calculating the laboratory grade L: $L = L1 \times 0.2 + L2 \times 0.2 + L3 \times 0.6$, where: L1 – grade for technical accomplishment of the task; L2 – grade for quality of the lab report; L3 – grade for efficiency of the lab report defense.</p>
Literature	<ul style="list-style-type: none"> • Hwaiyu Geng. Data Center Handbook. Wiley, 2014. • Gary Lee. Cloud Networking: Understanding Cloud-based Data Center Networks. Morgan Kaufmann; 1 edition, 2014. • Thomas Erl. Cloud Computing: Concepts, Technology & Architecture (The Prentice Hall Service Technology Series from Thomas Erl). Prentice Hall, 2013. • Nayan B. Ruparelia. Cloud Computing. MIT Press, 2016.

	<ul style="list-style-type: none">• Mr. Ray J Rafaels. Cloud Computing: From Beginning to End. CreateSpace Independent Publishing Platform, 2015.
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Course Title	Hydropower and Biofuel
Module ID	ELEIM17304/4EMINENT507
Responsible Lecturer	Prof. Dr. Audrius Grainys
University	Vilnius Gediminas Technical University
Semester	3
Relation to curriculum	Elective
Credit points (ECTS)	6
Teaching type	Lecture; Laboratory works; Individual or group projects; Case study
Workload	theory lectures: 28 h laboratory works: 28 h consultations: 2 h independent work: 115 h total number of working hours: 160 h
Course description	<p>Subject provides knowledge about the basic types of hydroelectric power plants, construction of hydropower stations, electrical and electronic devices and systems their design and operation.</p> <p>Syllabus:</p> <ul style="list-style-type: none"> • Fundamentals of hydroelectric power plants • Hydroelectric power plants in Lithuania and abroad • Types of hydroelectric system • Parts of hydroelectric system • Categories of turbines and how they are selected • Hydroelectric power plants in the grid • Power generation and transmission
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • know and critical assess the latest achievements in the electrical engineering that correspond to the hydropower and biofuel technologies. • be able to deal with multiply hydropower engineering problems through different study fields. • be able to make engineering decisions when faced with multiple, uncertain and inaccurately defined engineering problems that corresponds to the hydropower and biofuel technologies. • based on the knowledge of the hydropower and biofuel technologies, will be able to merge knowledge from different study fields, properly choose engineering equipment and software, will be able to deal with multiple engineering problems.
Assessment method	<p>Writing or oral exam; Homeworks; Report and defence of laboratory works; Report of individual or group project/work/paper.</p> <p>An expression for an evaluation of a final mark G: Session and intermediate examinations using identical questions for the whole group, report. Final assessment grade G: $G = SE \times 0,4 + K \times 0,4 + R \times 0,2$, here SE – session examination; K – intermediate examination; R – report.</p>
Literature	<ul style="list-style-type: none"> • Paul Breeze, Hydropower, 28th March 2018, Academic Press, https://www.sciencedirect.com/book/9780128129067/hydropower. • David M. Clemen, 194 Pages/Hardcover/1999. • Hermann-Josef Wagner, Jyotirmay Mathur. Introduction to Hydro Energy Systems, Springer-Verlag Berlin Heidelberg, 2011.

Course Title	Master Thesis
Module ID	ELKRM17402/4EMINENT005
Responsible Lecturer	All professors of the department
University	Vilnius Gediminas Technical University
Semester	4
Relation to curriculum	Mandatory
Credit points (ECTS)	30
Teaching type	Individual or group projects
Workload	independent work: 800 h total number of working hours: 800 h
Course description	Completion of research planned on the preparatory phase in the research lab course in the 3rd semester, preparation of analysis of economic and environmental impact and human safety, preparation of final report and graphical material of Graduation Thesis, preparation presentation for Graduation Thesis defence and presentation during public defence. Abilities to thoroughly prepare graphical and textual documentation, to responsibly schedule own work and time, to be communicative working in a team and making oral presentation, are developed.
Learning Outcomes	<p>The students will:</p> <ul style="list-style-type: none"> • be able to plan and carry out analytical, modelling and experimental studies of advanced sensor systems by applying new problem-solving methods and critically evaluate received data. • know and understand the importance of commercial requirements. • be able to effectively work independently and, in a team, be the leader of the team, will have very good knowledge on project management and business aspects and will be able to know how to communicate with the engineering community. • holistically understand the effects of engineering solutions on the society and the environment, will comply with professional ethics and understands of the responsibility for the engineering activities. • know the organising principles and requirements of engineering activities related to the computer systems and embedded systems, will be able to assess the engineering activities in a sense of workplace safety, environmental, ethical and commercial aspects.
Assessment method	The Master's Graduation Thesis is evaluated by defence committee. Evaluation is based on complexity of the Graduation Work task, quality of the technical report of Graduation Work, value of the research, created applications and models, evaluation of supervisor and reviewers, presentation and defence of the Graduation Thesis.
Literature	The literature is specified individually according to a specific problematic task.

