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10 Μαΐου 2019

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Αγαπητή κ. Κουτσελίνη,

Θέμα : Σχόλια επί της Έκθεσης της Εξωτερικής Επιτροπής Αξιολόγησης για το Πτυχίο, Μεταπτυχιακό και Διδακτορικό Mechanical and Manufacturing Engineering.

Σε συνέχεια των Εκθέσεων Αξιολόγησης των πιο πάνω Προγραμμάτων Σπουδών, το Πανεπιστήμιο Κύπρου εκφράζει την ευαρέσκεια του στο Φορέα ΔΙΠΑΕ και ειδικότερα προς τα μέλη της Επιτροπής Εξωτερικής Αξιολόγησης (ΕΕΑ), για το άρτιο και αντικειμενικό έργο που έχουν εκπονήσει κατά τη διάρκεια της επίσκεψή τους.

Η διαδικασία αυτή μπορεί να χαρακτηριστεί ως άκρως παραγωγική και εποικοδομητική, αφού τόσο τα σχόλια όσο και οι εισηγήσεις της Επιτροπής συμβάλλουν στη βελτίωση της ποιότητας και της ανταγωνιστικότητας των προγραμμάτων.

Επισυνάπτονται τα σχόλια που αφορούν τα πιο πάνω προγράμματα.

Με εκτίμηση,

ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΥΠΡΟΥ ★ UNIVERSITY OF CYPRUS

Καθηγητής Τάσος Χριστοφίδης
Πρύτανης

ΚΟΙΝ :
Καθ. Ειρήνη – Άννα Διακίδου, Αντιπρύτανης Ακαδημαϊκών Υπ., Πρόεδρος Επ. Εσωτερικής Ποιότητας
Πρόεδρο Τμήματος Μηχανικών Μηχανολογίας και Κατασκευαστικής

ΔΔ/ΧΕ

University of Cyprus
Department of Mechanical and Manufacturing Engineering

May 9th, 2019

We would like to thank all members of the external evaluation committee for their useful comments and constructive criticism that help us to significantly improve our programs in Mechanical and Manufacturing Engineering.
In the attached files, you will find our point-by-point response to all comments and concerns raised by the committee in their evaluation report. We specifically focused on the items that were evaluated with a score of 3 or less according to the guidelines of the Cyprus Agency of Quality Assurance and Accreditation in Higher Education. The comments of the evaluation committee appear in plain font and our response in blue font.

Theodora Kyratsi, Chair
Theodora Krasia, Coordinator of Undergraduate Studies
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RESPONSE TO THE COMMENTS OF THE EVALUATION COMMITTEE FOR THE BACHELOR PROGRAM IN MECHANICAL AND MANUFACTURING ENGINEERING

1. EFFECTIVENESS OF TEACHING WORK – AVAILABLE RESOURCES

1.1 Organization of teaching work

1.1.2 The number of students in each class allows for constructive teaching and communication, and it compares positively to the current international standards and/or practices [4].

Additional comments: On one hand, the currently low number of students allows for constructive teaching and communication even on a one-to-one basis. However, the committee felt that this is not necessarily sustainable in case of plans for future expansion of student numbers.

Our Response: No significant expansion in student numbers is expected in the future. More precisely, the planned number of students to be admitted in the Department of Mechanical and Manufacturing Engineering in the next years is 40-50 annually.

1.1.3.5. The procedures for the conduct and the format of the examinations and for student assessment [3]

Additional comments: The procedures for the conduct and format of the examinations is not part of a formal process of setting exams and moderating those on a departmental level but organized and applied individually by each Academic.

Our Response: The formatting of the examination procedures followed in the Department of Mechanical and Manufacturing Engineering are in line with the general University of Cyprus examination rules and procedures that are consistently applied in all Departments within the University. These include among others the following:

"The University of Cyprus applies the principle of continuous assessment to each course. Specifically, the student's performance on a particular subject is assessed, at the discretion of the lecturer and with the approval of the Department, in at least two different ways. One of them must be the final written examination. The percentage of participation in the final written examination in the final score cannot exceed 60% of the final score. The allocation of the percentages for each exam, as determined by the curriculum, is independent of the grade the student achieves in each exam. The final written exam does not apply only in the case of the diploma thesis, screenwriting lessons, study or teamwork".

In an effort to enhance quality assurance, the Department Chair will be evaluating the statistical analysis of course grades along with the existing students' evaluation reports and s/he will then be discussing the evaluation outcome with each Academic.

1.1.3.6. The effective provision of information to the students and the enhancement of their participation in the procedures for the improvement of the educational process. [3]

Additional comments: It is not clear how the students participate and contribute to the improvement of the educational process on a fundamental level to make it effective.

Our Response: So far, the students' involvement in the improvement of the educational procedures, the undergraduate curriculum, etc. was realized *via* their representatives (4 in total) in the Departmental Council where all the decisions related to the undergraduate curriculum are taken. For further participation and involvement in the improvement of the educational process on a fundamental level thus enhancing its efficacy, the Undergraduate Studies Committee will meet at least once per year with the undergraduate students from all years and discuss possible issues that need the Department's attention in order to improve the educational process.

1.1.4. Adequate and modern learning resources, are available to the students, including the following: 1.1.4.1 facilities [2], 1.1.4.3 infrastructure [2]

Additional comments (1.1.4.1. and 1.1.4.3): Although the research labs were equipped to a high standard and this benefited final year projects, teaching labs for core engineering subjects taught in the first three years of study were not considered of adequate number and quality to ensure that the learning objectives are met. This applies particularly to labs related to fluid mechanics, thermodynamics and solid mechanics. The committee appreciates that the current spread of the Department in many different sites has been a contributing factor to this situation. We encourage the Department to strategically develop teaching labs of this type on their new campus and not focus only on moving and expanding current research labs.

Our response: As recognized by the Committee members, the current spread of the Department in 4 different sites and the lack of adequate teaching laboratory space prevented the sufficient development of teaching labs for core engineering subjects taught in the first 3 years of study. This issue was already discussed within the Department and Committee's constructive comments put more pressure to proceed faster. The Department has put into force a strategic plan for the significant improvement of all teaching labs, but with emphasis to laboratories linked to fluid mechanics, thermodynamics and solid mechanics.

The Department already allocated internal funding of €50,000 for the 2019 calendar year for the development of teaching laboratories. In addition, a more significant level of funding (€500.000) has been allocated to the Department by the University for the same purpose in 2020. Therefore, all the suggested and other improvements of the teaching laboratories will be completed by the end of the 2020-21 academic year.

In the table appearing in **Annex I**, the "Existing" and "New" Laboratory exercises that are also included in the updated course syllabuses are provided. It is noteworthy to mention at this point that some of the "New" Laboratory exercises appearing below (highlighted in yellow) will be immediately introduced in the courses starting from the next academic semester, whereas the rest will be implemented within the next 2 years.

Particularly for labs related to fluid mechanics, thermodynamics and solid mechanics, (presented in detail in **Annex I**), the Department has already approved the introduction of a total of 60 new laboratory exercises:

- 9 for thermodynamics (MME 215 & MME 318)
- 8 for fluid dynamics (MME 216 & MME 316)
- 2 for heat transfer, MME 217
- 1 for thermal engines, MME 318
- 4 for strength of materials, MME 256 & MME 257
- 36 in all other courses

1.1.4 Adequate and modern learning resources, are available to the students, including the following: 1.1.4.5 academic mentoring [3].

<u>Additional comments (1.1.4.5):</u> There is no formal system of Academic mentoring in terms of personal tutors who follow the progress and development of the students from the beginning to the end of their studies. We encourage the Academics to put such a system in place because the general student welfare will benefit from.

Our response: Academic mentoring involving among others the following of the progress and development of the students throughout their studies already takes place through:

- Each student is assigned an Academic Advisor from day one as a student at the Department. Each faculty member has about 15 students to mentor.
- The Department has decided to hold annually a "Mentoring Day" at the beginning of each academic year. This decision will be applied from September 2019 onwards.
- Compulsory personal meeting of students with their Academic Advisor prior to course registration of mentees failing 50% or more of courses per semester.

1.1.5. A policy for regular and effective communication, between the teaching personnel and the students, is applied [2].

Additional comments: There is no formal policy in place outside of one-to-one interactions by individual initiative by Academic staff and students. (See above as well)

Our response: The regular communication between the teaching personnel and the students takes places during office hours set for each course on a weekly basis. The office hours are set at the beginning of the semester for each course and appear on all course syllabuses that the students get during the first lecture. The office hours are also announced in the Department's website. Additional meetings with students outside the announced office hours are regular.

1.1.7.-1.1.9. Statutory mechanisms, for the support of students and the communication with the teaching personnel, are effective [3]. Control mechanisms for student performance are effective [3]. Support mechanisms for students with problematic academic performance are effective [3].

Additional comments: No clear mechanisms were demonstrated to the committee in terms of control, support and effectiveness.

Our response: The control over the student's academic progress in all courses already takes place *via* banner web, where the Academic Advisor can find all information for his/her mentees related to their academic performance and development during their studies. Personal appointments between the academic mentor and the mentee are arranged during the semester (e.g. after the midterm examinations) to discuss on the student's progress. During these meetings, the Academic Advisor provides advice and support to his/her mentee and helps him/her to make corrective actions in cases of poor academic performance. Furthermore, the Department has decided to hold annually a "Mentoring Day" at the beginning of each academic year. This decision will be applied from September 2019 onwards.

In addition, compulsory personal appointments of mentees failing 50% or more of courses per semester with their Academic Advisor take place prior to on-line registration, after the mentees receive a personal e-mail from the Department's Secretariat.

For the 1st year undergraduate students, during the first personal meeting with their Academic Advisors, the latter provide also information on different sources of guidance and student support that are available at the University of Cyprus, including sources of specialist advice and support for students with disabilities, information on library services, information on existing possibilities for Erasmus exchange programs etc.

1.1.10. Academic mentoring processes are transparent and effective for undergraduate and postgraduate programs and are taken into consideration for the calculation of academic work load [2].

Additional Comments: Considering that such processes are not formally in place it is unclear to the committee how transparency can be applied effectively.

Our response: Academic mentoring for undergraduate students is not considered in the calculation of the academic load according the University of Cyprus regulations. However, with the Department's initiative, students are equally distributed among all faculty members. The same procedure is used for the number of Diploma Thesis students that each faculty member is supervising.

1.1.11. The program of study applies an effective policy for the prevention and detection of plagiarism [2].

Additional Comments: There is no policy that has been formally implemented based on current University regulations to deal with potentially widespread practices of plagiarisms in coursework and written exams. This can be improved by extended use of antiplagiarism online tools to include a database of coursework submissions over a gradually increasing period of time. Similarly, introduction of standardized calculators uniformly used by everybody could assist with exam plagiarism.

Our response: The antiplagiarism online tool *SafeAssign* is available through Blackboard (https://help.blackboard.com/SafeAssign/Instructor/Language_Support), which is accessible to all members of UCY academic staff. Students during exams are only allowed to use "simple" calculators that are not capable of storing information.

1.1.12. The program of study provides satisfactory mechanisms for complaint management and for dispute resolution [2].

Additional comments: Such mechanism is not clear from the provided information and it is important to develop those in view of future proofing the course in case of legal disputes.

Our response: Activities of courses are carried out based on University of Cyprus regulations. For example, the students have access to their exams and in case of a dispute the exam is re-evaluated. Also, in case of plagiarism the students are reported to the "Disciplinary Committee for Student Issues" where the case is thoroughly investigated.

1.3 Teaching Personnel

1.3.1., 1.3.2. and 1.3.11. The number of full-time academic personnel, occupied exclusively at the institution, and their fields of expertise, adequately support the program of study [2].
The program's Coordinator has the qualifications and experience to efficiently coordinate the program of study. [3]

Additional comments: All members of Academic staff are experts in their field of research. However, the committee felt that because the fields of expertise of some of the Academics (starting from their undergraduate degrees) are not all core mechanical engineering, the program of study and individual courses have not been structured from the beginning and throughout with traditional core mechanical engineering content. For example, this was particularly evident in the fluid mechanics stream, turbomachinery, traditional power systems (including nuclear) and mechanical design assignments.

Our response: It is true that basic training of some faculty members is not in Mechanical Engineering. The Department has decided that future hiring will have a first degree in Mechanical Engineering in order to increase the number of faculty with traditional Mechanical Engineering training. Already, all three new hires in 2019 have a first degree in Mechanical Engineering. The existing faculty with no Mechanical Engineering training are given teaching responsibilities that provide their expertise needed by the undergraduate program. For example, typical 4-year Mechanical Engineering programs have physics courses taught by the Physics Department, however, we have these courses taught by our faculty with Physics background. In addition, our Chemistry for Engineers course is taught by our faculty with Chemistry background and our Materials course is taught by our faculty with Material Science background. This provides better quality to the students since these courses are taught by experts in the courses' areas with direct guidance from the Department.

All courses related to the Fluid Mechanics stream have been significantly revised (actual context and the associated learning objectives). This particularly applies for the courses of thermodynamics (MMK215 & MMK315) and fluid dynamics (MMK215 & MMK315). The adopted improvements in these courses now allow the introduction of classical topics such as turbomachinery and power systems in the classes of "Thermal Engines" (MMK318) and "Energy Systems" (MMK417) accordingly. A section has been added in the latter where areas of nuclear energy related to Mechanical Engineers is discussed. These changes will be applied by the next academic semester after their approval by the Undergraduate Studies Committee of the University of Cyprus. Out of the 60 new laboratory exercises, 15 will be also applied next semester. The rest of the laboratory exercises will be introduced when the related equipment will be obtained by the Department in 2020-2021. Moreover, the Fluid Mechanics stream will be also strengthened by hiring an extra faculty member who is expected to start by the beginning of 2020.

There are three courses involving design: Machine Elements MME 345, Machine Design 346 and Design and Manufacturing 347. As part of evaluation for all three courses assignments in topics ranging from technical and industrial design to design conforming to current manufacturing capabilities are given.

1.3.3. The specializations of Visiting Professors adequately support the program of study [1].

<u>Additional comments:</u> We were not informed of any formal appointments of Visiting Professors to support the program of study.

Our response: Visiting Professors have been appointed in the MME Department in the past for supporting the program of study. Examples include the following:

- Prof. Andreas Polycarpou, Texas A&M University, U.S.A.
- Dr. Alesio Alexiades, University of Birmingham, United Kingdom
- Dr. Apostolos Korlos, University of Thessaly, Greece.
- Dr. Dimosthenis Michalopoulos, University of Patras, Greece.
- Prof. Panos Charalambides, University of Maryland, Baltimore County (UMBC), U.S.A.
- Dr. Damian Rouson, P.E., Sourcery Institute

It is noteworthy to mention at this point that although Visiting Professor positions are often announced in the Department, there are difficulties in attracting candidates from abroad due to language restrictions (official language at the undergraduate level is Greek) as well as different term schedule applied at the University of Cyprus (Fall semester: beginning of September – end of December; Spring Semester: mid-January – end of May) compared to Greek and other European Universities. Based on the above, in the future the Department will be targeting in attracting Visiting Professors for the summer semester.

1.3.10. Future redundancies / retirements, expected recruitment and promotions of academic personnel safeguard the unimpeded implementation of the program of study within a five-year span [3].

<u>Additional comments:</u> Considering the unfortunate event of a member of Academic staff passing away unexpectedly, the Department found itself in a position that safeguarding the program in a particular area was not easy to handle. Although, for planned retirements, redundancies, sabbaticals, etc. there maybe no issue, it seems that there is no contingency plan in place that would assist supervised students by smooth transition to a new status.

Our response: There are several courses that can be taught by at least 2 faculty members in the Department and this has been already applied in the past on various occasions (sabbatical and unpaid leaves, election of faculty members in higher administrative bodies, unexpected illness, etc.) More precisely the following courses have been already taught by more than 1 faculty members in the Department: *Materials Science and Engineering I and II:* Ioannis Giapintzakis, Theodora Kyratsi and Theodora Krasia*; Introduction to Electromagnetism:* Ioannis Giapintzakis, Matthew Zervos*; Numerical methods:* Michalis Averkiou, Vasileios Vavourakis, Triantafyllos Stylianopoulos*; Introduction to engineering:* Andreas Kyprianou, Theodora Kyratsi. There are many other courses that could be taught by more than 1 faculty member, however, so far there was no need for that. The recruitment of new faculty members (4 Mechanical Engineers by 2020) will further assist to the realization of course and student re-allocation on occasions as those stated above.

2. PROGRAM OF STUDY AND HIGHER EDUCATION QUALIFICATIONS

2.1 Purpose and Objectives and learning outcomes of the Program of Study

2.1.1., 2.1.2., 2.1.4.-2.1.7. The purpose and objectives of the program of study are formulated in terms of expected learning outcomes and are consistent with the mission and the strategy of the institution [3]. The purpose and objectives of the program and the learning outcomes are utilized as a guide for the design of the program of study [2]. The program's content, the methods of assessment, the teaching materials and the equipment, lead to the achievement of the program's purpose and objectives and ensure the expected learning outcomes [3]. The learning process is properly designed to achieve the expected learning outcomes [2]. The higher education qualification awarded to the students, corresponds to the purpose and objectives and the learning outcomes of the program [3].