STUDENT AGREEMENT

Erasmus Mundus Joint Master Programme under Erasmus+

European Master of Science (M.Sc.) in Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors (EMINENT)

Student recipient of an Erasmus Mundus Scholarship Academic Years 20XX-20XX

The Coordinating Institution, Universität Siegen, School of Science and Technology, Adolf- Reichwein-
Straße 2, 57076 Siegen, represented by Prof. Dr.-Ing. Peter Haring Bolívar, as the *First Signatory*,

on behalf of the Consortium of the Joint Erasmus Mundus Master Program “*Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors*” (EMINENT),
formed by the following Universities:

- University of Siegen (USIEGEN), Germany
- Hellenic Mediterranean University (HMU), Greece
- Nova University Lisbon (UNL), Portugal
- University of Orléans (UO), France
- Vilnius Gediminas Technical University (VILNIUS TECH), Lithuania

of the one part, and

Name:

First name:

Date of birth:

Place of birth:

Nationality:

Passport number:

**Place(s) of residence in the
12 months prior to enrolment:**
(supporting documents are
provided by the student)

hereafter referred to as *the Student*, the *Second Signatory*, on the other part, have agreed the following
terms and conditions:

Preamble

The joint EMINENT coordination, represented by the EMINENT director Prof. Dr.-Ing. Haring Bolívar, on behalf of the EMINENT Consortium, is responsible towards the students for the obligations arising from the agreement. The EMINENT director exercises the functions specified in this Student Agreement.

The academic organization and assessment rules are given in the *Examination Regulations for the European Master on Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors (EMINENT)*. The Examination Regulations, as well as other relevant information on the programme are provided on the programme's website:

<https://eminent-master.eu>

Consortium

The consortium of the Erasmus Mundus Joint Master Degree Programme entitled “Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors” (henceforth *EMINENT*), is constituted of the University of Siegen (henceforth USIEGEN), the Hellenic Mediterranean University (henceforth HMU), the Nova University Lisbon (henceforth UNL), University of Orléans (henceforth UO), and the Vilnius Gediminas Technical University (henceforth VILNIUS TECH).

The EMINENT master's programme is supported by the European Commission Erasmus+ Programme under the Grant Agreement GAP-101128051-1 and in full compliance with the EMJM action.

1. Scope

The student has been selected by the EMINENT consortium to participate in the EMJM-EMINENT programme (worth 120 ECTS¹; having a duration of two academic years of full-time study) for the academic session 2024 - 2026 in accordance with the rights and obligations stipulated below. *The student* has been selected to receive a scholarship in accordance with section 3 of this agreement.

2. Admission

The student declares

- a. to have met the necessary requirements to be admitted to the programme, according to § 5 in the *Examination Regulations for the European Master on Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors (EMINENT)*.
- b. to have provided true and authentic information during all stages of the application and registration process
- c. to have never been granted an Erasmus Mundus Master Scholarship or another scholarship funded by the European Commission
- d. to refuse any other scholarship or bursary funded by the European Commission under other EU Funded programmes while receiving the Erasmus Mundus Master Scholarship to avoid double funding

¹ <https://education.ec.europa.eu/levels/higher-education/inclusion-connectivity/european-credit-transfer-accumulation-system>

- e. to provide the documentation and information necessary for processing the scholarship and its administration

3. Financial Management

3.1 Tuition

No tuition fees will be requested from students participating in the EMINENT programme (with or without a scholarship). Ancillary fees may be charged in accordance with the respective university regulations (e.g., semester fees at USIEGEN covering the semester ticket, solidary contributions and social contributions to the Student Union). Up-to-date information on the collection of additional contributions is published on the EMINENT website.

3.2 Contribution to insurance costs

The consortium will provide the necessary insurance of the student under the Erasmus+ programme according to the “Minimum Requirements for the health and accident insurance coverage provided under EMJM”. To do so, the coordinating institution will contract an insurance policy for the students for the whole duration of his/her participation in the programme. This insurance includes health, liability and accident insurance. All details on the insurance coverage and general conditions will be provided to the student before he/she starts his/her studies. For further insurance beyond these minimum requirements, it is recommended that the student takes out additional insurance at his/her own expense.

The Consortium shall supply the student with detailed information about the specific risks existing in the environment in which he/she will be studying.