Additional Comments: On the basis of the program document and the discussions that followed the committee felt that the way learning objectives and outcomes had been formulated was not consistent across all courses. It was not clear how the learning outcomes were matched against coursework assessment and written examinations. The program document needs to be streamlined and harmonized to illustrate better the coherence of the learning outcomes as a whole. The order of courses MME 155 and MME 255 does not seem right, at least according to how the learning outcomes are listed. Also, a similar problem was identified in the sequence of MME 325 and MME 327.

Our response: The Undergraduate Studies Committee handled this issue and the modified syllabus documentation in terms of learning objectives and outcomes reflecting the comments from the Evaluation Committee are provided in **Annex II**. More specifically the content of MME 327 has been enhanced in order to build on the material taught in MME 325. Similarly, the content of MME155 and MME255 has been modified to avoid overlap and guarantee smooth transition between the two courses.

2.2 Structure and Content of the Program of Study

2.2.1The course curricula clearly define the expected learning outcomes, the content, the teaching and learning approaches and the method of assessing student performance [3]. 2.2.3. The program of study is structured in a consistent manner and in sequence, so that concepts operating as preconditions precede the teaching of other, more complex and cognitively more demanding, concepts [2]. 2.2.4. The higher education qualification awarded, the learning outcomes and the content of the program are consistent [4]. 2.2.6. The content of courses and modules, and the corresponding educational activities are suitable for achieving the desired learning outcomes with regards to the knowledge, skills, and abilities which should be acquired by students [3]. 2.2.7. The number and the content of the program's courses are sufficient for the achievement of learning outcomes [3].

Additional comments: There are issues of consistency and coherence in the structure of the program along the lines elaborated in the previous section.

Our response: Based on the Committee's remarks concerning the consistency and coherence in the program's structure, the Undergraduate Studies Committee oversaw the modification of courses and the curriculum revised course descriptions are provided in **Annex II**. In general, the content of most courses was modified in order to avoid overlaps between courses, provide continuation among courses and built on material preceding the courses. Also, experimental exercises are added in many courses in order to augment the understanding of the theory. Two more drastic changes were made: Mechatronics II content is modified to include electric machines and their drives; a new course is added in Solid Mechanics (now have Solid Mechanics and Strength of Materials) see revised curriculum in **Annex III** - in order to provide students with more depth in their knowledge of the topics and introduce failure criteria. The addition of this new course results in the reduction of all courses in the 4^{th} semester to 5 ECTS and the appropriate adjustment of their workload.

2.2.2 The European Credit Transfer System (ECTS) is applied and there is true correspondence between credits and workload per course and per semester for the student either he / she studies in a specific program or he/she is registered and studies simultaneously in additional programs of studies according to the European practice in higher education institutions [3].

Additional comments: It was felt both from the program document and discussions with students that there is a mismatch in the allocated 10 ECTS of the final year project and the actual workload experienced in practice by the students. It is suggested that the number of ECTS be increased to at least 15 or perhaps up to 20. The larger figure would apply in case the Department elected to proceed with substantial group projects like Formula Student, Shell 21 Eco marathon, drone competitions, etc. This would need to be balanced by removal of ECTS from elective courses.

Our response: Following the Committee's suggestion, the ECTS allocated for the final year project is increased to 15. This increase will be balanced by the decrease of ECTS in 4th year elective courses from 7 ECTS to 6 ECTS. Consequently, the content in 4XX technical elective courses is appropriately adjusted in terms of students' work load. Moreover, the Formula Racing Team University of Cyprus (FRTUCY) has been recently established by the Department, starting officially in September 2019 (https://ucy.ac.cy/frtucy/).

2.3 Quality Assurance of the Program of Study

2.3.1.,2.3.3. The arrangements regarding the program's quality assurance define clear competencies and procedures [2]. The guide and / or the regulations for quality assurance, provide detailed information and data for the support and management of the program of study [2].

Additional comments: The committee were not made aware of any clear procedures and detailed information to support quality assurance.

Our response: The operation of the Undergraduate Studies Committee is modified by the Department's Council in order to better handle quality assurance. The Undergraduate Studies Committee will be having a meeting with all undergraduate students at the end of the academic year in order to address their concerns related to the courses and studies in general. Based on this meeting corrective measures can be taken. Also, the Undergraduate Studies Committee will have meetings with the Teaching Assistants for identifying possible issues that need to be addressed. In addition, the Department Chair will be now collecting the statistical analysis of all courses and will be using it along the course evaluation provided by the students for possible corrective actions (see also in 2.4.1-2.4.2 for more detail).

2.3.2. Participation in the processes of the system of quality assurance of the program, is ensured for: 2.3.2.2. the members administrative personnel [3] and 2.3.2.3 the students [2].

Additional comments: The committee felt that the members of Academic staff safeguard quality by ad-hoc efforts. Considering the lack of clear formal procedures for quality assurance, it is again unclear how administrative personnel and students participate effectively in such efforts.

Our response: There are four elected student representatives with voting rights who attend the Departmental Council which determines the quality assurance processes. In addition, the Undergraduate Studies Committee will meet at least once per year with the undergraduate students from all years and discuss possible issues that need the Department's attention in order to improve the educational process.

The administrative personnel support the day-to-day operation of the program in order to ensure the smooth operation of the non-teaching aspects of the program. There is an annual meeting of the Chair of the Department with the administrative personnel where they discuss in detail the effectiveness of their support, their participation in all activities as well as their assessment. This is part of the evaluation process of the administrative personnel that is carried out annually by the Department. Chair.

2.3.3 The guide and / or the regulations for quality assurance, provide detailed information and data for the support and management of the program of study [2].

Our response: The University of Cyprus in promoting recognition of quality and excellence in teaching, has developed a policy for ensuring quality teaching at the Institution. More information can be found in the following link:
https://www.ucy.ac.cy/graduateschool/documents/Phd/ENGLISH_QualityofTeachingPolicyDocument.pdf.

2.4 Management of the Program of Study

2.4.1.-2.4.2. Effective management of the program of study with regard to its design, its approval, its monitoring and its review, is in place [3]. It is ensured that learning outcomes may be achieved within the specified timeframe [3].

Additional comments: Although the program of study is managed by members of Academic staff within the merit of their own individual courses, there is no higher level dedicated committee to oversee the whole program development and running throughout the Academic year. Such a committee would need to report to departmental meetings after having met on a regular 23 basis. It is suggested to form such a “Teaching Committee” that will meet at least twice per semester, preferably at the start and the end of each semester. This could act as a starting point to harmonize the syllabus documentation in terms of learning objectives and outcomes. Then, it could focus on highlighting needs in terms of teaching equipment and planning any new courses.

Our response: One of the main duties of the existing Undergraduate Studies Committee is to oversee the whole program development teaching and running throughout the Academic year on a systematic basis. The Undergraduate Studies Committee members have already worked on the harmonization of the course documentation in terms of learning objectives and outcomes as pointed out by the Evaluation Committee. The Undergraduate Studies Committee will continue to work on this in order to further improve the courses’ effectiveness and overall undergraduate curriculum quality. In the following Table the existing and new Tasks set for the Undergraduate Studies Committee are summarized:

Table 1: Existing and new tasks set for the Undergraduate Studies Committee

Already existing tasks	**New tasks (already approved by the Departmental Council)**
Preparation of the course timetable per semester	Meeting (at least once per year) with the undergraduate students from all years and discuss possible issues that need the Department’s attention in order to improve the educational process.
Student transfers	Internships with industry
Course ECTS units transfer	Students exchange programs
Coordination of diploma theses	Meetings with the Teaching Assistants (at the beginning of each semester)
Allocation of Teaching Assistants per course	Evaluation of Teaching Assistants

2.4.3.-2.4.8. Additional comments: No major issue was identified but it is suggested to introduce two different sections in the course evaluation forms were the students will grade the course itself and the instructor separately. In the case of practical training, note: Not relevant beyond practical training involved with workshops sessions or final year projects.
- The number of credit units for courses and the number of credits for practical training
- In which semester does practical training takes place?

- Note if practical training is taking place in a country other than the home country of the institution which awards the higher education qualification

Our response: The course evaluation forms introduce several sub-sections as follows: (a) Demographics (b) Section A: Course classes (c) Section B: The course overall (d) Section C: The lab/the tutorial/fieldwork (if valid) and (e) comments. The course evaluation form is provided in **Annex IV.**

Students placement will begin on an optional basis and accredited with 10 ECTS units from September 2019 onwards. The placement will be taking place during summer between the 3rd and 4th year of studies. However, the Department already encouraged student placements in Cyprus and abroad in cooperation with the Liaison Office or via personal initiatives of members of the academic personnel. A few examples appear below:

Students placement in Cyprus

- Elysee Irrigation
- Vassiliko Cement Works Public Company Ltd.
- Electricity Authority of Cyprus
- Cyprus Telecommunications Authority
- Hellenic Copper Mines
- PWC
- TELMEN
- Novatex Solutions Ltd.
- Department of Mechanical and Electrical Services

Students placement in Europe and in the U.S.A.

- Germany - Bosch, Airbus
- Netherlands - Medspray
- USA – Simulations Plus, Omeros Corporation

2.5 International Dimension of the Program of Study

2.5.1. The program's collaborations with other institutions are compared positively with corresponding collaborations of other departments / programs of study in Europe and internationally [3].

Additional comments: Although research collaborations may compare positively with other institutions, it is unclear whether any teaching collaborations are being pursued actively to a high level.

Our response: The Department has a specific plan to improve its teaching collaborations through targeted actions such as Erasmus+ exchange programs by offering some undergrad courses in English, undergraduate exchange visits (e.g. with Texas A&M), Erasmus+ staff mobility for teaching programs, participation of the Department's academic personnel in short Short-Cycle Training Courses (e.g. Erasmus+ Short-Cycle training course on Thermal Analysis in Material Science/SC-ThAnMA), summer short courses offered by visiting professors etc.

2.5.2. The program attracts Visiting professors of recognized academic Standing [1].

Additional comments: There has not been any formal proof of visiting professors of high international standing being attracted to the program of study.

Our response: Response as in 1.3.3.

2.5.4. The academic profile of the program of study is compatible with corresponding programs of study in Cyprus and internationally [3].

Additional comments: The matter has been commented on in previous sections. Also, comment on the degree the program compares positively with corresponding programs operating in Cyprus and abroad in higher education institutions of the same rank.

Our response: We believe that we provide great education to our students who are well prepared for either employment and/or graduate studies. Indications of the quality of our program and graduates are of the high employability of our graduates reaching 85%, of which 89% in Mechanical Engineering related jobs. It is noteworthy to mention that our graduates are employed abroad by Bosch, Rolls Royce, General Electric Health Care, UK, etc. Moreover, our graduates with a BSc continued graduate studies at internationally recognized universities like: University of California Berkeley, ETH Zurich, Imperial College, National Technical University of Athens, Delft, UCL, University of Nottingham, EPFL, Kingston, Sheffield, Warwick etc. In terms of admissions, our Department is 4^{th} in the selection of high school students among all public university departments in Cyprus and 1^{st} among engineering departments at University of Cyprus. Finally, the external evaluation of our Department by an international committee in 2011 ranked our Department among the best 25% Mechanical Engineering Department in the USA and UK.

2.6 Connection with the labor market and the society

2.6.1.-2.6.3. The procedures applied, so that the program conforms to the scientific and professional activities of the graduates, are adequate and effective [3].

Additional comments: Although indicators for the employability of graduates appear satisfactory, there is room for improvement in terms of effective support procedures to be applied formally. Similarly, benefits to the society can be strengthened by industrial involvement in terms of advice and feedback.

Our response: Starting next year the UCY career office will offer CV writing clinic and interview simulation specifically designed for the needs of our students. The University organizes annually a career fair where local companies are invited and our students have a chance to talk to companies' representatives and identify employment opportunities.

4. ADMINISTRATION SERVICES, STUDENT WELFARE AND SUPPORT OF TEACHING WORK

4.1 Administrative Mechanisms

4.1.1.-4.1.3. Statutory administrative mechanisms for monitoring and supporting students are sufficient [3]. The efficiency of these mechanisms is assessed on the basis of specific criteria [3].

Additional comments: Although, mechanisms are in place for Academic and personal matters, there is no clear evidence of how these are applied formally and efficiently, neither their associating criteria.

Our response: The Department provides all necessary support services to our students through the secretariat of the Department. The efficiency of this support is assessed by the Chair who takes corrective actions to improve these services.

4.2 Infrastructure / Support

4.2.3.,4.2.4. The facilities are adequate in number and size [2]. The equipment used in teaching and learning (laboratory and electronic equipment, consumables etc.) are quantitatively and qualitatively adequate [2].

Additional comments: While the research labs are well equipped, the teaching labs suffer from low level investment in terms of equipment and strategically defined priorities for experiments to support the curriculum.

Our response: As above (see 1.1.4)

4.3 Financial Resources

4.3.1. The management and allocation of the financial resources of the program of study, allow for the development of the program and of the academic / teaching personnel [3].

Additional comments: There could have been better allocation of financial resources to develop the program in terms of practical lab exercises in purposely designed teaching labs.

Our response: Part of the financial resources provided in the past by the University of Cyprus, have been used in developing the program and the teaching personnel. This was achieved by hiring new personnel and through technical training of technicians and laboratory teaching staff. The financial resources from the University of Cyprus will increase in the next 2 years and a significant part of this money will be allocated for the development of our teaching personnel and laboratories.

FINAL REMARKS – SUGGESTIONS

Please note your final remarks and suggestions for the program of study and/or regarding particular aspects of the program.
In addition to suggestions made earlier on this report, the following need to be considered as well:

Personal homepages should be constructed for all faculty.

Our response: Following the Committee's comment the personal homepages of all MME faculty members have been constructed with the same template and displaying similar information (http://www.ucy.ac.cy/mme/en/staff/academic).

Teaching sharing between departments is encouraged.

Our response: Our students take courses from the Department of Mathematics and Statistics and the Language Center during the 1st and 2nd year of their studies as well as free electives. In return, our Department offers one course (MME 145-Computer Aided Drafting) for the students of the Center of Entrepreneurship at the University of Cyprus and another one (MME 156) as a free elective to all University students.

The students felt that their maths courses should be more aligned with engineering mathematics that would be applied to their engineering courses later on, rather than be abstract or purely theoretical.

Our response: The students' comments concerning the mathematics courses offered by the Department of Mathematics and Statistics have already been discussed with the students' representatives at the Departmental council and they have been taken into account. More precisely, there are ongoing discussions with faculty members of the Department of Mathematics and Statistics in order to better satisfy this request.

Although the experimental methods and statistical analysis course is commendable, there is a need for technical report writing tutorial/course.

Our response: Tutorials on Technical report writing have been included in the course MME 105-Experimental and Statistical Analysis. Moreover, tutorials on Technical Report Writing will be conducted for the Diploma Thesis students.

We encourage course delivery by more than one Academic member of staff.

Our response: Delivering courses by more than one Academic member of the staff could be applicable in some cases for example Mechatronics II, Experimental and Statistical analysis and Computer-Aided drafting. In addition, several courses can be taught by different faculty members on a rotation basis (see also response in 1.3.10).

We encourage adding a course, such as a non-examinable course "Horizons in Mechanical Engineering" in the first year, which will consist of popular science presentations given by relevant sectors in order to expose the students to practical aspects of the profession.

Our response: A seminar series entitled "*Horizons in Mechanical Engineering*" has been included in the course MME 106-Introduction to Engineering. (5x2 hours in total). This seminar series will include presentations from professional mechanical engineers that work in various sectors of the Cypriot economy. The students have the opportunity to discuss on various issues at the end of each presentation.

Statistical analysis of student grades needs to be strengthened by inclusion of distributions.

Our response: Statistical analysis of the students' grades including distributions will be carried out for all courses of the undergraduate curriculum and the outcome will be used by Chair of the MME Department as additional information to the course evaluations provided by the students. These two pieces of information are complementary and will provide direction to the instructor for improving the course.

Annex I – Course Laboratory Exercises - Existing and New

New laboratory exercises highlighted in yellow will be introduced during the next academic semester.

Course Code/Name	Existing Laboratory Exercises	New Laboratory Exercises
	General Engineering	
MME105 Experimental and Statistical Analysis	• Law of conservation of linear momentum (Newton's 2nd Law) • Determination of friction coefficient • Spring Constitutive Law: Statics and Dynamics • Conservation of Energy: Torque – Work • Torque of Parallel and non-parallel forces • Moment of inertia • Thermal expansion and specific heat capacity • Gas Laws: Boyle's Law and Charles' Law • Determination of viscosity by falling sphere method	• Dynamics of rotation - gyroscope • Measuring electrical quantities – Ohm's Law • DC motor and electric circuit • Study of flows around bodies (drag and lift measurements) • Buoyancy effects in immersed objects and density of a fluid - Archimede's principle
	Thermal Fluids	
MME 215 Thermodynamics I	• None	• Heat Capacity of Gases from Pressure Volume and Temperature Data • Adiabatic Process • Isothermal Process • Operation of Heat Engine / Otto Cycle • Matlab assignment using thermodynamic tables with applications on cycles
MME 216 Fluid Mechanics I	• None	• Flow visualization • Manometry and Bernoulli's principle • Drag and lift around bodies (assignment, they print bodies) in a wind tunnel • Pipe Flow: frictional losses in pipes • Introduction to Flow metering techniques (manometers, pitot, Venturi, orifice)

MME 217 Heat Transfer	• Measurement of thermal conductivity • Coefficient of thermal emissivity • Effect of distance on thermal radiation	• Laboratory assignment in Matlab • Laboratory assignment in SolidWorks
MME 315 Thermodynamics II	• None	• Design competition for the optimization of a thermodynamic system using computer software • Thermodynamics of the refrigeration circuit • Vapor pressure of water Boiling process • Heat pump for cooling / heating operation
MME 316 Fluid Mechanics II	• None	• Hydraulic gradient in a pipe network • Pump performance & operational envelopes • Experimental techniques in fluid dynamics (measurement in a BL with hot wires, pitot tubes, venture meters)
MME 318 Thermal Engines	• Assembly-disassembly of an ICE • Torque and power delivered by a petrol ICE • Emissions of an ICE	• PV diagram of a diesel engine
Dynamics and Control		
MME 225 Dynamics	• None	• Study of mass moment of inertia and angular acceleration • Study of centrifugal force on rotating masses • Study of Coriolis force in rotating reference systems
MME 226 Mechatronics I	• None	• Half and full wave rectifier • RLC circuits • Transformers • RLC-DC circuits • RLC-AC circuits • Digital circuits and logic gates

MME 227 Vibrations	• None	• Responses of free undamped and damped systems • Free bending vibration and natural frequency determination • Forced vibration and experimental determination of frequency response functions
MME 228 Mechatronics II	• Familiarization with the front panel and block diagram environment of LabView • Manipulation and interconversion of numeric types, logic variables and operations • Introduction to strings, arrays matrices • Timing and timers, indicators and controls • Iteration control and conditionals • Data acquisition and signal processing	• Dynamic analysis and parameter identification of DC, brushless DC, stepper, servo motors. • Design and implementation of motor drive
MME 325 Modeling and Analysis of Dynamic Systems	• Low-frequency electromechanical system	• Two-tank fluid system • Fluid-Mechanical component interaction
MME 327 Control Engineering	• None	• Rotary flexible joint / flexible link arm control • Linear / rotary servo inverted pendulum control
MME 420 Robotics	• None	• Motion planning and programming of basic pick-and-place tasks • Industrial application simulation using a belt conveyor
	Materials, Design and Manufacturing	
MME 155 Material Science and Engineering I	• Introduction to crystallography • Metallography • Phase diagrams • Impact test • Hardness test (Rockwell, Vickers)	• None
MME 256 Solid Mechanics	• Tensile test (of ductile and brittle metals) • Bending test (Three-point, Cantilever)	• Compression test • Torsion test (axisymmetric, non-axisymmetric)

MME 257 Strength of Materials	• None	• Buckling • Photo-elasticity (stress flow, stress concertation)
MME 345 Machine Elements	• None	• Experimental setups for hands-on experience and demonstrations of the machine elements taught in this course • Demonstration of spur, helical and worm gear units • Disassembly/Assembly of gearbox
MME 346 Mechanical Design	• None	• Belt drive and belt friction • Clutches and friction • Determination of gear efficiency
MME 347 Design and Manufacturing	• Metrology • Screws and thread-generating processes • Manual turning exercises and project (spinning top competition)	• None
MME 348 Manufacturing Processes	• CAD-CAM project • Additive manufacturing • Electro-discharge machining • Thermoforming • Welding (fusion and solid state)	• None
MME 442 Laser-based Manufacturing Applications	• Laser marking and cutting • Laser scanning • Laser surface measurements and modifications • Laser welding	• None
MME 443 Advanced Metal Working Processes	• None	• Cold and hot forging • Material strengthening • Sheet blanking, bending and forming
MME 456 Properties of Polymers and Polymer Processing	• Thermomechanical testing by Dynamic Mechanical Analysis • Fabrication of polymer nanofibers by electrospinning	• Rheological characterization of polymers • Synthesis of physically crosslinked polymer networks

Annex II - Revised Course descriptions & Learning Outcomes
Items in green are new laboratory exercises.

General Engineering

Course Title	**Experimental and Statistical Analysis**				
Course Code	**MME 105**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	1st year / 1st Semester				
Teacher's Name	Theodora Krasia-Christoforou				
ECTS	5	Lectures / week	1 hour	Laboratories / week	3 hours
Course Purpose and Objectives	This experimental course aims to introduce the students to basic experimental techniques, statistical data analysis and technical (laboratory) report writing. Moreover, one of its primary objectives is to enable the students to make the transition from the physical principles they have been taught, to engineering notions.				
Learning Outcomes	• Comprehend basic engineering principles. • Perform laboratory experiments with accuracy and report accurately their observations during an experiment. • Analyze primary experimental data and perform statistical data analysis. • Develop the ability to evaluate the experimental results and appraise the quality of an experiment. • Demonstrate the ability to prepare and submit well-structured written laboratory reports. • Understand the significance of complying with health and safety regulations in laboratories. • Be able to compare the experimental results with bibliographic data.				
Prerequisites	None	Required	None		
Course Content	This experimental course aims to introduce the students to basic experimental techniques employed for the determination of physical parameters, to the statistical analysis of experimental data, graphical methods for data presentation and to the preparation of laboratory reports. Moreover, one of its primary objectives is to enable the students to make the transition from the physical principles they have been taught, to engineering notions. In addition, during this course the students attend a series of seminars including health and safety regulations in laboratories, technical report writing, introduction to library services, training on the use of the electronic library catalogue, information resources, and reference tools and a seminar related to plagiarism.				

	Laboratory Exercises • Law of conservation of linear momentum (Newton's 2nd Law) and dynamics of rotation - gyroscope • Determination of friction coefficient • Spring Constitutive Law: Statics and Dynamics • Conservation of Energy: Torque – Work • Torque of Parallel and non-parallel forces • Moment of inertia • Thermal expansion and specific heat capacity • Gas Laws: Boyle's Law and Charles' Law • Determination of viscosity by falling sphere method • Measuring electrical quantities – Ohm's Law • DC motor and electric circuit • Study of flows around bodies (drag and lift measurements) • Buoyancy effects in immersed objects and density of a fluid - Archimede's principle
Teaching Methodology	• Introductory lectures "Introduction in experimental and statistical analysis" (PowerPoint presentations) (6 hours in total, during the first 2 weeks) • Lectures: Health and safety regulations in laboratories (PowerPoint presentations). • Introductory lectures on Technical report writing (PowerPoint presentations) • Library seminar series: (PowerPoint presentations) • Laboratory exercises (13 in total) carried out in small groups (3 students/group). • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Laboratory Guide: MME 105: Experimental and Statistical Analysis (http://www.eng.ucy.ac.cy/krasia/)
Assessment	• Weekly laboratory reports 30% • Quizzes 10% • Midterm exam 20% • Final exam 40%
Language	Greek

Course Title	**Introduction to Engineering**
Course Code	**MME 106**
Course Type	Compulsory
Level	Undergraduate
Year / Semester	1st year / 1st Semester
Teacher's Name	Theodora Kyratsi

ECTS	5	Lectures / week	3+1 hours	Laboratories / week	10 hours total (seminars)

Course Purpose and Objectives	The introduction to applied thinking and solving basic engineering problems.
Learning Outcomes	• Define units and unit systems. • Define physical concepts and parameters such as forces, pressure, work, energy, temperature, heat transfer. • Apply the basic laws of nature - Newton's Laws, energy conservation, momentum conservation. • Analyze simple systems/ problems from the various sub-disciplines of mechanical engineering such as statics and dynamics of rigid bodies, thermodynamics, heat transfer and fluid flow. • Familiarize with the profession of the Mechanical Engineer.

Prerequisites	None	Required	None

Course Content	Units and unit systems - Physical concepts such as forces, pressure, work, energy, temperature, heat – Newton's Laws – Motion – Inertial and Non-inertial Reference Frames – Work and Energy – Equilibrium – Energy conservation – Momentum conservation – Law of Gravity – States of Matter – Density and Pressure – Heat and Internal Energy – Heat Capacity and Specific Heat - The First Law of Thermodynamics. Introduction to the profession of the Mechanical Engineer through seminars from professional engineers working in various sectors of the Cypriot economy. The students have the opportunity to discuss on various issues at the end of each presentation.
Teaching Methodology	• Lectures and tutorials • Seminars given by professional Mechanical Engineers (under the series of seminars "Horizons in Mechanical Engineering"). • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Serway. R.A., *Physics for Scientists and Engineers* (selected chapters), Greek translation by L. Resvanis, Volumes I and II.
Assessment	• Midterm exam 40% • Final exam 60%
Language	Greek

Course Title	**Introduction to Electromagnetism**
Course Code	**MME 107**
Course Type	Compulsory
Level	Undergraduate
Year / Semester	1st year / 2nd Semester
Teacher's Name	Ioannis Giapintzakis

ECTS	5	Lectures / week	3+1 hours	Laboratories / week	0
Course Purpose and Objectives	The aim of the course is the comprehension of basic concepts and phenomena of Electromagnetism, and development of students' ability in solving problems using calculus. Particular emphasis is given to the relationship between the basic physical phenomena and their application in technology.				
Learning Outcomes	• Define and apply Gauss's law in electricity • Define and apply Gauss' Law in magnetism • Define and apply the general form of Ampère's law • Define and apply Faraday's law of induction • Analyze DC circuits using Kirchhoff's rules • Analyze RC, LC and RL circuits • Analyze the RLC series ac circuit using phasors • To explain the basic operation principal of various electrical devices and systems.				
Prerequisites	None	Required	None		
Course Content	The aim of the course is the comprehension of basic concepts and phenomena of Electromagnetism, and development of students' ability in solving problems using calculus. Particular emphasis is given to the relationship between the basic physical phenomena and their application in technology. Topics covered: Electric charge and matter; Electric field; Electrostatic potential; Capacitors and dielectrics; Electric current and resistance; DC circuits; Magnetism; Magnetic fields; Ampere's law; Faraday's law; Inductance and coils; Electromagnetic oscillations; AC circuits; Electromagnetic waves.				
Teaching Methodology	• Lectures • Tutorials • Homework problems • Demonstrations (during lecture) • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.				
Bibliography	• Serway, R.A. and J.W. Jewett, *Physics for Scientists & Engineers: - Electricity, Magnetism, Light and Optics*, *Modern Physics* (8th edition, Translated in Greek). Klidarithmos.				
Assessment	• Homework exercises 10% • 1st Midterm exam 20% • 2nd Midterm exam 30% • Final exam 40%				
Language	Greek				

Course Title	**Programming and Numerical Methods**
Course Code	**MME 218**

Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	2nd year / 4th Semester				
Teacher's Name	Vasileios Vavourakis				
ECTS	5	Lectures / week	3 hours	Laboratories / week	1 hour
Course Purpose and Objectives	This course aims to familiarize the students using a personal computer (PC) in numerical analysis. As such, they will be taught computer programming using MATLAB and FORTRAN for engineers, and in building their foundations in numerical methods.				
Learning Outcomes	• Code computer programs in MATLAB (in serial programming, debugging and code design). • Solve numerically mathematical problems in linear algebra, • Solve numerically mathematical problems in data interpolation and approximation. • Solve numerically linear and non-linear equations and systems. • Solve numerically problems involving differential algebra, complex numbers, and symbolic algebra. • Design/develop computer code using MATLAB to solve simple problems in engineering and physics. • Develop MATLAB code in order to represent experimental and numerical data using graphs, plots and contours.				
Prerequisites	MAS 029	Required	None		
Course Content	This course concerns teaching the basic principles in computer programming and numerical methods. Through MATLAB, the students will be taught a wide range of topics in numerical methods and analysis in linear algebra, developing graphs and plots, root finding, numerical solution of linear and non-linear systems, interpolation and approximation methods, numerical integration and differentiation, complex numeric algebra, and an introduction using symbolic algebra. Also, a brief introduction programming with FORTRAN will be carried out. This includes teaching material in basic syntax rules and coding in FORTRAN (program structure, basic data types, arrays, variables read/write, etc.) as well as coding subroutines and functions.				
Teaching Methodology	• Class lectures (PowerPoint, Socrative, Screencast-o-matic) • Laboratory lectures – hands-on practice at the computing center • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.				

<table>
<tr><td>Bibliography</td><td>

- Course notes / slideshow presentation (in English)
- Chapra. C.S., *Applied numerical methods with MATLAB: for Engineers & Scientists*. McGraw-Hill.
- Βάβαλη, Μ., Τ. Κατελανή. *Ξεκινώντας με το MATLAB*. http://www.mas.ucy.ac.cy/~xenophon/misc/GreekMatlab.pdf (in Greek)
- MathWorks®, *Getting Started with MATLAB*. https://www.mathworks.com/help/releases/R2017a/matlab/getting-started-with-matlab.html
- Mathews, J.H. and K.D. Fink, *Numerical methods: Using Matlab*. Prentice-Hall.
- Ellis, T.M.R., I.R. Philips and T.M. Lahey, *Fortran 90 Programming*. Addison-Wesley.

</td></tr>
<tr><td>Assessment</td><td>

- Midterm exams (x2) 54%
- Final exam 46%
- Course project assignment 10%

For perfect grade the students need 100 points out the total 110.</td></tr>
<tr><td>Language</td><td>Greek</td></tr>
</table>

<table>
<tr><td>Course Title</td><td colspan="5">Numerical Methods</td></tr>
<tr><td>Course Code</td><td colspan="5">MME 317</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">3rd Year / 5th Semester</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Triantafyllos Stylianopoulos</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3 hours</td><td>Laboratories / week</td><td>1 hour</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">Students should be able to, program in FOTRAN and Matlab, numerically solve problems on ordinary and partial differential equations (initial value and boundary value problems), compute numerical integrals and derivatives.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">

- Perform numerical differentiation and integration.
- Solve a single or a set of Ordinary Differential Equations with the established pertinent numerical methods.
- Solve Ordinary Differential Equations of higher order (2nd or higher derivative).
- Use the finite differences method to solve a Partial Differential Equation in one and two dimensions.
- Combine the finite differences method with a time-integration method to solve a time-dependent Partial Differential Equation.
- Program efficiently in FOTRAN and Matlab.

</td></tr>
<tr><td>Prerequisites</td><td colspan="2">MME 218, MAS 027</td><td colspan="2">Required</td><td>None</td></tr>
</table>

Course Content	This course is an introduction to numerical methods for the solution of real engineering problems. Topics covered include numerical integration and optimization and solution of ordinary and partial differential equations (ODEs and PDEs). Methods that are used for the solution of ODEs include the Implicit and Explicit Euler method, the Runge-Kutta methods and the Adams-Bashforth-Moulton methods. The solution of PDEs is performed with the finite difference method in one and two-dimensions. Both steady state and time-dependent problems are solved. The course also covers a brief introduction to the finite element method. It includes a programming component for writing algorithms for the numerical solutions in FORTRAN and Matlab.
Teaching Methodology	• 2 weekly lectures • 1 weekly computer lab session • Weekly homework problems • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Fausett, L.V., *Applied numerical analysis using Matlab*. • Fausett, L.V., *Numerical Methods: Algorithms and Applications*. • Rao, S.S., *Applied numerical methods for engineers and scientists*.
Assessment	• Homework assignments 10% • Midterm exam 30% • Final exam 60%
Language	Greek

Thermal Fluids

Course Title	**Engineering Thermodynamics I**				
Course Code	**MME 215**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	2^{nd} Year / 3^{rd} Semester				
Teacher's Name	Stavros Kassinos				
ECTS	5	Lectures / week	3+1 hours	Laboratories / week	1 hour
Course Purpose and Objectives	An introduction to engineering thermodynamics. Fundamental conservation principles for mass, momentum and energy and the principle of the non-destruction of entropy are applied to the engineering analysis of open and closed thermodynamic systems. A well-organized engineering analysis through the method of "production accounting" is emphasized. Basic concepts such as work, heat, internal energy and entropy are clearly defined. The thermodynamic state postulate is introduced leading to the use of thermodynamic diagrams, tables and equations of state. The ideal gas model is discussed in detail including its range of applicability. Basic energy conversion and heating/refrigeration cycles are considered giving emphasis to energy availability and efficiency analysis.				
Learning Outcomes	• Define the concepts of energy, internal energy, heat, work, entropy thermodynamic property and state. • Comprehend the basic conservation laws and their application in thermodynamics in closed (control mass) and open (control volume) systems. • Utilize thermodynamic phase diagrams and tables in electronic or printed form to calculate changes in thermodynamic state. • Analyze simple thermodynamic systems and calculate their thermodynamic efficiency. • Combine the first and second law of thermodynamics in order to apply availability analysis to complex thermodynamic systems. • Comprehend the operation of classic thermodynamic cycles for the conversion of energy and for heating or cooling.				
Prerequisites	None	Required	None		
Course Content	Units, dimensions and measurements; basic properties (pressure, temperature); equation of state for perfect gas; calorimetry; specific heat capacities; energy, internal energy, heat, work, entropy. Conservations laws in closed (control mass) and open (control volume) systems. 1st and 2nd law of thermodynamics, implications. Thermodynamic phase diagrams & process paths. Cyclic thermodynamic processes, isothermal, adiabatic and polytropic processes. Thermodynamic cycles and efficiency. Vapour and gas-power cycles, Carnot cycle, Diesel & Otto cycles. Real substances, properties of steam. Basic computational simulation tools.				