3.3 Contribution to individual needs of students with disabilities

Contribution for individual needs are eligible if they fulfil the general eligibility conditions set in the grant agreement.

Enrolled students will declare what type of items/services are needed and their cost. The applicable unit cost will be identified as the rate corresponding to or immediately lower than the estimated expenses. This unit cost is a contribution and is not intended to fully cover the actual costs.

3.4 Student Scholarship

3.4.1 The scholarship is awarded for full-time enrolment only.

3.4.2 The student will receive a scholarship to cover subsistence, installation, travel and fees, granted by the European Commission to finance the participation in the EMINENT programme, starting in the academic year 2024/2025.

3.4.3 The student receives a scholarship of up to 33.600€ in total. The student receives a maximum of 24 instalments à 1.400€ per month, with a minimum of 12 instalments. The scholarship might be terminated as stated in 3.5.

The student receives a monthly sum of 1.400€. The sum will be transferred to the students' bank account in monthly instalment at the end of each month in advance for the next month. If the student does not start his/her enrolment at the 1st day of a month the full month sum will be transferred. The difference is deduced from the final scholarship transfer.

3.4.4 The scholarship will be transferred to a European bank account provided by the scholarship recipient. The student will open a personal European bank account in € currency if he/she does not already have one and will provide the full details of this account to the administrative coordinator at the University of Siegen. The account details must be forwarded before or immediately after the student arrives at his/her first semester institution. Changes of the bank account must be promptly forwarded.

3.4.5 The scholarship does not create or entitle an employer-employee relation between EMINENT and the student.

3.5 Termination of the Scholarship

3.5.1 Academic shortcoming

To keep the scholarship after the first year, the grant holder must successfully pass the modules of the first two semester with an average grade of 2.7 (in the German grading system). If the student fails to reach the goal, the student will be interviewed by the EMINENT Steering Committee to explain the non-achievement. In addition, the opinion of the student's Academic Tutor (see section 5.3) on the student's potential shall be requested. The EMINENT Steering Committee will decide on the continuation of the scholarship. In case the Steering Committee has decided to terminate the scholarship for a student, the student must be informed three months before the payment is cancelled.

3.5.2 Drop-out of the programme

In case a student drops out of the programme, the student is not eligible to receive any payment from the month on he/she is not enrolled anymore in the programme. The payment received for the month of the exmatriculation must be returned to the Consortium Coordinator within 10 days.

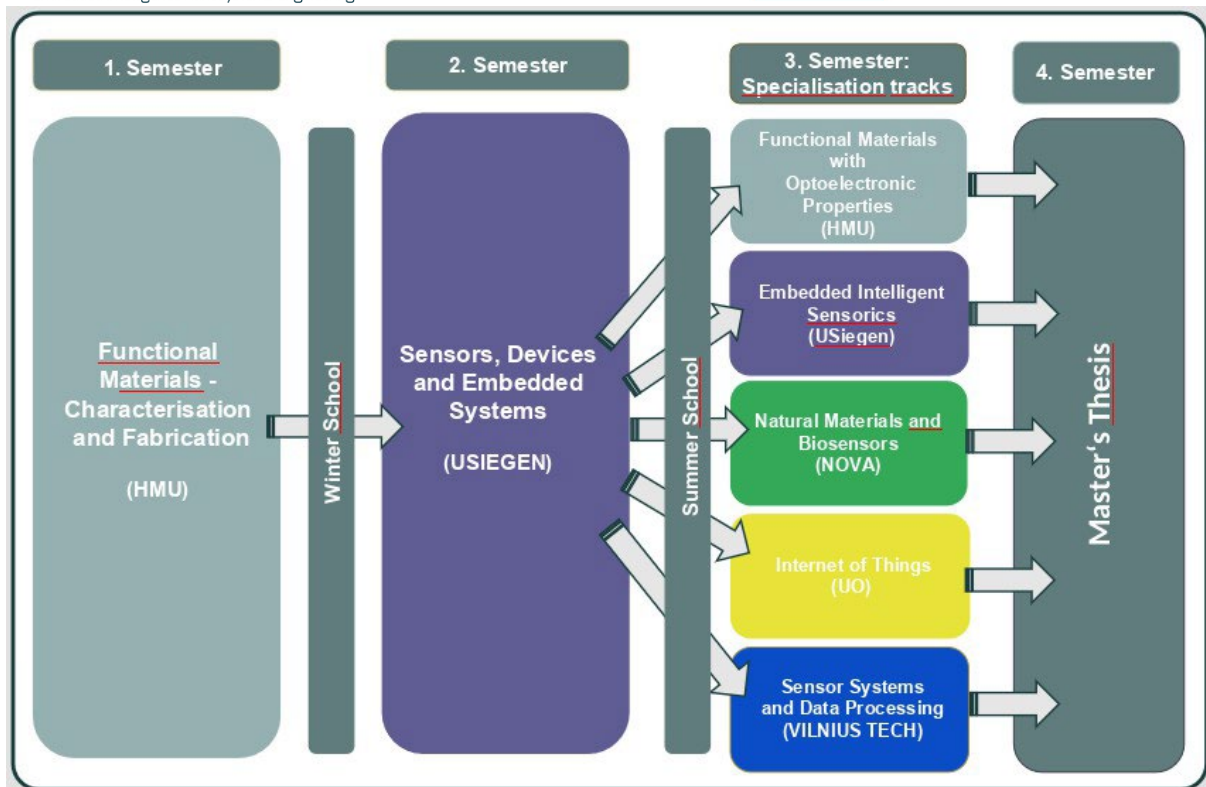
3.5.3 Violation of the code of conduct

In cases of misconduct and violations of the code of conduct mentioned in 6.2, the EMINENT Steering Committee may decide, after hearing the student, to terminate the scholarship immediately.

4. Content

4.1 Study track and mobility

The student must at least spend two study periods in two countries with a minimum of one academic semester each. These two countries must be different from the country of residence of the student at enrolment stage. Each of the two mandatory study periods must correspond to a workload of at least one academic semester (30 ECTS credits or equivalent). Compulsory mobility periods cannot be replaced by virtual mobility (distance learning). The student must achieve a total of 120 ECTS. The study path is outlined below. All students spend their first semester at the Hellenic Mediterranean University (HMU) in Greece and the second semester at the University of Siegen (USIEGEN). In the beginning of the second semester students will choose their specialization track and therewith their host university during the third semester. In addition to their first choice, students shall provide a second choice as an alternative in case a placement in the first-choice track is not feasible. Students whose state of residence, at the time of enrolment, was Greece or Germany, must spend their third semester (specialisation track) and/or their fourth semester (master thesis) at VILNIUS TECH, UO or UNL in order to cover the minimum requirement of two full-semester mobilities (see above). In case the student decides to spend the fourth semester at a different partner university as the one he/she is currently staying at, he/she needs to inform the EMINENT Examination Committee (see *Examination Regulations* § 4,3) by the 30st of November of the respective year. All important dates of the academic year (including Welcome Days, lecture periods, exam periods, Summer and Winter Schools) will be given on the EMINENT website.



4.2 Examinations

All matters regarding examination are set out in the “*Examination Regulations for the European Master on Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors (EMINENT)*”.

4.3 Complaints and appeals

The EMINENT Examination Committee is responsible for deciding on appeals against decision made in examination proceedings as outlined in the EMINENT examination regulations.

Any other complaints shall be directed to the respective facility of the concerned institution. Complex requests might be appealed to the Steering Committee. The Steering Committee will consider the complaint or request.

4.4 Language

The language of the courses is English for the whole duration of the EMINENT programme. All examinations shall be conducted in English language.

4.5 Master's certificate

When the student has successfully completed the EMINENT programme, he/she will be awarded the academic degree “Master of Science “(M.Sc.), a joint master’s degree in “Embedded Intelligence Nanosystems Engineering” with single diploma parchment issued by the partner universities the student has spent at least one semester and earned at least 30 ECTS during his/her participation in the programme.

5. Student Support Service

5.1 International Relations Offices

Each partner university is committed to welcome international students, to assist them in registration procedures and to provide them with information about accommodation facilities. The International Relations Offices at each partner institution will help students to find their way around the university and will assist in questions about visas, accommodation, and mobility. In addition, the student will receive the “How To Get Around EMINENT” manual containing all necessary contacts and practical information. At the beginning of each winter semester, the EMINENT Foreign Student Support Office at HMU, will organise a Welcome Day for the new cohort of EMINENT students. During that day, students will meet each other and receive the most important information regarding the programme, including the programme’s structure, the offered facilities, and the scheduled mobility throughout. In addition, a similar Welcome Day will be organised at each partner institution in the beginning of the second and third semester to welcome their new students.

5.2 Website

Information on the programme, the universities, the lecturers and latest news connected to the EMINENT programme are given on the programme’s website: <https://eminent-master.eu>.

5.3 Mentoring

The EMINENT Mentoring System is carried out on two levels:

- At the beginning of their studies, students are assigned an Academic Tutor. The academic tutor will advise on academic issues such as specialisation coaching. Students will keep their academic tutor throughout their first three semesters where communication will take place virtually or face-to-face. After the third semester, the supervisors of the master’s thesis take over this task.
- At each partner institution where a student is staying, he/she is assigned a local Student Buddy who is not a student of the EMINENT programme but who has been studying at the respective university for at least one year. The Student’s Buddy will help and assist EMINENT students to get integrated into campus life and within the local society during the mobility period.