	Laboratory Exercises • Heat Capacity of Gas from Pressure Volume and Temperature Data • Adiabatic Process • Isothermal Process • Operation of a Heat Engine / Otto Cycle • Matlab assignment using thermodynamic tables with applications on cycles
Teaching Methodology	• Lectures • Tutorial sessions • Laboratory exercises • Demonstrations • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Course notes
Assessment	• Laboratory reports 15% • Computational assignment 10% • Midterm exam 25% • Final exam 50%
Language	Greek

Course Title	**Fluid Mechanics I**				
Course Code	**MME 216**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	2nd Year / 4th Semester				
Teacher's Name	New hire				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	1 hour
Course Purpose and Objectives	The teaching of the basic principles of the flow of incompressible fluids and the training of the students to the solution of professional-type problems.				
Learning Outcomes	Students will work to formulate the models necessary to study, analyze, and design fluid systems through the application of these concepts, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications.				

	• Analyze fluid kinematics and characterize fluid motion. • Apply Control Volume Analysis to analyze mass and momentum flows. • Conduct Control Volume Analysis for advanced applications such as open channel flows, compressible flows in ducts, turbomachines etc. • Describe through the use of Control Volume Analysis the mathematical basis for the Navier-Stokes equations. • Understand dimensional analysis and similarity conditions. • Apply the Navier-Stokes equations to analyze viscous laminar flows.		
Prerequisites	MAS 025	Required	None
Course Content	Introduction to principal concepts and methods of fluid mechanics. Description of Fluids and their properties (density, viscosity, surface tension). Fluid statics: manometry, pressure, hydrostatics and buoyancy. Forces on submerged surfaces. Fluid shear and viscosity, Newtonian and non-Newtonian fluids. Open systems and control volume analysis; mass conservation, momentum and energy conservation for moving fluids. The Bernoulli equation & practical applications. Hydraulic jumps and waves in fluids. Differential fluid flow analysis, Continuity (mass conservation) and Navier-Stokes equation (momentum conservation); analytical solutions. Viscous fluid flows in pipes: Laminar, transitional and turbulent flows. Re-scaling and; boundary layers. External and internal flows. Forces on bodies, lift and drag. introduction to flow measurement techniques (pitot, orifice plate, Venturi etc). **Laboratory Exercises** • Flow visualization • Manometry and Bernoulli's principle • Drag and lift around bodies (assignment, they print bodies) in a wind tunnel • Pipe Flow: frictional losses in pipes • Introduction to Flow metering techniques (manometers, pitot, Venturi, orifice)		
Teaching Methodology	• Lectures • Tutorial sessions • Laboratory exercises • Demonstrations • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.		
Bibliography	• Course notes • Alexandrou, A., *Principles of Fluid Dynamics*. Prentice Hall. • White, F.M., *Fluid Mechanics*, 8th Edition. McGraw-Hill. • Munson, B.R., D.F. Young and T.H. Okiish, *Fundamentals of Fluid Mechanics*, 3rd Edition Update Edition. Wiley.		
Assessment	• Laboratory reports 15% • Computational assignment 10% • Midterm exam 25% • Final exam 50%		
Language	Greek		

<table>
<tr><td>Course Title</td><td colspan="5">Heat Transfer</td></tr>
<tr><td>Course Code</td><td colspan="5">MME 217</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">2^{nd} Year / 4^{th} Semester</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Dimokratis G.E. Grigoriadis</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3+1 hours</td><td>Laboratories / week</td><td>1.5 hours</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">Introduction to heat transfer phenomena so that students familiarize with the basic principles of thermal energy transfer and governing equations. Understanding the physical mechanisms of Heat Transfer in a variety of applications and Recognition of heat transfer phenomena in practical problems, including analysis design and solution methods.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">• Analyze, measure and report thermal properties such as linear and expansion coefficient, thermal conductivity and capacity.
• Identify and estimate the relative importance of different modes of heat transfer for engineering problems.
• Draw equivalent thermal circuits and estimate heat transfer rates
• Apply the laws of heat transfer to analyze and evaluate heat transfer rates with conduction and convection.
• Solve practical problems involving heat transfer problems including conduction, convection and radiation.
• Review the importance of dimensionless groups in heat transfer and calculate heat transfer rates using empirical correlations.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">MAS 025</td><td colspan="2">Required</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="5">Linear and volumetric expansion. Mechanisms of Heat Transfer (HT), Fourier, Newton and thermal radiation laws of HT. Conductivity and diffusion coefficients, emissivity. Electrical analog of HT, electrical resistance and equivalent thermal circuits. General differential equation of heat conservation. Steady conduction in one dimension with or without internal heat sources, analytical solutions of flat walls, cylinders and spheres. Steady conduction in two dimensions, shape factors, numerical solutions. HT from fins and extended surfaces. Transient HT, Heisler charts. Lumped capacitance method, Biot and Fourier numbers. Forced and natural convection, Reynolds, Prandtl, Nusselt, Rayleigh and Grashof dimensionless numbers. Mixed convection, boiling and condensation. Heat exchangers.

Laboratory Exercises
• Measurement of thermal conductivity
• Measurement of coefficient of emissivity
• Effect of distance on thermal radiation
• Laboratory assignment in Matlab
• Laboratory assignment in SolidWorks</td></tr>
</table>

Teaching Methodology	• Lectures • Tutorial sessions • Laboratory exercises (groups of four students) • Demonstrations • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Course notes • Incropera, F.P. and D.P. DeWitt, *Fundamentals of Heat and Mass Transfer*, 5th edition. Willey. • Cengel, Y.A., *Heat Transfer: A Practical Approach*, 2nd ed. McGraw-Hill, ISBN: 9780072458930.
Assessment	• Laboratory reports 10% • Computational assignment 5% • Midterm exam 30% • Final exam 55%
Language	Greek

Course Title	**Engineering Thermodynamics II**				
Course Code	**MME 315**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	2nd Year / 4th Semester				
Teacher's Name	Stavros Kassinos				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	1 hour
Course Purpose and Objectives	This course is a continuation of Thermodynamics I considering the design and performance of advanced energy conversion systems. The thermodynamics of nonreactive mixtures are introduced giving emphasis to air-water-vapor mixtures and applications to air conditioning systems: psychrometry, comfort zones, accounting for thermal loads, design of air conditioning systems. Introduction to the thermodynamics of compressible fluid flow follows: speed of sound, Mach number, regimes in compressible flow, one-dimensional steady isentropic flow, choking in isentropic flow, shock waves, isentropic flow in convergent-divergent passages, compressibility effects with friction and heat transfer. A design competition for the optimization of a thermodynamic system using thermodynamics software is included.				

Learning Outcomes	• Perform thermodynamic analysis of complex engineering systems. • Design thermodynamic systems with the use of software and computers. • Understand the behaviour and properties of non-reacting mixtures with emphasis on mixtures of ideal gases. • Preform psychrometric analysis of air-conditioning systems. • Understand the thermodynamics of compressible flows and normal shock waves.		
Prerequisites	MME 215	Required	None
Course Content	Behaviour and properties of non-reacting mixtures with emphasis on mixtures of ideal gases. Psychrometric analysis of air-conditioning systems. Origin of irreversibilities & entropy, properties of liquids and gases, process and cycle representation on T-s and h-s chart. Turbines, compressors and isentropic efficiency. Simple steam and gas turbine cycles (Rankine and Brayton), refrigeration cycles, combined cycles. Introduction to the thermodynamics of compressible flows: steady isentropic flows with choking, shock waves, convergent-divergent passages, compressibility effects with friction and heat transfer. Design of thermodynamic systems using computer software. **Laboratory Exercises** • Design competition for the optimization of a thermodynamic system using computer software. • Thermodynamics of the refrigeration circuit • Vapor pressure of water Boiling process • Heat pump for cooling / heating operation		
Teaching Methodology	• Lectures • Tutorial sessions • Laboratory exercises • Demonstrations • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.		
Bibliography	• Course notes		
Assessment	• Laboratory reports 15% • Computational assignment 10% • Midterm exam 25% • Final exam 50%		
Language	Greek		

Course Title	**Fluid Mechanics II**
Course Code	**MME 316**
Course Type	Compulsory
Level	Undergraduate
Year / Semester	3rd Year / 6th Semester

<table>
<tr><td>Teacher's Name</td><td colspan="5">Triantafyllos Stylianopoulos</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3+1 hours</td><td>Laboratories / week</td><td>1 hour</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">This course is a continuation of Fluid Dynamics I. The course objective is to teach students how to solve independently fluid mechanics problems related to fluid pumps and power engines.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">• Understand the properties of boundary layers.
• Understand similarity laws and preform dimensional analysis for engineering problems.
• Formulate and solve basic problems in fluid mechanics. Including networks of internal and external flows.
• Analyze simple compressible flow systems and understand the concepts of subsonic, sonic, supersonic and hypersonic flows.
• Understand the operation of power engines such as pumps & fans.
• Familiarize with modeling and experimental techniques used in fluid dynamics.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">MME 216</td><td colspan="2">Required</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="5">Frictional flow resistance in single pipes and pipe networks, Moody diagram. Local losses and friction factors in fittings. losses in series, energy line and hydraulic gradient. Darcy-Weisbach equation, friction factors for laminar and turbulent pipe flows. Dimensional analysis and similarity, scale modelling. Low and high-speed aerodynamics. Boundary layers, Blasius solutions and separation. Compressible flows, Subsonic, sonic, supersonic and hypersonic flows, shock waves, connection with thermodynamics. Introduction to turbulent flows, transition criteria and turbulence modelling. Fluid Machinery: Turbomachinery: conservation of angular momentum, principles of energy exchange, machine losses and characteristics; fluid pumps and fans operating point; non-dimensional groups. Cavitation. Experimental techniques in fluid dynamics.

Laboratory Exercises
• Hydraulic gradient in a pipe network
• Pump performance & operational envelopes
• Experimental techniques in fluid dynamics (measurement in a BL with hot wires, pitot tubes, venture meters)</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">• Lectures
• Tutorial sessions
• Laboratory assignments
• Demonstrations
• Communicative, Collaborative
• During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.</td></tr>
<tr><td>Bibliography</td><td colspan="5">• Course notes
• Alexandrou, A., Principles of Fluid Mechanics. Prentice Hall.
• Papaioannou, A., Fluid Mechanics II (in Greek).
• Bird, R.B., W.E. Stewart and E.N. Lightfoot, Transport Phenomena, Revised 2nd Edition. Wiley.</td></tr>
</table>

Assessment	• Laboratory reports 15% • Assignments 10% • Midterm exam 25% • Final exam 50%
Language	Greek

Course Title	**Thermal Engines**				
Course Code	**MME 318**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	3rd Year / 6th Semester				
Teacher's Name	Dimokratis G.E. Grigoriadis				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	1.5 hours
Course Purpose and Objectives	Introduction to Heat Engines so that students familiarize with basic principles, the structure, operation, existing technologies and performance characterization of thermal engines. Understanding the energy exchange during the operation of thermal engines and the thermodynamic cycles involved.				
Learning Outcomes	• Identify different phenomena and technologies involved in thermal engines. Examine, analyze, measure and report the torque, power and the emissions generated by thermal engines. • Classify and propose different types of thermal engines based on application, timing, type of fuel used, fuel delivery method etc. • Calculate, measure and report the kinematic characteristics and assembly of different thermal engines. • Calculate the thermodynamic performance of thermal engines using different cycles. • Differentiate and explain the differences between the theoretical and actual cycles of real thermal engines. • Identify the flow of energy in thermal engines and analyze the heat transfer rates in thermal engines.				
Prerequisites	MME 315	Required	None		
Course Content	Types, technologies and classification of thermal engines, thermodynamic cycles and performance Internal Combustion Engines (ICE), kinematics. Thermodynamic cycles and performance metrics. Timing, two-stroke and four-stroke ICE. Operating principles of Otto, Diesel, HCCI and gas turbines. Combustion of gas mixtures. Theoretical and actual cycles of reciprocating engines and gas turbines. Energy balance. Heat transfer, lubrication and cooling. Special conditions and problems of combustion of various fuels. Mixture Formation, load settings. Configuration of the combustion chambers and fuel injection. Pollutants & emissions. Turbocharging and supercharging. The course includes a series of laboratory exercises.				

	Laboratory Exercises • Disassembly and assembly of an ICE engine • Torque and power output of a petrol engine • Emissions experiment using a diesel engine • PV diagram of a diesel engine
Teaching Methodology	• Lectures • Tutorials • Exercises • Seminars • Laboratory exercises • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Course notes • Heywood, J.B., *Internal Combustion Engine Fundamentals*. McGraw-Hill, ISBN0-07-028637-X. • Pulkrabek, W.W., *Engineering Fundamentals of the Internal Combustion Engine*. Prentice-Hall.
Assessment	• Laboratory reports 15% • Computational assignment 10% • Midterm exam 25% • Final exam 50%
Language	Greek

Dynamics and Control

Course Title	**Statics**				
Course Code	**MME 125**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	1st year / 1st Semester				
Teacher's Name	Theodora Kyratsi				
ECTS	5	Lectures / week	3+1 hours	Laboratories / week	0
Course Purpose and Objectives	The main objective of this course is understanding the equilibrium of rigid bodies.				
Learning Outcomes	• Replace a given system of forces by a simpler equivalent system. • Solve 3D equilibrium problems of rigid bodies including friction. • Find the centroids and centers of gravity. • Analyze trusses by the methods of joints and sections. • Determine the values of shear force and bending moment along a beam. • Determine the moment of inertia of an area and mass for simple and composite bodies.				
Prerequisites	None	Required	None		
Course Content	Moment of a force about a point and a given axis – Replacement of a given system of forces by a simpler equivalent system - Equilibrium 3D problems of rigid bodies - Centroids and centers of gravity - Analysis of Structures – Trusses - Analysis of Trusses by the Method of Joints and Method of Sections – Frames - Equilibrium problems of rigid bodies including friction - Shear Force and Bending Moment – Calculate Moment of inertia of area and mass - Determine the moment of inertia of area and mass for composite bodies.				
Teaching Methodology	• Lectures and tutorials • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.				
Bibliography	• Beer, F.P., E.R. Johnson, D. Mazurek and E.R. Eisenberg, *Statics*, (Greek translation). TZIOLA.				
Assessment	• Midterm exam 40% • Final exam 60%				
Language	Greek				

Course Title	**Dynamics**
Course Code	**MME 225**

<table>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">2nd Year / 3rd Semester</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Eftychios Christoforou</td></tr>
<tr><td>ECTS</td><td>5</td><td>Lectures / week</td><td>3+1 hours</td><td>Laboratories / week</td><td>5 hours total</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of the course is to introduce the fundamental principles of engineering dynamics and their application to motion analysis of particles and rigid bodies in two and three dimensions. Develop relevant problem-solving skills applied to practical engineering problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">
Apply vector analysis for obtaining relationships between displacement, velocity, and acceleration for a particle, a system of particles and rigid bodies in two- or three-dimensions.
Use free-body diagrams and apply Newton’s second law of motion to analyze the motion of a particle, a system of particles or a rigid body.
Understand the concepts of work, energy, power and mechanical efficiency.
Apply energy and momentum methods for analyzing the dynamic behavior of mechanical systems.
Solve practical problems regarding direct and oblique central impact.
Analyze planar as well as three-dimensional kinematics and dynamics of rigid bodies
Develop analytical skills required to systematically deal with practical dynamics problems involving mechanical systems.
</td></tr>
<tr><td>Prerequisites</td><td colspan="2">MME 125</td><td>Required</td><td colspan="2">None</td></tr>
<tr><td>Course Content</td><td colspan="5">The course introduces the student to the fundamental principles of dynamics and their application in the analysis of motion of particles and rigid bodies in two and three dimensions. Topics covered: (a) kinematics of particles, (b) kinetics of particles (Newton's second law, D’Alembert’s principle and dynamic equilibrium, methods of energy and momentum), (c) impact: direct central impact; oblique central impact, (d) kinematics of rigid bodies, (e) planar kinetics of rigid bodies (forces and acceleration, planar motion, energy and momentum methods), and (f) introduction to the dynamics of rigid bodies in three dimensions.