6. Participation

6.1 Attendance

The student commits to duly attend the EMINENT programme, including the prescribed courses, examinations and Summer/Winter Schools.

The student may attend the graduation ceremony at the institution he/she is staying last at or might take part in the graduation ceremony of one of the partner institutions he/she has spent at least one semester and earned at least 30 ECTS.

The student shall follow the rules for attendance and discipline in place in each of the EMINENT institutions that the student attends, following the students’ individual study track, if not stated otherwise in the *Examination Regulations*.

6.2 Code of Conduct

The student hereby commits to:

- a. If applicable: Take all necessary measures to obtain a visa, and apply for their residence permit from the national and local authorities upon their arrival in the host countries.

- b. to participate in the orientation and welcome meetings/courses as well as informative and official meetings and events.
- c. to attend assiduously, and with the objective of successfully passing, the courses, seminars, laboratories, thesis, and Winter/Summer schools inherent to the EMINENT programme.
- d. behave in an ethical way. The student does not commit any fraudulent acts, does not cheat, falsify or plagiarize any academic work.
- e. respectfully use the access to equipment and installations and handle them with greatest care. The student will not perform any unauthorized access or violation of departmental, school or institution rules.
- f. fulfil all administrative requirements established by the EMINENT Coordinating institution and all consortium partners by due date.
- g. provide information and documentation that support the reporting obligations of the consortium and its institution regarding the EMJM and its mobility requirements.
- h. to take part in QA surveys/evaluations conducted by the consortium and/or the European Commission/EACEA.

Any incident against the above stipulated commitments will be treated by the respective authorities and/or the Steering Committee.

6.3 Erasmus Mundus Students and Alumni Association

The student is strongly encouraged to join the Erasmus Mundus Students and Alumni Association (EMA). More information is given on the association's website: <http://www.em-a.eu/>

6.4 Exclusion from the EMINENT programme

The student might be excluded from the EMINENT programme if:

- a. the student is subject to disciplinary measures leading to their exclusion from the EMINENT programme
- b. the student is subject to legal prosecutions that prevents the attendance of the programme
- c. the student withdraws from the EMINENT programme on their own will or by force majeure
- d. the student does not meet the academic requirement as set in the examination rules

The procedure, including the appeal and exclusion procedure, is subject to the rules and regulations of the institution the student is staying at the time of the decision of exclusion, involving the Steering Committee.

Upon exclusion, the student shall in due time and before the departure pay all outstanding costs.

7. Modification of the Contract

Any alteration to the present contract must be communicated in writing. Upon mutual agreement of contractual modifications, EMINENT will issue an addendum to the present agreement.

8. Data protection

The European Education and Culture Executive Agency (EACEA), in the context of managing the Erasmus Mundus Joint master's degrees, collects and processes the personal data of some of the candidates. In particular, certain data of the scholarship holders, non-scholarship holders and reserve list candidates is shared with the Agency through the EACEA Mobility Tool and treated according to the following privacy statement.

9. Intellectual Property

The student agrees that the consortium may store the master's thesis either as a hardcopy or as electronic version. The results of the student's work belong to the hosting institutions.

10. Duration of the contract

The student agreement is valid from the academic years of 2024/2025 for as long as the student is enrolled in the EMINENT programme.

If the student fails to provide evidence of fulfilling the agreement, the payment of the scholarship will be terminated according to the reasons stipulated in 3.4 and the student might be excluded from the EMINENT programme according to 3.5.

Signatures

Both parties have read and accepted the conditions defined above.

The student agrees with the terms of this contract by signature. Signed in twofold.

The Student

Name, Surname

Signature

Place, Date

The Programme Director

Prof. Dr.-Ing. Peter Haring
Bolivar

Signature

Place, Date

STUDENT AGREEMENT
Erasmus Mundus Joint Master Programme under Erasmus+

**European Master of Science (M.Sc.) in Embedded Intelligence Nanosystems Engineering –
from Nanoscale Technologies to Ubiquitous Smart Sensors
(EMINENT)**

Academic Years 20XX-20XX

**The Coordinating Institution, Universität Siegen, School of Science and Technology, Adolf- Reichwein-
Straße 2, 57076 Siegen, represented by Prof. Dr.-Ing. Peter Haring Bolívar, as the *First Signatory*,**

on behalf of the Consortium of the Joint Erasmus Mundus Master Program “*Embedded Intelligence
Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors*” (EMINENT),
formed by the following Universities:

- University of Siegen (USIEGEN), Germany
- Hellenic Mediterranean University (HMU), Greece
- Nova University Lisbon (UNL), Portugal
- University of Orléans (UO), France
- Vilnius Gediminas Technical University (VILNIUS TECH), Lithuania

of the one part, and

Name:

First name:

Date of birth:

Place of birth:

Nationality:

Passport number:

**Place(s) of residence in the
12 months prior to enrolment:**
(supporting documents are
provided by the student)

hereafter referred to as *the Student*, the *Second Signatory*, on the other part, have agreed the following
terms and conditions:

Preamble

The joint EMINENT coordination, represented by the EMINENT director Prof. Dr.-Ing. Haring Bolívar, on behalf of the EMINENT Consortium, is responsible towards the students for the obligations arising from the agreement. The EMINENT director exercises the functions specified in this Student Agreement.

The academic organization and assessment rules are given in the *Examination Regulations for the European Master on Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors (EMINENT)*. The Examination Regulations, as well as other relevant information on the programme are provided on the programme's website:

<https://eminent-master.eu>

Consortium

The consortium of the Erasmus Mundus Joint Master Degree Programme entitled “Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors” (henceforth *EMINENT*), is constituted of the University of Siegen (henceforth USIEGEN), the Hellenic Mediterranean University (henceforth HMU), the Nova University Lisbon (henceforth UNL), University of Orléans (henceforth UO), and the Vilnius Gediminas Technical University (henceforth VILNIUS TECH).

The EMINENT master's programme is supported by the European Commission Erasmus+ Programme under the Grant Agreement GAP-101128051-1 and in full compliance with the EMJM action.

1. Scope

The student has been selected by the EMINENT consortium to participate in the EMJM-EMINENT programme (worth 120 ECTS¹; having a duration of two academic years of full-time study) for the academic session 2024 - 2026 in accordance with the rights and obligations stipulated below. *The student* participates in the study programme at his/her own expenses.

2. Admission

The student declares

- a. to have met the necessary requirements to be admitted to the programme, according to § 5 in the *Examination Regulations for the European Master on Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors (EMINENT)*.
- b. to have provided true and authentic information during all stages of the application and registration process.

3. Financial Management

3.1 Tuition

No tuition fees will be requested from students participating in the EMINENT programme (with or without a scholarship). Ancillary fees may be charged in accordance with the respective university regulations (e.g., semester fees at USIEGEN covering the semester ticket, solidary contributions

¹ <https://education.ec.europa.eu/levels/higher-education/inclusion-connectivity/european-credit-transfer-accumulation-system>

and social contributions to the Student Union). Up-to-date information on the collection of additional contributions is published on the EMINENT website.

3.2 Contribution to insurance costs

The consortium will provide the necessary insurance of the student under the Erasmus+ programme according to the “Minimum Requirements for the health and accident insurance coverage provided under EMJM”. To do so, the coordinating institution will contract an insurance policy for the students for the whole duration of his/her participation in the programme. This insurance includes health, liability and accident insurance. All details on the insurance coverage and general conditions will be provided to the student before he/she starts his/her studies. For further insurance beyond these minimum requirements, it is recommended that the student takes out additional insurance at his/her own expense.

The Consortium shall supply the student with detailed information about the specific risks existing in the environment in which he/she will be studying.

3.3 Contribution to individual needs of students with disabilities

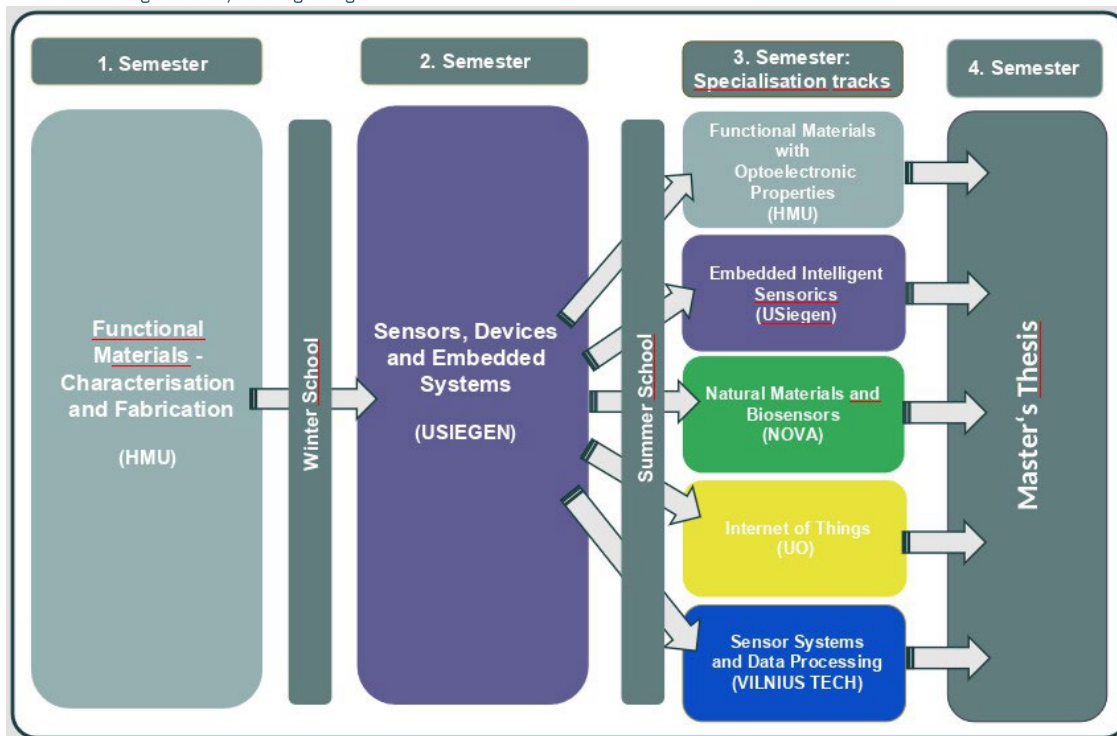
Contribution for individual needs are eligible if they fulfil the general eligibility conditions set in the grant agreement.

Enrolled students will declare what type of items/services are needed and their cost. The applicable unit cost will be identified as the rate corresponding to or immediately lower than the estimated expenses. This unit cost is a contribution and is not intended to fully cover the actual costs.

4. Content

4.1 Study track and mobility

The student must at least spend two study periods in two countries with a minimum of one academic semester each. These two countries must be different from the country of residence of the student at enrolment stage. Each of the two mandatory study periods must correspond to a workload of at least one academic semester (30 ECTS credits or equivalent). Compulsory mobility periods cannot be replaced by virtual mobility (distance learning). The student must achieve a total of 120 ECTS. The study path is outlined below. All students spend their first semester at the Hellenic Mediterranean University (HMU) in Greece and the second semester at the University of Siegen (USIEGEN). In the beginning of the second semester students will choose their specialisation track and therewith their host university during the third semester. Students whose state of residence, at the time of enrolment, was Greece or Germany, must spend their third semester (specialisation track) and/or their fourth semester (master thesis) at VILNIUS TECH, UO or UNL in order to cover the minimum requirement of two full-semester mobilities (see above). In case the student decides to spend the fourth semester at a different partner university as the one he/she is currently staying at, he/she needs to inform the EMINENT Examination Committee (see *Examination Regulations* § 4,3) by the 30st of November of the respective year. All important dates of the academic year (including Welcome Days, lecture periods, exam periods, Summer and Winter Schools) will be given on the EMINENT website.



4.2 Examinations

All matters regarding examination are set out in the “*Examination Regulations for the European Master on Embedded Intelligence Nanosystems Engineering – from Nanoscale Technologies to Ubiquitous Smart Sensors (EMINENT)*”.

4.3 Complaints and appeals

The EMINENT Examination Committee is responsible for deciding on appeals against decision made in examination proceedings as outlined in the EMINENT examination regulations.

Any other complaints shall be directed to the respective facility of the concerned institution. Complex requests might be appealed to the Steering Committee. The Steering Committee will consider the complaint or request.

4.4 Language

The language of the courses is English for the whole duration of the EMINENT programme. All examinations shall be conducted in English language.

4.5 Master's certificate

When the student has successfully completed the EMINENT programme, he/she will be awarded the academic degree “Master of Science “(M.Sc.), a joint master's degree in “Embedded Intelligence Nanosystems Engineering” with single diploma parchment issued by the partner universities the student has spent at least one semester and earned at least 30 ECTS during his/her participation in the programme.

5. Student Support Service

5.1 International Relations Offices

Each partner university is committed to welcome international students, to assist them in registration procedures and to provide them with information about accommodation facilities. The

International Relations Offices at each partner institution will help students to find their way around the university and will assist in questions about visas, accommodation, and mobility. In addition, the student will receive the “How To Get Around EMINENT” manual containing all necessary contacts and practical information. At the beginning of each winter semester, the EMINENT Foreign Student Support Office at HMU, will organise a Welcome Day for the new cohort of EMINENT students. During that day, students will meet each other and receive the most important information regarding the programme, including the programme’s structure, the offered facilities, and the scheduled mobility throughout. In addition, a similar Welcome Day will be organised at each partner institution in the beginning of the second and third semester to welcome their new students.