Laboratory Exercises
Study of mass moment of inertia and angular acceleration
Study of centrifugal force on rotating masses
Study of Coriolis force in rotating reference systems
</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">
2 weekly lectures
1 weekly tutorial
Weekly homework problems
Laboratory exercises
During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
</td></tr>
</table>

Bibliography	• Beer, F.P., R. Johnston and P. Cornwell, *Vector Mechanics for Engineers: Dynamics*. McGraw-Hill. • Bedford, A. and W. Fowler, *Engineering Mechanics: Dynamics*. Pearson.
Assessment	• Laboratory 10% • Midterm exam 40% • Final exam (comprehensive) 50%
Language	Greek

Course Title	**Mechatronics I**				
Course Code	**MME 226**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	2nd Year / 3rd Semester				
Teacher's Name	Matthew Zervos				
ECTS	5	Lectures / week	3+1 hours	Laboratories / week	9 hours total
Course Purpose and Objectives	This course is an introduction to mechatronics which is the union of mechanical, electronic and computer programming. It focuses on electronic engineering given that it is taken by mechanical engineering students. Computer and visual programming languages are dealt with in detail in MME 228. The purpose of MME 226 is to complement and broaden the basic knowledge and skills of mechanical engineering students which is necessary in understanding mechatronics and as such give them a competitive edge in their careers. The objective of the course is to give mechanical engineering students a working knowledge of electrical and electronic engineering which is necessary for the design and implementation of mechatronic systems.				
Learning Outcomes	• Analyze DC and AC circuits consisting of passive elements e.g. R, L, C. • Understand single phase, three phase and other forms of signals, how and where they are used. • Understand the principles of operation and use of active circuits elements. • Understand the operation of amplifiers with feedback. • Design amplifiers. • Design and analyze simple digital and logic circuits. • Understand the principles of operation of different sensors and actuators. • Build, test and analyze basic circuits consisting of active and passive elements.				
Prerequisites	MME 105, MME 107	Required	None		

Course Content	Circuit elements, waveforms, DC and AC circuits including RLC, complex notation. Thevenin and Norton theorem, maximum power transfer theorem, power and power factor, transformers. Also, semiconductors, diodes, transistors, types and operation, rectifiers, photodiodes. Operational amplifiers, inverting, non-inverting, sum and difference, integrator, differentiator, buffer amplifiers. Digital electronics, binary arithmetic, logic gates NOT, OR, AND, NOR, NAND, XOR truth tables and circuits. Half/full adders. Introduction to sensors and actuators. The course also includes three lab sessions on circuits including passive and active elements thereby extending the skills and knowledge of students which were acquired in MME 105 on how to use multi meters, oscilloscopes, and waveform generators to build and analyze circuits. **Laboratory Exercises** • Half and full wave rectifier • RLC circuits • Transformers • RLC-DC circuits • RLC-AC circuits • Digital circuits and logic gates
Teaching Methodology	• Lectures • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Alciatore, D.G. and M.B. Histand, *Introduction to Mechatronics and Measurement Systems*. McGraw-Hill.
Assessment	• Laboratory Exercises 20% • Midterm Exam 30% • Final Exam 50 %
Language	Greek

Course Title	**Vibrations**				
Course Code	**MME 227**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	2nd Year / 4th Semester				
Teacher's Name	Andreas Kyprianou				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	6 hours total
Course Purpose and Objectives	The purpose of the course is to give an introduction to vibration engineering and discuss its importance in real life applications.				

Learning Outcomes	• Recognize the sources and causes of vibration as well as the conditions under which a mechanical system oscillates. • Apply mathematical concepts drawn from real and complex analysis, linear algebra, Fourier transforms and differential equations for analyzing and understanding vibrating systems. • Find the time response of free and forced vibration systems. • Find the natural frequencies and mode shapes of two degree of freedom systems. • Understand the role of mechanical engineers in society as technology creators. • Recognize that vibrations can be exploited in novel multidisciplinary applications; much the same way the atomic force microscope exploits cantilever vibrations to probe nanoscale.		
Prerequisites	MAS 025, MME 225	Required	None
Course Content	This is an introductory course on mechanical vibrations. One degree of freedom systems are used to explain: (a) the basic principles of modelling, (b) the second order differential equations that modelling yields, and (c) the relationship between the system physical parameters and the differential equations. The notions of (un)damped natural frequency and resonance are defined using the system parameters and their real-life importance is thoroughly discussed. Two degree of freedom systems are studied in order to define the concept of mode shape. Computation of mode shapes and natural frequencies of two degree of freedom systems. Computation of the frequency response function of forced two degree of freedom systems. **Laboratory Exercises** • Responses of free undamped and damped systems • Free bending vibration and natural frequency determination • Forced vibration and experimental determination of frequency response functions		
Teaching Methodology	• Lectures and discussion of solved examples • Communicative, Collaborative • Laboratory exercises • During the first week of the semester, the Syllabus of the course is given by the teacher, which includes information on the course content, expected learning outcomes, assessment and office hours		
Bibliography	• Rao, S.S., *Mechanical Vibrations*. Prentice Hall.		
Assessment	• Homework 5% • Laboratory 15% • Midterm exam 30% • Final exam 50%		
Language	Greek		

Course Title	**Mechatronics II**
Course Code	**MME 228**
Course Type	Compulsory

<table>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">2nd Year / 4th Semester</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Matthew Zervos</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3+1 hours</td><td>Laboratories / week</td><td>1 hour</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of this course is to complete the introduction to mechatronics that started in MME 226. This includes computer and visual programming languages and simple but relevant laboratory exercises on data acquisition, signal processing and control. In addition, the course will focus on sensors and actuators in the context of mechatronics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">
Understand the structure of a LabView program, implement control using conditionals and implement iteration using loops.
Use timers and timing, basic data acquisition and signal processing in LabView.
Store and recover data in LabView.
Design, build, analyze and trouble shoot simple mechatronic systems involving sensors and actuators.
Understand the theory of electromechanical energy conversion of DC motors.
Develop dynamic models of DC motors, brushless DC motors, stepper motor, servo motors.
Develop models for motor energy losses and derive characteristic torque-speed curve.
Understand and develop models of motor drives.
</td></tr>
<tr><td>Prerequisites</td><td colspan="2">MME 226</td><td>Required</td><td colspan="2">None</td></tr>
<tr><td>Course Content</td><td colspan="5">The first half of Mechatronics II is focused on LabView which will be taught in a computer lab. It will cover basics aspects of LabView such as the front panel, block diagram, numeric types, logical variables and operations, strings, arrays, matrices, graphs, controls, indicators, timing, structure, while and for lops, conditionals, data acquisition, signal processing and control. Students will be evaluated by programming exercises. During the second half the basic background notions of electrical motors will be introduced: magnetic circuits, energy conversion, torque production and motor drives. These notions will be used to understand the operation of DC, brushless DC, stepper and servo motors. Laboratory exercises using various types of DC electric motors are included.</td></tr>
</table>

	Laboratory Exercises • Familiarization with the front panel and block diagram environment of LabView • Manipulation and interconversion of numeric types, logic variables and operations • Introduction to strings, arrays matrices • Timing and timers, indicators and controls • Iteration control and conditionals • Data acquisition and signal processing • Dynamic analysis and parameter identification of DC, brushless DC, stepper, servo motors • Design and implementation of motor drive
Teaching Methodology	• Lectures • Laboratory • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Alciatore, D.G. and M.B. Histand, *Introduction to Mechatronics and Measurement Systems*. McGraw-Hill. • Chang-liang Xia, *Permanent Magnet Brushless DC Motor Drives and Controls*. Wiley. • Filizadeh, S., *Electric Machines and Drives: Principles, Control, Modeling, and Simulation*. CRC Press.
Assessment	• Weekly exercises 50% • Project 30% • Final Exam 20%
Language	Greek

Course Title	**Modeling and Analysis of Dynamic Systems**				
Course Code	**MME 325**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	3rd Year / 5th Semester				
Teacher's Name	Loucas Louca				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	10 hours total

Course Purpose and Objectives	To teach a unified approach for the modeling of real systems with mechanical, thermal, fluid, and electrical elements. Models of dynamic systems are represented using suitable graphical form models and state space equations. Time and frequency response are calculated, and system parameters are identified. By the end of the course students will be able to model and analyze multi-energy domain dynamic systems in order to understand the dynamic interaction between different physical phenomena.		
Learning Outcomes	• Perform systematic choices of ideal elements for modeling a real dynamic system with mechanical, thermal, fluid and electrical elements and their interactions. • Develop the differential equations that describe the input/output behavior of a dynamic system. • Compute the input/output transfer function of a dynamic system. • Compute the response using the Laplace transform of a linear system with an input that is a combination of simple functions. • Define the stability of a real system. • Compute the frequency response of high order linear systems. • Identify the parameters of a system using the time response and a dynamic model of the system. • Find the time and frequency response using computer simulation of a dynamic system.		
Prerequisites	MAS 027, MME 225	Required	None
Course Content	The course introduces a unified approach for modeling real dynamic systems. Modeling is accomplished using appropriate graphical or state-space equation models, in order to meet the requirements during the use of the models in design and automatic control. System analysis is used to calculate behavioral characteristics and to evaluate the accuracy of modeling assumptions. Topics taught include lumped parameter models; models with electric, fluid and thermal elements; interfaces; state-space equations; block diagrams; Laplace transforms – transfer functions; time and frequency domain response; stability. Students use Matlab/Simulink as a computational analysis tool. Laboratory exercises are used to identify parameters and demonstrate the interaction between different physical phenomena. **Laboratory Exercises** • Low-frequency electromechanical system • Fluid-Mechanical component interaction • Two-tank fluid system		
Teaching Methodology	• Lectures using whiteboard • Recitation for solving sample problems • Laboratory exercises • Homework • Demos/exercises using Matlab/Simulink • Office hours • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.		

Bibliography	• Palm, W.J. III, *System Dynamics (2nd Edition – International Edition)*. McGraw-Hill, ISBN 978-0071267793. • Shearer, J.L., B.T. Kulakowski and J.F. Gardner, *Dynamic Modeling & Control of Engineering Systems*. Prentice Hall, ISBN 13-356403-7. • Ogata, K., *System Dynamics*. Prentice Hall, ISBN 013-124714-X. • Karnopp, D.C., D.L. Margolis and R.C. Rosenberg, *System dynamics: Modeling and Simulation of Mechatronic Systems*. Wiley, ISBN 0471333018. • Doebelin, E., *System Dynamics: Modeling, Analysis, Simulation, Design*. Published by Marcel Dekker, ISBN 9780824701260.
Assessment	• Laboratory 15% • Midterm Exam 40% • Final Exam 45%
Language	Greek/English

Course Title	**Control Engineering**				
Course Code	**MME 327**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	3rd Year / 6th Semester				
Teacher's Name	Eftychios Christoforou				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	6 hours total
Course Purpose and Objectives	The purpose of the course is to introduce the fundamental principles of classical feedback control theory for linear-time-invariant (LTI) systems, both in the time domain and the frequency domain. Understand the concept of feedback and how it affects the stability, transient and steady-state response of dynamic systems. Learn how to design controllers to meet a given set of specifications. Understand basic controllers including the proportional-integral-derivative (PID) control. Familiarize with the analytical methods and software tools used in control system analysis and design. Develop relevant problem-solving skills applied to practical engineering problems.				
Learning Outcomes	• Understand the fundamental concepts of feedback control and its modern engineering applications. • Have a sound understanding the classical control theory and ability to exploit knowledge from modeling and response of dynamic systems				

	(Laplace transform, transfer function, block diagram representations) to design and analyze control systems. • Understand the fundamental characteristics and properties of feedback control systems. • Understand the concept of stability and apply the relevant theory, such as the Routh-Hurwitz and Nyquist stability criterions, to the analysis and design of control systems. • Design feedback controllers using the standard root-locus and the frequency response (Bode plot) techniques. • Design basic controllers to achieve desired performance specifications including the proportional-integral-derivative controller. • Use computer software for the analysis and design of control systems.

Prerequisites	MME 325	Required	None

Course Content	The course introduces students to feedback control systems and the classical control theory. Topics covered: (a) History of control and modern applications. (b) Use of dynamical system modeling (mathematical models, Laplace transform, transfer function, block diagrams, system response) in the design of control systems. (c) Feedback control setup and characteristics. (d) Time-domain specifications. (e) System stability and the Routh-Hurwitz criterion. (f) Feedback properties and simple controllers including the PID controller. (g) Steady-state analysis, system type and error constants. (g) Root locus analysis and design. (h) Frequency response design and analysis using Bode plots and Nyquist plots. **Laboratory Exercises** • Rotary flexible joint / flexible link arm control • Linear / rotary servo inverted pendulum control
Teaching Methodology	• 2 weekly lectures • 1 weekly tutorial • Weekly homework problems • Laboratory exercises • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Franklin, G.F., J.D. Powell and A. Emami-Naeini, *Feedback Control of Dynamic Systems*. Pearson. • Dorf, R.C. and R.H. Bishop, *Modern Control Systems*. Pearson. • Ogata, K., *Modern Control Engineering*. Pearson.
Assessment	• Laboratory 10% • Midterm exam 40% • Final exam (comprehensive) 50%
Language	Greek

Course Title	**Robotics**
Course Code	**MME 420**
Course Type	Elective

<table>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">4th Year / 7th or 8th Semester</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Eftychios Christoforou</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3+1 hours</td><td>Laboratories / week</td><td>4 hours total</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of the course is to provide an introduction to robotics with the emphasis being on robotic manipulators. Examine the various types of robotic systems, their applications and the methodologies used for their mathematical analysis, design, and control. Develop relevant problem-solving skills applied to practical engineering problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">• Identify and classify robotic systems, use the relevant terminology and cite their applications.
• Understand the kinematics of robotic manipulators and be able to apply the mathematical methodologies used for kinematic and workspace analysis.
• Understand the dynamics of robotic systems and how the relevant equations of motion are formulated.
• Apply common motion control methodologies as used in robotics.
• Identify sensors and actuators used in robotic systems, understand their principles of operation and characteristics, and be able to select them.
• Design motion trajectories for robotic manipulation tasks.
• Interpret the specifications of a robotic system and evaluate it based on the needs of a specific application.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">MME 327</td><td colspan="2">Required</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="5">The course introduces the students to the field of robotics with emphasis on robotic manipulators. Applications, theoretical analysis, design, and control issues are considered. Topics covered: (a) History, types of robotic systems and applications, (b) Terminology, main parts, kinematic chain, end-effectors, (c) Coordinate transformations, rotation matrices, and homogeneous transformations, (d) Forward kinematics analysis, Denavit-Hartenberg procedure, inverse manipulator kinematics, (e) Velocity kinematics, Jacobian matrix, inverse velocity kinematics, singular configurations, (f) Dynamics modeling, the method of Newton-Euler and the method of Lagrange, equations of motion, (g) Feedback control schemes, trajectory planning, (h) Sensors and actuators used in robotics, (i) Specifications of industrial robotic systems and safety measures.

Laboratory Exercises
• Motion planning and programming of basic pick-and-place tasks
• Industrial application simulation using a belt conveyor</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">• 2 weekly lectures
• 1 weekly tutorial
• Weekly homework problems
• Laboratory demonstration/exercise
• During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.</td></tr>
</table>

Bibliography	• Craig, J., *Introduction to Robotics: Mechanics and Control*. Prentice Hall • Sciavicco, L. and B. Siciliano, *Modeling and Control of Robot Manipulators*. Springer. • Spong, M.W. and M. Vidyasagar, *Robot Dynamics and Control*. Wiley.
Assessment	• Laboratory 10% • Midterm exam 40% • Final exam (comprehensive) 50%
Language	Greek

Course Title	**Advanced Dynamics and Applications**				
Course Code	**MME 421**				
Course Type	Elective				
Level	Undergraduate				
Year / Semester	4^{th} Year / 7^{th} or 8^{th} Semester				
Teacher's Name	Loucas Louca				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	0
Course Purpose and Objectives	The purpose of the course is to introduce formal approaches for performing kinematic and dynamic analysis of rigid bodies moving in space. Newton-Euler and Lagrangian formulations for three-dimensional motion of particles and rigid bodies is used. By the end of the course students will be able to model and analyze multi-degree of freedom rigid body systems.				
Learning Outcomes	• Formulate the Newton/Euler equations of motion for systems of particles and rigid bodies in three-dimensions. • Calculate inertia properties and angular velocity of rigid bodies. • Identify constraints and degrees-of-freedom for dynamical systems. • Formulate Lagrange's equations of motion for particles and rigid bodies. • Analyze the kinematics of linkage mechanisms. • Analyze kinematics and dynamics of rigid-body systems through computational approaches using Matlab and SolidWorks.				
Prerequisites	MME 225	Required	None		
Course Content	The course focuses on the motion of rigid bodies in three-dimensional space. Kinematics and dynamics of rigid bodies are studied in order to derive the equations of motion using various modern approaches. Topics taught include inertia properties and angular velocity; Newton-Euler equations of motion; degrees-of-freedom and constraints; kinetic/potential energy and virtual work; Lagrange's equations for holonomic systems; numerical analysis of derived equations of motion. The formulations are applied to various multi-body dynamics problems that arise in mechanical and aerospace engineering, and the special case of planar mechanisms is also studied. Students use generalized and specialized software, like Matlab and SolidWorks, to analyze rigid-body systems.				