5.2 Website

Information on the programme, the universities, the lecturers and latest news connected to the EMINENT programme are given on the programme’s website: <https://eminent-master.eu>.

5.3 Mentoring

The EMINENT Mentoring System is carried out on two levels:

- At the beginning of their studies, students are assigned an Academic Tutor. The academic tutor will advise on academic issues such as specialisation coaching. Students will keep their academic tutor throughout their first three semesters where communication will take place virtually or face-to-face. After the third semester, the supervisors of the master’s thesis take over this task.
- At each partner institution where a student is staying, he/she is assigned a local Student Buddy who is not a student of the EMINENT programme but who has been studying at the respective university for at least one year. The Student’s Buddy will help and assist EMINENT students to get integrated into campus life and within the local society during the mobility period.

6. Participation

6.1 Attendance

The student commits to duly attend the EMINENT programme, including the prescribed courses, examinations and Summer/Winter Schools.

The student may attend the graduation ceremony at the institution he/she is staying last at or might take part in the graduation ceremony of one of the partner institutions he/she has spent at least one semester and earned at least 30 ECTS.

The student shall follow the rules for attendance and discipline in place in each of the EMINENT institutions that the student attends, following the students’ individual study track, if not stated otherwise in the *Examination Regulations*.

6.2 Code of Conduct

The student hereby commits to:

- a. If applicable: Take all necessary measures to obtain a visa, and apply for their residence permit from the national and local authorities upon their arrival in the host countries
- b. to participate in the orientation and welcome meetings/courses as well as informative and official meetings and events
- c. to attend assiduously, and with the objective of successfully passing, the courses, seminars, laboratories, thesis, and Winter/Summer schools inherent to the EMINENT programme

- d. behave in an ethical way. The student does not commit any fraudulent acts, does not cheat, falsify or plagiarize any academic work
- e. respectfully use the access to equipment and installations and handle them with greatest care. The student will not perform any unauthorized access or violation of departmental, school or institution rules.
- f. fulfil all administrative requirements established by the EMINENT Coordinating institution and all consortium partners by due date.
- g. inform the Consortium as soon as possible of any events of circumstances likely to affect the Student Agreement.
- h. provide information and documentation that support the reporting obligations of the consortium and its institution regarding the EMJM and its mobility requirements.
- i. to take part in QA surveys/evaluations conducted by the consortium and/or the European Commission/EACEA.

Any incident against the above stipulated commitments will be treated by the respective authorities and/or the Steering Committee.

6.3 Erasmus Mundus Students and Alumni Association

The student is strongly encouraged to join the Erasmus Mundus Students and Alumni Association (EMA). More information is given on the association's website: <http://www.em-a.eu/>

6.4 Exclusion from the EMINENT programme

The student might be excluded from the EMINENT programme if:

- a. the student is subject to disciplinary measures leading to their exclusion from the EMINENT programme
- b. the student is subject to legal prosecutions that prevents the attendance of the programme
- c. the student withdraws from the EMINENT programme on their own will or by force majeure
- d. the student does not meet the academic requirement as set in the examination rules

The procedure, including the appeal and exclusion procedure, is subject to the rules and regulations of the institution the student is staying at the time of the decision of exclusion, involving the Steering Committee.

Upon exclusion, the student shall in due time and before the departure pay all outstanding costs.

7. Modification of the Contract

Any alteration to the present contract must be communicated in writing. This also applies to any deviation from the written form requirement itself. Upon mutual agreement of contractual modifications, EMINENT will issue an addendum to the present agreement.

8. Data protection

The European Education and Culture Executive Agency (EACEA), in the context of managing the Erasmus Mundus Joint master's degrees, collects and processes the personal data of some of the candidates. In particular, certain data of the scholarship holders, non-scholarship holders and reserve list candidates is shared with the Agency through the *EACEA Mobility Tool* and treated according to the following [privacy statement](#).

9. Intellectual Property

The student agrees that the consortium may store the master's thesis either as a hardcopy or as electronic version.

10. Duration of the contract

The student agreement is valid from the academic years of 2024/2025 for as long as the student is enrolled in the EMINENT programme.

If the student fails to provide evidence of fulfilling the agreement the student might be excluded from the EMINENT programme.

Signatures

Both parties have read and accepted the conditions defined above.

The student agrees with the terms of this contract by signature. Signed in twofold.

The Student

Name, Surname

Signature

Place, Date

The Programme Director

Prof. Dr.-Ing. Peter Haring
Bolivar

Signature

Place, Date