Teaching Methodology	• Lectures • Homework • Recitation for solving sample problems • Computer lab for solving three-dimensional dynamics • Office hours • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Greenwood, D.T., *Advanced Dynamics*. Cambridge University Press, ISBN 978-0-521-02993-3. • Jazar, R.J, *Advanced Dynamics Rigid Body, Multibody, and Aerospace Applications*. John Wiley & Sons, ISBN 978-0-470-39835-7. • Norton, R.L., *Design of Machinery: An introduction to the Synthesis and Analysis of Mechanisms and Machines*. McGraw-Hill, ISBN 978-0-07-312158-1.
Assessment	• Homework 20% • Midterm Exam 35% • Final Exam 45%
Language	Greek

Course Title	**Vibrations Theory and Applications**				
Course Code	**MME 426**				
Course Type	Technical Elective Course				
Level	Undergraduate				
Year / Semester	4th Year / 7th or 8th Semester				
Teacher's Name	Andreas Kyprianou				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	0
Course Purpose and Objectives	The purpose of this course is to extend the principles of vibration engineering to continuum and non-linear systems.				
Learning Outcomes	• Recognizing the characteristic features of multi-degree of freedom systems and infinite degree of freedom systems. • Application to vibration absorption. • Recognizing the characteristic features of infinite degree of freedom systems. • Modelling using ordinary and partial differential equations. • Simple qualitative and quantitative analysis of non-linear systems. • Applications of non-linear systems to population growth rate and LASER emission.				
Prerequisites	MME 227	Required	None		

Course Content	This course studies the vibrations of linear systems consisting of finite multiple and infinite degrees of freedom. The theory of vibration absorption as generated by the basic theory of linear multi-degree of freedom systems is analyzed in its full detail. The partial differential equations describing the behavior of infinite degree of freedom systems are derived from the basic principles of strength of materials. The distinctive qualitative and quantitative characteristics of non-linear systems are described and subsequently and subsequently the methodology of extracting them for simple non-linear systems is presented. Topics studied: structure of dynamics and dynamical examples from various scientific disciplines, generalized coordinates, vibrations of multi-degree and infinite degree of freedom systems, non-linear system behaviour characterization: limit cycles, bifurcations and chaos.
Teaching Methodology	• Lectures • Problem exercises • Concise and extensive study of a relevant scientific article • Computational solution of differential equations • Communicative, Collaborative • During the first week of the semester the students receive the course syllabus, which includes the course content, bibliography, learning outcomes, assessment and office hours.
Bibliography	• Bishop, R.E.D. and D.C. Johnson, *The mechanics of Vibration*. Cambridge University Press. • Kaplan, D. and L. Glass, *Understanding Non-linear Dynamics*. Springer. • Rao, S.S., *Mechanical Vibrations*. Pearson. • Strogatz, S.H., *Non-linear Dynamics and Chaos, with Applications to Physics, Chemistry, and Engineering*. CRC Press. • Weaver, W., S.P. Timoshenko and D.H. Young, *Vibration problems in Engineering*. Wiley.
Assessment	• Homework 5% • Midterm exam 25% • Final exam 50% • Analysis of a scientific article 20%
Language	Greek

Materials, Design and Manufacturing

<table>
<tr><td>Course Title</td><td colspan="5">Computer Aided Drafting</td></tr>
<tr><td>Course Code</td><td colspan="5">MME 145</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">1st Year / 1st Semester</td></tr>
<tr><td>Teacher's Name</td><td colspan="5">Loucas Louca</td></tr>
<tr><td>ECTS</td><td>5</td><td>Lectures / week</td><td>3 hours</td><td>Laboratories / week</td><td>1 hour</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">To teach the fundamental capability to document mechanical engineering ideas using graphical communication techniques. This is achieved by teaching the necessary skills and familiarity for drawing two-dimensional geometries using AutoCAD Mechanical and building three-dimensional component models and mechanical system assemblies using SolidWorks. By the end of the course the students will be able to represent mechanical systems using three-dimensional models and two-dimensional drawings.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">• Know and recognize items related to drafting from the ISO standard.
• Generate drawings with the correct title block and the correct scale and positioning of the objects.
• Draw projections (Multiview, isometric, oblique) with the correct scale, line type/thickness and dimensions.
• Draw two-dimensional geometries with the correct title block using drawing tools from AutoCAD Mechanical.
• Build three-dimensional models of components by adding and removing material and other modification features using SolidWorks.
• Create standardized holes and threaded holes in custom parts using SolidWorks.
• Create assemblies of mechanical systems using custom and standardized parts (bold, nuts, washers, gears, etc.) using SolidWorks and its toolbox.
• Generate annotated drawings, with the correct title block, in isometric projections, multiview projections and sections, of components and assemblies using SolidWorks.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">None</td><td colspan="2">Required</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="5">Engineers must be able to create and interpret detailed and assembled drawings in order to communicate their ideas. The course emphasizes on the connection between the drawings and three-dimensional geometric models of a product and its design and manufacturing processes. Topics taught include: international conventions and standards; drawing scales; drawing line types; projection planes; views and view layout; isometric views; auxiliary views; sections; three-dimensional geometric modeling. All topics are implemented through a team project that develops an integrated three-dimensional model of a mechanical device. Autodesk Mechanical and SolidWorks are the software used to create drawings and geometric models.</td></tr>
</table>

Teaching Methodology	• Lectures using PowerPoint and software demos of Autodesk Mechanical and SolidWorks • Recitation for solving sample problems • Homework • Hands-on experience and demonstrations of simple mechanical components • Office hours • Team project for the three-dimensional modeling of a mechanical system • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.
Bibliography	• Hardcopies of lecture PowerPoint slides and other assistive material. • Bertoline, G.R. and E.N. Wiebe, *Technical Graphics Communication* (third edition), ISBN 0-07-365598-8. • Gladfelter, D., *AutoCAD 2014 and AutoCAD LT 2014: no experience required*, ISBN 9781118757710. • Lombard, M.J., *SolidWorks 2013 Bible*, ISBN 9781118508398.
Assessment	• Team Project 15% • Quiz 15% • Midterm Exam 30% • Final Exam 40%
Language	Greek

Course Title	**Material Science and Engineering I**				
Course Code	**MME 155**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	1st year / 2nd Semester				
Teacher's Name	Theodora Kyratsi				
ECTS	5	Lectures / week	3+1 hours	Laboratories / week	1 hour
Course Purpose and Objectives	A course in understanding the structure-property relations of metals, ceramics, polymers and composites with emphasis on mechanical properties.				

Learning Outcomes	• Define crystallinity, typical unit cells, density, Miller indices; crystal defects. • Describe the diffusion mechanism at atomic level. • Name and describe the two atomic mechanisms of steady-state and non-steady-state diffusion. • Read engineering stress-strain diagram and define elasti/plastic deformation, mechanical terms and properties (tensile strength, yield strength, Young modulus, Poisson ratio, ductility etc). • Describe strengthening mechanisms (grain size effect, solid solutions and cold-working) based on dislocations and define fatigue and creep. • Describe (qualitative) and analyze (quantitative) microstructures based on phase diagrams. • Describe heating processes of metals via isothermal transformation, annealing and precipitation. • Compare the mechanical behavior of metallic, ceramic and polymeric materials using stress-strain graphs. • Predict the mechanical properties of composite materials.		
Prerequisites	None	Required	None
Course Content	This course is the first part of the series “Materials Science and Engineering” and includes: Crystal structure; Unit cells – density – crystallographic directions and planes; Dislocations and Defects; Material microstructure; Diffusion – Elastic and Plastic Deformation; Stress vs Strain – Definition of Mechanical Properties (tensile strength, yield strength, Young modulus, Poisson ratio, ductility etc); Strengthening of metals (grain size, solid solutions, cold work); Failure of materials; Fatigue; Creep; Phase diagrams and phase transformations; Heat treatment of metals; Annealing; Precipitation Hardening; Characteristics of common alloys (i.e. perlite, benite, martensite, temper martensite), Processing and mechanical properties of metals and ceramics; Composite materials; Fiber Composites; Prediction of mechanical properties of composites made by known materials. **Laboratory Exercises** • Introduction to crystallography • Metallography • Phase diagrams • Impact test • Hardness test (Rockwell, Vickers)		
Teaching Methodology	• Lectures • PowerPoint presentations • Laboratory exercises • Laboratory demonstrations • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.		
Bibliography	• Callister, W.D., *Materials Science and Engineering* (translated in Greek). Tziolas.		

Assessment	• Midterm exam 35% • Final exam 50% • Laboratories 5% • Presentation 10%				
Language	Greek				

Course Title	**Chemistry for Engineers**				
Course Code	**MME 156**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	1st year / 2nd Semester				
Teacher's Name	Theodora Krasia-Christoforou				
ECTS	5	Lectures / week	3+1 hours	Laboratories / week	0
Course Purpose and Objectives	In today's modern society, Chemistry is greatly involved in all engineering fields. The aim of MME156 is the understanding of basic chemistry concepts by the undergraduate students and the acquiring of knowledge that is directly interweaved with the Mechanical and Manufacturing Engineering as well as Materials Science and Engineering fields.				
Learning Outcomes	• Understand and describe the different types of chemical bonds. • Balance chemical equations and solve stoichiometric problems. • Understand redox processes and solve related problems. • Understand and describe the basics on Chemical Thermodynamics and solve thermochemistry-related problems. • Understand the meaning of equilibrium in physical and chemical processes, the influencing parameters and solve related problems of a chemical reaction by altering the aforementioned parameters. • Understand the meaning of the strength of acids and bases, pH and pOH and solve related problems. • Acquire general knowledge and understanding on polymers. • Acquire general knowledge and understanding on the importance of nanotechnology and nanomanufacturing in the generation of advanced nanomaterials for use in several applications.				
Prerequisites	None	Required	None		

Course Content	The aim of the course is the understanding of basic chemistry concepts by the undergraduate students and the acquiring of knowledge that is directly interweaved with the Mechanical and Manufacturing Engineering as well as Materials Science and Engineering fields. Atomic structure and chemical bonds. Chemical equations: Stoichiometry, moles, concentration, molarity, density etc. Chemical reactions between acids and bases; chemical reactions involving gases; combustion reactions. Redox reactions. Examples: electrolysis, corrosion, fuel cells, etc. Chemical Thermodynamics and Thermochemistry. Equilibrium in physical processes, characteristics of a dynamic equilibrium, equilibrium in chemical reactions, equilibrium constant and equilibrium Law, parameters influencing the chemical equilibrium. Strength of acids and bases: The meaning of pH. Special topics: Polymers and Advanced materials and nanotechnology.
Teaching Methodology	• PowerPoint presentations • Tutorials (on a weekly basis) • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.
Bibliography	• Graham, H. and J. Holman, *Chemistry in Context*, 5th Edition Nelson Thornes Ltd. 2000. • Callister, W.D. JR., *Materials Science and Engineering. An introduction*. • MME 156 course handouts (http://www.eng.ucy.ac.cy/krasia/).
Assessment	• Exercise sets (x3) 10% • Midterm examination 40% • Final examination 50%
Language	Greek

Course Title	**Materials Science and Engineering II**				
Course Code	**MME 255**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	2nd Year / 3rd semester				
Teacher's Name	Ioannis Giapintzakis				
ECTS	5	Lectures / week	3+1 hours	Laboratories / week	0
Course Purpose and Objectives	The main objective is the understanding of the structure-physical properties relationship for the whole range of materials - metals, ceramics and polymers.				

Learning Outcomes	• Explain the differences in the electrical properties of metals, semiconductors and insulators • Explain electrical phenomena in semiconductor devices • Describe the basic mechanisms of heat absorption and conduction in solids • Explain the thermal expansion effect in solids • Explain the origin of magnetism in diamagnetic, paramagnetic, ferrimagnetic and ferromagnetic materials • Describe the particular magnetic characteristics of soft and hard magnetic materials • Explain the optical properties of conductive, semiconductor and non-conductive materials • Describe how to select materials for different technological applications		
Prerequisites	MME 155	Required	None
Course Content	This course is the second part of the series "Materials Science and Engineering". The first part of the course focuses on the thermal (heat capacity, thermal expansion, thermal conductivity), electrical (electrical conduction, semiconductivity, dielectric materials), magnetic (diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, soft and hard magnetic materials, storage) and optical properties of metals, ceramics and polymers. The last part of the course discusses both how to select materials for engineering applications and the economic, environmental and social issues related to the science and technology of materials.		
Teaching Methodology	• Lectures • Tutorials • Homework problems • Demonstrations (during lecture) • Presentations by students of group projects (on topics of materials and technologies related to the course) • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.		
Bibliography	• Callister, W.D., *Materials Science and Engineering*, 5th Edition, (translated in Greek). Tziolas.		
Assessment	• Homework exercises 10% • Group project 20% • Midterm Exam 30% • Final Exam 40%		
Language	Greek		

Course Title	**Solid Mechanics**
Course Code	**MME 256**
Course Type	Compulsory
Level	Undergraduate

<table>
<tr><td>Year / Semester</td><td colspan="5">2nd year / 3rd semester</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Vasileios Vavourakis</td></tr>
<tr><td>ECTS</td><td>5</td><td>Lectures / week</td><td>3 hours</td><td>Laboratories / week</td><td>8 hours total</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The aim of this course is to teach the students the fundamental principles of the mechanics of solids. This will permit the students evaluate and calculate stresses and strains in basic solid mechanics problems and in simple-geometry structural analysis problems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">
Understand the basic concepts and principles of the mechanics of solids.
Calculate stresses and strains in solid deformable bodies / structures subject to external loadings – under quasi-static conditions:

uniaxial loading (tension, compression),
shear due to torsion,
pure bending and transverse loading,
combination of the above loading conditions.

Build their ability to critically think and apply their theoretical knowledge in solid mechanics on relevant mechanical engineering problems.
Identify, formulate and solve design problems in mechanical engineering.
</td></tr>
<tr><td>Prerequisites</td><td colspan="2">MME 125</td><td colspan="2">Required</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="5">The material being taught in this course covers the introduction and theoretical description of the fundamental notions in solid mechanics (stress and strain measures, stiffness, etc.), generalized theory of elasticity (Hooke’s law), Mohr’s circle (in 2D and in 3D), uniaxial stress analysis (tension, compression), uniform loading of plates, (elastic and elastoplastic) shaft torsion, (elastic and elastoplastic) beam bending and eccentric beam loading. The course also contains laboratory sessions that are supported by hands-on lab work and experiments of the following tests: tensile test (of ductile and brittle metals), compression test, three-point bending test, hardness test (Rockwell, Vickers).

Laboratory Exercises

Tensile test (of ductile and brittle metals)
Bending test (Three-point, Cantilever)
Compression test
Torsion test (axisymmetric, non-axisymmetric)
</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">
Class lectures (whiteboard, PowerPoint)
Course-supporting lectures
Laboratory lectures – experimental mechanics of solids
Communicative, Collaborative
During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.
</td></tr>
</table>

Bibliography	• Beer, F.P., E.R. Johnston, J.T. DeWolf and D.F. Mazunek, *Mechanics of Materials*. McGraw-Hill. • Morrow, H.W. and R.P. Kokernak, *Statics and strength of materials*. Prentice Hall. • Malvern, L.E., *Introduction to the Mechanics of a Continuous Medium*. Pearson ISBN-10: 0134876032. • Timoshenko, S.P. and J.N. Goodier, *Theory of Elasticity*. McGraw-Hill.
Assessment	• Midterm exams (x2) 46% • Final exam 44% • Laboratory 10%
Language	Greek

Course Title	**Strength of Materials**				
Course Code	**MME 257**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	2nd year / 4th Semester				
Teacher's Name					
ECTS	5	Lectures / week	3 hours	Laboratories / week	8 hours total
Course Purpose and Objectives	The aim of the course is to enhance the students' knowledge on the basic principles of the strength of solid materials for the understanding of failure mechanisms, the assessment of the stresses in simple structural members, and the deformation of beams and shafts.				
Learning Outcomes	• Determine normal and shear stresses in metallic plates and shells. • Explain the failure theories of metals and other solid materials. • Explain the effect of column buckling. • Calculate stresses in structural problems involving combined load conditions. • Estimate stress concentrations at geometric discontinuities. • Understand the applicability of energy theorems in the stress analysis in linear elasticity quasi-static problems.				
Prerequisites	MME 256	Required	None		
Course Content	The material being taught in this course extends from MME 256 and covers course material related to the evaluation of stress concentrations and residual stresses, stress evaluation in composite members and structures, flexural loading of beams and shafts, buckling of slender bodies and structures, uniform loading of metallic plates, shells and pressure vessels, and a brief outline of the energy theorems and methods, and the failure criteria involved in (elastic-perfectly plastic) metals, ceramic, polymers and fibrous materials.				

	Laboratory Exercises • Buckling • Photo-elasticity (stress flow, stress concertation)
Teaching Methodology	• Class lectures (whiteboard, PowerPoint) • Course-supporting lectures • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.
Bibliography	• Nash, W.A., *Schaum's outline of theory and problems of strength of materials*. McGraw-Hill. • Bower, A.F., *Applied Mechanics of Solids*. ISBN-13: 978-1439802472. • Beer, F.P., E.R. Johnston, J.T. DeWolf and D.F. Mazunek, *Mechanics of Materials*. McGraw-Hill. • Morrow, H.W. and R.P. Kokernak, *Statics and strength of materials*. Prentice Hall. • Spiegel, L. and G.F. Limbrunner, *Applied statics and strength of materials*. Prentice Hall.
Assessment	• Midterm exams (x2) 46% • Final exam 44% • Laboratory 10%
Language	Greek

Course Title	**Machine Elements**				
Course Code	**MME 345**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	3rd Year / 5th semester				
Teacher's Name	Loucas Louca				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	6 hours total
Course Purpose and Objectives	To teach methodologies for the calculation, selection and use of components (machine elements) that are used in mechanical systems, under static and dynamic loading conditions. By the end of the course the students will be able to design a machine with mechanical components taught in the course.				

<table>
<tr><td>Learning Outcomes</td><td colspan="3">• Implement theories of material failure under static and dynamic loading conditions for various machine elements.
• Select and dimension the following components under real operating conditions:
  ♦ Shafts and shaft elements
  ♦ Screws and nonpermanent joints
  ♦ Welding and permanent joints
  ♦ Springs
  ♦ Roller/Journal bearings
  ♦ Gears
• Design and perform the selection of components and material for a real mechanical system and build its three-dimensional model using SolidWorks.</td></tr>
<tr><td>Prerequisites</td><td>MME 256</td><td>Required</td><td>None</td></tr>
<tr><td>Course Content</td><td colspan="3">The course will teach methods for the calculation, selection and use of components (machine elements) required in mechanical engineering. The course first introduces engineering design principles, while also reinforcing students’ understanding of material properties, load and stress analysis, deformation and elasticity, and theories of material failure under static and dynamic loads. Subsequently, the main machine elements, their properties and selection procedure are defined. The machine elements studied include: shafts; screws/nonpermanent joints; welding/permanent joints; springs; roller/journal bearings, gears. The course includes a team project to design an engineering device and create its 3D geometric model on a computer.

Laboratory Demonstrations
• Experimental setups for hands-on experience and demonstrations of the machine elements taught in this course
• Demonstration of spur, helical and worm gear units
• Disassembly/Assembly of gearbox</td></tr>
<tr><td>Teaching Methodology</td><td colspan="3">• Lectures using PowerPoint
• Recitation for solving sample problems
• Homework
• Laboratory exercises
• Office hours
• Team project for the design of real mechanical system
• During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.</td></tr>
<tr><td>Bibliography</td><td colspan="3">• Budynas, R.G. and J.K. Nisbett, Shigley’s Mechanical Engineering Design, 9th Edition in SI Units. McGraw-Hill, ISBN 978-0071328401.
• Mott, R., 1999, Machine Elements in Mechanical Design. Prentice Hall, ISBN 0138414467.
• Shigley, J.E., Mechanical Engineering Design: Metric Edition. McGraw-Hill, ISBN 0070568987.
• Norton, R.L., Machine design: an integrated approach. Prentice Hall, ISBN 9780133356717.</td></tr>
<tr><td>Assessment</td><td colspan="3">• Team Project 15%
• Midterm Exam 40%
• Final Exam 45%</td></tr>
</table>

Language	Greek

Course Title	**Mechanical Design**				
Course Code	**MME 346**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	3rd Year / 6th Semester				
Teacher's Name	Andreas Kyprianou				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	4 hours total
Course Purpose and Objectives	The purpose of the course is to extend the theory of machine elements to rotational machine elements used for power transfer and to introduce the general procedure of design and its constituent stages.				
Learning Outcomes	• Explain the differences and similarities between the industrial and technical design. • Identify a design brief and explain how it relates to a specific need that the outcome of the design process should satisfy. • Explain the differences and similarities between industrial and technical design. • Understand the principle of operation of brakes, clutches and belts. • Analyze the forces acting in gear-, brake, clutch- and belt-systems • Understand the thermal loads in brake systems.				
Prerequisites	MME 345	Required	None		
Course Content	This is a two-part course on machine elements and design. The topics of the machine elements part of the course are: gears and power transmission, strength of gears, principles of operation of clutches and brakes, and the theory of flexible machine elements such as belts and chains. In the design part of the course the design process will be discussed in detail starting from design brief preparation, to the generation of ideas and concepts that could satisfy the need as described in the design brief and ending with the materialization of the final product. **Laboratory Demonstrations** • Belt drive and belt friction • Clutches and friction • Determination of gear efficiency				
Teaching Methodology	• Lectures • Recitation for solving sample problems • Design project • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.				

Bibliography	• Shigley, J.E. and C.R. Mischke, *Mechanical Engineering Design*. McGraw-Hill. • Ullman, D.G., *The mechanical design process*. McGraw-Hill.
Assessment	• Homework 5% • Midterm Exam 20% • Final exam 50% • Design project 25%
Language	Greek

Course Title	**Design and Manufacturing**				
Course Code	**MME 347**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	3rd Year / 5th semester				
Teacher's Name	Denis Politis				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	1 hour
Course Purpose and Objectives	Provide an overview of design methods and manufacturing techniques to understand how things are made.				
Learning Outcomes	• Familiarity with computational design methods • Description and modelling of manufacturing processes • Understanding of machining and shaping processes • Knowledge of rapid prototyping and surface patterning processes • Description and modelling of integration, metrology, automation and robotics methods • Familiarity with methods above in the laboratory and practice				
Prerequisites	MME 145	Required	None		
Course Content	Introduction to modern Computer-aided Design and Manufacturing Technology, with emphasis on geometrical aspects (material aspects are covered in MME 348). Design by CAD, representation of 2D/3D lines, surfaces and objects, geometric processing by homogeneous transformations. Rapid prototyping with material deposition - technologies, systems and applications. Machining processes, material removal, non-traditional technologies, manufacturing by CAM. Shaping by deformation/flow of foil and bulk material, CAE analysis. Surface patterning by lithography, coating and etching, micro- and nanotechnology. Metrology, microscopy, scanning and machine vision, instruments and image processing. Tolerances, fits, surface quality and defects. Assembly and transportation with automation, robotics and navigation systems. Applications of design and manufacturing systems. **Laboratory Exercises**				

	• Metrology • Screws and thread-generating processes • Manual turning exercises and project (spinning top competition)
Teaching Methodology	• Lectures • Tutorials • Laboratory demos and projects in machining shop • Educational field trips to local industries • Communicative, Collaborative • During the first week of the semester, the Syllabus of the course is given by the teacher, which includes information on the course content, expected learning outcomes, assessment and office hours
Bibliography	• Tempelman,E., H. Shercliff and B. Ninaber van Eyben, *Manufacturing and Design: understanding the principle of how things are made* (1st Edition). Elsevier. • Kalpakjian, S. and S. Schmid, *Manufacturing Engineering & Technology* (7th Edition). Pearson. • Groover, M.P., *Fundamentals of Modern Manufacturing: Materials, Processes and Systems* (6th Edition). Wiley.
Assessment	• Homework & Labs 30% • Midterm Exam 30% • Final Exam 40%
Language	Greek

Course Title	**Manufacturing Processes**				
Course Code	**MME 348**				
Course Type	Compulsory				
Level	Undergraduate				
Year / Semester	3rd Year / 6th semester				
Teacher's Name	Claus Rebholz				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	1 hour
Course Purpose and Objectives	Focus on manufacturing processes to understand the relation between properties, structure and processing and select the right material for the job.				
Learning Outcomes	• Familiarity with manufacturing processes for engineering materials • Knowledge of plastic deformation and structure and manufacturing properties of metals • Understanding the relationship between properties, structure and processing • Knowledge of surface structure, treatment and processes • Understanding manufacturing processes such as casting and forging • Recognition of new design opportunities offered by materials selection • Familiarity with methods above in the laboratory and practice				

Prerequisites	MME 347	Required	None
Course Content	This course will take a broad look at the various manufacturing processes for available engineering materials. The lecture material will be reinforced by laboratory sessions and problem sets. Topics covered include: Introduction to manufacturing processes for engineering materials; Review of fundamental mechanics of plastic deformation; Structure and manufacturing properties of metals; Surface structure, treatments and tribology; Metal-casting and heat treatment processes; Bulk deformation processes: turning, milling, drilling, etc.; Material removal processes: abrasive, chemical, electrical and high-energy beams; Joining processes: soldering, brazing, welding, etc.; Micro- and nanofabrication. **Laboratory Exercises** • CAD-CAM project • Additive manufacturing • Electro-discharge machining • Thermoforming • Welding (fusion and solid state)		
Teaching Methodology	• Lectures • Tutorials, laboratory demos and projects in machining shop • Educational field trips to local industries • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.		
Bibliography	• Kalpakjian, S. and S. Schmid, *Manufacturing Processes for Engineering Materials* (6th Edition). Pearson. • Groover, M.P., *Fundamentals of Modern Manufacturing: Materials, Processes and Systems* (6th Edition). Wiley.		
Assessment	• Homework & Labs 30% • Midterm Exam 30% • Final Exam 40%		
Language	Greek		

Course Title	**Laser-based Manufacturing Applications**				
Course Code	**MME 442**				
Course Type	Technical Elective Course				
Level	Undergraduate				
Year / Semester	4th year / 7th or 8th Semester				
Teacher’s Name	Claus Rebholz				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	8 hours total

Course Purpose and Objectives	Provide an overview of new and evolving manufacturing applications where laser processing plays a significant enabling role or relating to new production techniques.		
Learning Outcomes	• Familiarity with different laser types and their general applications • Recognition of production processes offered by lasers • Understanding of what applications are emerging in lasers, processes and materials • Knowledge of additive manufacturing processes • Acquaintance with materials joining, surface processing/modifications and micro-manufacturing processes • Familiarity with methods above in the laboratory and practice		
Prerequisites	MME 348	Required	
Course Content	Lasers are part of everyday tasks, such as reading grocery prices and printing or copying paper documents. This course emphasizes on the innovative use of lasers in manufacturing and material processing. Topics covered include: Laser background and general applications; Additive manufacturing (selective laser melting and sintering, manufacturing of multi-materials); Laser joining (welding of metals and plastics); Laser surface processing and modifications (texturing and coating deposition, and general surface processing and modification applications); Micro-manufacturing (laser cutting, drilling and welding for automotive, medical and other applications). The lecture material will be reinforced by laboratory sessions and problem sets. **Laboratory Exercises** • Laser marking and cutting • Laser scanning • Laser surface measurements and modifications • Laser welding		
Teaching Methodology	• Lectures • Tutorials • Laboratory demos and projects in machining shop • Educational field trips to local industries • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.		
Bibliography	• *Advances in Laser Materials Processing* (2nd Edition) edited by Jonathan Lawrence. Elsevier. • Steen, W.M. and J. Mazumder, *Laser Material Processing* (4th Edition). Springer. • Kannatey Asibu, E., *Principles of Laser Materials Processing* (1st Edition). Wiley.		
Assessment	• Homework & Labs 30% • Midterm Exam 30% • Final Exam 40%		
Language	Greek		

Course Title	**Advanced Metal Working Processes**				
Course Code	**MME 443**				
Course Type	Elective				
Level	Undergraduate				
Year / Semester	4th year / 7th or 8th Semester				
Teacher's Name	Denis Politis				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	8 hours total
Course Purpose and Objectives	Provides a detailed overview of forging and sheet forming processes to produce high performance components.				
Learning Outcomes	• Scientific understanding of cold, and hot forging processes • Understanding of analytical methods for analyzing forging operations • Recognition of processes to maximize performance of forged components. • Scientific understanding of sheet metal forming processes • Understanding of analytical methods for analyzing sheet forming operations • Recognition of processes to maximize performance of sheet formed components • Familiarity with these methods in the laboratory and practice				
Prerequisites	MME 348	Required	None		
Course Content	Manufacturing technologies are used to produce components of various shapes and sizes. This course focuses on manufacturing technologies commonly used by industry, with the focus on forging and sheet metal forming. The topics covered in the course include: scientific understanding of cold, warm and hot forging and cold and warm sheet metal forming processes, component and tooling design principles to maximize mechanical performance of produced components, modelling theory and analytical analysis of material behavior under cold, warm and hot operations, innovations in metal forming to maximize component performance. **Laboratory Exercises** • Cold and hot forging • Material strengthening • Sheet blanking, bending and forming				
Teaching Methodology	• Lectures • Tutorials • Laboratory projects and demonstrations • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.				

Bibliography	• Altan, T., G. Ngaile and G. Shen, *Cold and Hot Forging: Fundamentals and Applications*. • Altan, T. and E. Tekkaya. *Sheet Metal Forming Fundamentals*. ASM International.
Assessment	• Homework & Labs 30% • Midterm Exam 30% • Final Exam 40%
Language	Greek

Course Title	**Linear Static and Dynamic Finite Element Analysis of Solids**				
Course Code	**MME 451**				
Course Type	Technical Elective Course				
Level	Undergraduate				
Year / Semester	4th year / 7th or 8th Semester				
Teacher's Name	Vasileios Vavourakis				
ECTS	6	Lectures / week	3 hours	Laboratories / week	1 hour
Course Purpose and Objectives	This course aims to introduce the students to the realm of solid mechanics and structural analysis using the Finite Element Method (FEM). In addition to the theory, the students will attend laboratory workshops on a commercially available FEM software.				
Learning Outcomes	The present course has in its core a two-fold learning outcome; the students will: • Obtain fundamental theoretical knowledge in computational mechanics – with special emphasis in solid mechanics. • Gain experience utilizing a commercial FEM software: ABAQUS. Thus, the students will develop their capacity to: • Design and construct 2D and 3D finite element models in linear elastostatic problems. • Design and construct 2D and 3D finite element models in linear elastodynamic problems. • Evaluate and analyze the numerical results using FEM. • Develop their critical thinking towards assessing, improving and correcting their finite element models.				
Prerequisites	MME 317, MME 257	Required	None		

Course Content	The material of this rather introductory course in finite elements identifies two major parts: (a) the simulation and analysis of linear elastostatic boundary value problems, in two and three dimensions respectively, and (b) the modelling of transient (time-dependent) solid mechanics problems and the modal finite element analysis of structures. In summary, this course covers essential material in computational solid mechanics using FEM for final year undergraduates and postgraduates in mechanical engineering, bioengineering and civil engineering. Students will also receive hands-on training on commercially available finite element software through laboratory workshops. Throughout these workshops, the students will develop representative 3D FEM models to simulate quasi-static and transient problems in linear elasticity. The course also contains laboratory sessions to provide hands-on experience in ABAQUS.
Teaching Methodology	• Class lectures (PowerPoint, Socrative, Screencast-o-matic) • Laboratory lectures – hands-on practice at the School computing center. • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.
Bibliography	• Zienkiewicz, O.C. and R.L. Taylor. *Finite Element Method: Vol.1*. ISBN-13: 978-0750650496. • Hughes, T.J.R., *The Finite Element Method: Linear Static and Dynamic Finite Element Analysis*. ISBN-13: 978-0486411811. • Bathe, Klaus-Jürgen, *Finite Element Procedures*. ISBN-13: 978-0979004957. • Logan, D.L., *A First Course in the Finite Element Method*. ISBN-13: 978-0495668251. • Bonet J. and Wood R.D., *Nonlinear continuum mechanics for finite element analysis*. ISBN-13: 978-0521838702.
Assessment	• Assignments (x5) 60 • Final Exam 20 • Course project 30 For perfect grade the students need 100 points out the total 110.
Language	Greek

Course Title	**Properties of Polymers and Polymer Processing**				
Course Code	**MME 456**				
Course Type	Technical Elective Course				
Level	Undergraduate				
Year / Semester	4^{th} year / 7^{th} or 8^{th} Semester				
Teacher’s Name	Theodora Krasia-Christoforou				
ECTS	6	Lectures / week	3 hours	Laboratories / week	1 hour

Course Purpose and Objectives	The course MME 456 aims in the acquiring of special knowledge and skills on topics involving the structure-to-property relationship in polymers, their rheological behavior, the polymers' mechanical properties and the use of various methods in polymer processing. Besides the theoretical background, the students come are also exposed to the aforementioned on a practical level by performing laboratory exercises and attend laboratory demonstrations involving the investigation of the thermomechanical properties of polymers, fabrication of different plastic products starting from polymer films and powders, and the processing of polymer solutions towards the generation of ultrathin fibers by electrospinning. Moreover, during the course the students visit a local company (polymer processing manufacturer).		
Learning Outcomes	• Associate the chemical structure and architecture of polymers to their thermal and mechanical properties and predict polymer properties from chemical and structural information. • Describe the rheological behavior of polymer solutions and melts. • Define and discuss on different mechanical properties of polymers at the solid state (elastic, elastomeric, viscoelastic). • Describe the techniques employed for determining the mechanical properties of polymers (creep, stress-relaxation, dynamic mechanical analysis). • Discuss polymer additives and their roles and describe methodologies employed for the incorporation of additives in polymers. • Describe and discuss on extrusion, injection molding as well as on different mixing systems employed in polymer processing. • Investigate experimentally the thermomechanical properties of polymers by means of Dynamic Mechanical Analysis. • Perform polymer processing experiments on an electrospinning set-up towards the production of polymer nanofibers.		
Prerequisites	MME 155	Required	None
Course Content	The course is divided into two parts. In the first part, the mechanical properties of polymers (e.g., elasticity, viscoelasticity, strength, etc.) and the effect of their structural and chemical characteristics on their mechanical behavior are discussed. The structure-properties correlation, the thermal transitions of polymers and how these are capable of affecting their properties, as well as the rheological characteristics of polymeric solutions and melts are analyzed. In the second part, different methods used in polymer processing such as mixing, reinforcement, molding, etc. are discussed. Moreover, the students are involved in laboratory demonstrations and exercises including the synthesis of physically-crosslinked polymer networks having variable crosslinking density, the fabrication of polymer nano/micro fibers by electrospinning and the determination of the thermomechanical properties of polymers by Dynamic mechanical analysis. **Laboratory Exercises** • Thermomechanical testing by Dynamic Mechanical Analysis • Fabrication of polymer nanofibers by electrospinning • Rheological characterization of polymers • Synthesis of physically crosslinked polymer networks		

Teaching Methodology	• PowerPoint presentations • Experimental demonstrations • Laboratory exercises • Visit at the premises of a local company involved in polymer processing • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.
Bibliography	• MME 456 Course handouts (http://www.eng.ucy.ac.cy/krasia/). • Panayiotou, K., *Science and Technology of Polymers*, 2nd Edition, Pigasus (in Greek). • Cowie, J.M.G., *Polymers: Chemistry and Physics of Modern materials,* Stanley Thornes. • Kalpakjian, S. and S.R. Schmid, *Manufacturing Processes for Engineering Materials,* 4th ed. Prentice Hall.
Assessment	• Laboratory exercises and written laboratory reports 10% • Midterm examination 40% • Final examination 50%
Language	Greek/English

Course Title	**Material Measurements and Testing**				
Course Code	**MME 457**				
Course Type	Technical Elective Course				
Level	Undergraduate				
Year / Semester	4th year / 7th or 8th Semester				
Teacher's Name	Theodora Kyratsi				
ECTS	6	Lectures / week	3+1 hours	Laboratories / week	0
Course Purpose and Objectives	The objectives of the course include the understanding of the methodology of a wide range of techniques for measurements and testing as well as limitations and applications. Emphasis is also given on metrology issues.				
Learning Outcomes	• Understand the basic principles of metrology and standards. • Describe typical measurement/testing procedure and significant digits. • Select the suitable technique for studying the mechanical properties based on capabilities and limitations of each technique. • Select the suitable technique for studying the thermal properties based on capabilities and limitations of each technique. • Select the suitable technique for studying the electrical properties based on capabilities and limitations of each technique. • Select the suitable testing procedure in corrosion and wear cases. • Combine different measurements/testing procedures when required.				
Prerequisites	None	Required	None		

Course Content	Measurements methodology. Metrology. Quality in measurements and testing. Reference materials. Accreditation. Measurements of mechanical properties - elasticity, plasticity, hardness, strength, fracture – standards – applications – limitations. Measurements of thermal properties - thermal conductivity, heat capacity, enthalpy, thermal expansions – standards – applications – limitations. Measurements of electrical properties - electrical conductivity, measurements in metals and semiconductors – standards – applications – limitations. Nondestructive testing and reliability evaluation – standards – applications – limitations. Materials testing for corrosion – standards – applications – limitations. Materials testing for friction and wear – standards – applications – limitations. The course includes labs on selected techniques.
Teaching Methodology	• Lectures • PowerPoint presentations • Laboratory demonstrations • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.
Bibliography	• *Handbook of Introduction to Metrology and Testing* / Editors H. Czichos, T. Saito, L. Smith. Springer.
Assessment	• Midterm exam 35% • Final exam 55% • Presentation 10%
Language	Greek

Course Title	**Materials for Energy and Environment**				
Course Code	**MME 458**				
Course Type	Technical Elective Course				
Level	Undergraduate				
Year / Semester	4th year / 7th or 8th Semester				
Teacher's Name	Ioannis Giapintzakis				
ECTS	7	Lectures / week	3+1 hours	Laboratories / week	0
Course Purpose and Objectives	The main objective of the course is to familiarize the students with materials and technologies for production, conversion, storage, transport and use of energy, as well as capturing and storing pollutants such as CO_2.				

Learning Outcomes	• Identify and discuss materials and technologies for energy production • Identify and discuss materials and technologies for energy storage • Identify and discuss materials and technologies for energy transport • Identify and discuss materials and technologies for energy conversion • Identify and discuss materials and technologies for CO2 capture and storage • Describe the operation mechanism of different types of solar cells, fuel cells and batteries • Identify material properties critical for designing such devices		
Prerequisites	MME 255	Required	None
Course Content	The course addresses questions such as: How will we meet rising energy demands? What are our options? Are there viable long-term solutions for the future? In addition, the course introduces the students to the fundamental materials science at the heart of: Renewable energy sources, Nonrenewable energy sources, Future transportation systems, Energy efficiency, Energy storage and, CO_2 capture and storage.		
Teaching Methodology	• Lectures • Tutorials, homework problems • Presentations by students of group projects (on topics of materials and technologies related to the course), written report. • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.		
Bibliography	• *Fundamentals of Materials for Energy and Environmental Sustainability*, edited by D. Ginley and D. Cahen. Materials Research Society & Cambridge University Press.		
Assessment	• Written report 25% • Project presentation 15% • Midterm Exam 20% • Final Exam 40%		
Language	Greek		

Course Title	**Composite Materials Science and Engineering**				
Course Code	**MME 459**				
Course Type	Elective Course				
Level	Undergraduate				
Year / Semester	4th year / 7th or 8th Semester				
Teacher's Name	Matthew Zervos				
ECTS	6	Lectures / week	3 hours	Laboratories / week	0

Course Purpose and Objectives	An introduction to composite materials and their engineering applications with emphasis on materials. The purpose of this course is to expand the knowledge which mechanical engineering students have acquired from the materials science and engineering courses of the undergraduate curriculum in the direction of composites and their engineering applications. The objective of the course is to give students a working knowledge of composite materials science and engineering, how they are made and their engineering applications.		
Learning Outcomes	• Understand dimensionality and lengths scales of materials. • Have a knowledge of one-dimensional materials, how they are made. • Understand what is bottom-up versus top down manufacturing. • Understand what additive manufacturing is. • Know which matrix materials are used with one-dimensional materials • Know which naturally occurring fiber materials are important and their applications. • Know the mechanical properties of the most important fiber and composite materials. • Demonstrate use in important engineering applications including aerospace, marine, automotive.		
Prerequisites	MME 155, MME 156	Required	None
Course Content	Length scales, dimensionality, three, two, one and zero dimensional materials. Definition of nano, meso and macro scales. One dimensional materials: fibers, nanowires, nanorods, nanotubes; organic and inorganic e.g. carbon, polymethylmethacrylate etc. Methods of production. Ordered versus disordered networks of one-dimensional materials. Assembly, self-assembly, bottom-up versus top down approaches. Fabrication methods of ordered networks and additive manufacturing. Matrix materials e.g. metal, polymers etc. Prepreg composites. Naturally occurring fiber materials e.g. balsa wood, spider silk and their applications. Engineering applications, aerospace, marine, automotive, energy related.		
Teaching Methodology	• Lectures • Communicative, Collaborative • During the first week of the semester, the course syllabus is given to students, which includes information on the course content, expected learning outcomes, assessment and office hours.		
Bibliography	• Gajanan, B., *Structure and Properties of High-Performance Fibers*. Elsevier.		
Assessment	• Assignments and Presentations 30% • Midterm exam 30% • Final exam 40%		
Language	Greek		

Annex III. Revised Curriculum

1st YEAR					
WINTER SEMESTER		**ECTS**	**SPRING SEMESTER**		**ECTS**
MAS 025	Engineering Mathematics I	5	MAS 026	Engineering Mathematics II	5
MAS 029	Elements of Linear Algebra	5	LAN 104	English for Technical Purposes	5
LAN 100	General Advanced English	5	MME 107	Introduction to Electromagnetism	5
MME 105	Experimental and Statistical Analysis	5	MME 125	Statics	5
MME 106	Introduction to Engineering	5	MME 155	Material Science and Engineering I	5
MME 145	Computer Aided Drafting	5	MME 156	Chemistry for Engineers	5
	Total	*30*		*Total*	*30*
2nd YEAR					
MAS 027	Engineering Mathematics III	5	MME 218	Programming and Numerical Methods	5
MME 215	Thermodynamics I	5	MME 216	Fluid Mechanics I	5
MME 225	Dynamics	5	MME 217	Heat Transfer	5
MME 226	Mechatronics I	5	MME 227	Vibrations	5
MME 255	Material Science and Engineering II	5	MME 228	Mechatronics II	5
MME 256	Solid Mechanics	5	MME 257	Strength of Materials	5
	Total	*30*		*Total*	*30*
3rd YEAR					
MME 315	Thermodynamics II	6	MME 316	Fluid Mechanics II	6
MME 317	Numerical Methods	6	MME 318	Thermal Engines	6
MME 325	Modeling and Analysis of Dynamic Systems	6	MME 327	Control Engineering	6
MME 345	Machine Elements	6	MME 346	Mechanical Design	6
MME 347	Design and Manufacturing	6	MME 348	Manufacturing Processes	6
	Total	*30*		*Total*	*30*
4th YEAR					
MME 405	Final Year Project I	7	MME 406	Final Year Project II	8
MME 4..	Technical Elective Course	6	MME 4..	Technical Elective Course	6
MME 4..	Technical Elective Course	6	MME 4..	Technical Elective Course	6
MME 4..	Technical Elective Course	6		Free Elective Course	5
	Free Elective Course	5		Free Elective Course	5
	Total	*30*		*Total*	*30*

Annex IV. Course Evaluation form

Course Number							
Course Name							
Reg. Students							
Completed							
%Response Rate							

Course Evaluation Questionnaire, Fall Semester 2018 - 2019

Demographics:

		Count	**%**				
1) Sex:	Male						
	Female						
	Total						
	Total						
2) At what Course level are you?	Undergraduate						
	Total						
3) My grade point average is:	0.01 - 4.99 -						
	5 - 6.49 -						
	6.5 - 8.49 -						
	8.5 - 10 -						
	Not applicable -						
	Total						

Section A: Course classes

		Count	**%**	**Median**		
4) The goals and demands of the course were comprehensible.	(1) Not at all					
	(2) -					
	(3) -					

	(4) -					
	(5) Absolutely					
	Total					
5) The course content corresponded to the goals of the course.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
6) Each class was clearly structured.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
7) There was cohesion between thematic units.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5)Absolutely					
	Total					
8) The bibliography was easily accessible.	(1) Not at all					
	(2) -					
	(3) -					

	(4) -					
	(5) Absolutely					
	Total					
9) The bibliography was useful and helpful.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
10) The evaluation methods were relevant to the course content.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
11) The instructor respected all of the students' opinions.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
12) The instructor inspires interest/enthusiasm for the course subject.	(1) Not at all					
	(2) -					
	(3) -					

	(4) -					
	(5) Absolutely					
	Total					
13) The instructor analyses and presents concepts in a straightforward and interesting manner using examples.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
14) The instructor encourages students to raise questions and to develop their critical ability.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
15) The instructor develops a spirit of collaboration with all students.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
16) The instructor is consistent in his/her obligations in terms of teaching (timely correction of coursework, consistency in student office hours).	(1) Not at all					

	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
Section B: The course overall						
		Count	**%**	**Median**		
17) I feel I have learned many interesting ideas from this course.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
18) I believe the course was useful for my scientific development.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
Section C: The lab/The tutorial/ fieldwork (if valid)						
		Count	**%**	**Median**		
19) The teaching assistant or the head researcher is helpful in better understanding the course content and/or fieldwork (e.g. on land or underwater excavation, surface survey).	(1) Not at all					
	(2) -					

	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
20) The material and notes provided are sufficient for the lab exercises or fieldwork.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
21) The basic principles of the experiments/exercises/fieldwork techniques are clearly explained.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
22) The lab/field research equipment is adequate.	(1) Not at all					
	(2) -					
	(3) -					
	(4) -					
	(5) Absolutely					
	Total					
Comments and Suggestions:						

	Total:								

RESPONSE TO THE COMMENTS OF THE EVALUATION COMMITTEE
FOR THE MASTER PROGRAM
IN MECHANICAL AND MANUFACTURING ENGINEERING

1. Effectiveness of teaching work

1.1 Organization of teaching work

1.1.2 The number of students in each class allows for constructive teaching and communication, and it compares positively to the current international standards and/or practices. Additional comments: On one hand, the currently low number of students allows for constructive teaching and communication even on a one-to-one basis. However, the committee felt that this is not necessarily sustainable in case of plans for future expansion of student numbers.

No significant expansion in student numbers is expected in the future. More precisely, the planned number of students to be admitted in the Master program of MME Department in the next years is 8-15 annually.

1.1.3.5. The procedures for the conduct and the format of the examinations and for student assessment.

The procedures for the conduct and the format of the examinations is not part of a formal process of setting exams and moderating those on a departmental level, but organized and applied individually by each Academic ad-hoc.

The formatting of the examination procedures followed in the Department of Mechanical and Manufacturing Engineering are in line with the general examination rules and procedures set at the University of Cyprus. The latter are consistently applied in all Departments of the University of Cyprus. These include among others the following:

“The University of Cyprus applies the principle of continuous assessment to each course. Specifically, the student's performance on a particular subject is assessed, at the discretion of the lecturer and with the approval of the Department, in at least two different ways. One must be the final written examination. The percentage of participation in the final written examination in the final score cannot exceed 60% of the final score. The allocation of the percentages for each exam, as determined by the curriculum, is independent of the degree the student achieves in each exam. The final written exam does not apply only in the case of the diploma thesis, screenwriting lessons, study or teamwork”.

In an effort to develop a more uniform process of setting examination papers on an individual basis thus maintaining the quality assurance in all graduate courses as per the Committee’s suggestion, the Department Chair will be responsible for the statistical analysis of students’ grades and will discuss the evaluation outcome with each Academic.

1.1.3.6. 1.1.3.6. The effective provision of information to the students and the enhancement of their participation in the procedures for the improvement of the educational process.

It is not entirely clear how the students participate and contribute to the improvement of the educational process on a fundamental level to make it more effective.

Based on the comments of the evaluators, the department has assigned to the graduate studies committee to act also as a teaching committee to be in charge of the quality assurance of the graduate studies and make sure that administrative stuff and students participate to the improvement of the educational process. The graduate studies committee will assure that all procedures and regulations of the graduate programs are implemented properly and will formally meet with administrative staff and students once every year to discuss any issues related to the educational process and how they can be improved.

1.1.4.1. and 1.1.4.3. Although the research labs were equipped to a high standard and this benefited research projects, more focused teaching labs for core engineering subjects would be required. This applies particularly to labs related to experimental fluid mechanics and thermodynamics. The committee appreciates that the current spread of the Department in many different sites has been a contributing factor to this situation. We encourage the Department to strategically develop teaching labs of this type on their new campus and not focus only on moving and expanding current research labs.

We thank the evaluation committee for highlighting the lack of teaching laboratories in some thematic areas and courses including courses related to fluid mechanics and thermodynamics.

As recognized by the Committee members, the current spread of the Department in 4 different sites and the lack of adequate teaching laboratory space prevented the development of teaching labs for core engineering subjects.

The Department has put into force a strategic plan for the development of teaching labs, with emphasis to laboratories linked to fluid mechanics, thermodynamics and solid mechanics.

As a result of this effort, the University of Cyprus has committed to provide to the department an amount of €500,000 within the next 2 years (by 2021) to be spent exclusively for the needs of the department for teaching laboratories and equipment. An amount of €50,000 has already be given to the department for this purpose. The laboratory equipment will be used for both undergraduate and graduate level laboratory exercises.

1.1.5. A policy for regular and effective communication, between the teaching personnel and the students, is applied.

There is no formal policy in place outside of one-to-one interactions by individual initiative by Academic staff and students.

As far as the graduate courses are concerned every academic instructor assigns weekly office hours for effective communication with the students. For the supervision of the graduate students at the Master level and following the suggestions of the evaluators, the department established the “thesis committee meeting” to take place at least six months before the expected examination of the Master thesis project (the Master thesis defense). The student will have to present the progress of his research work in front of the three members of the Master committee consisting of the academic advisor and two other faculty members of the department whose research interests are close to the research of the student. The role of the committee will be to assess the progress and performance of the student, support the student’s research activities by providing advice, identify potential problematic performances and find ways to improve them.

1.1.7.-1.1.9. Statutory mechanisms, for the support of students and the communication with the teaching personnel, are effective.

Control mechanisms for student performance are effective.

Support mechanisms for students with problematic academic performance are effective.

No clear mechanisms were demonstrated to the committee in terms of control, support and effectiveness.

The thesis committee meetings described in our response to the comment #1.1.5 above will be an sufficient and effective mechanism for the support of the Master students, for assessing of their academic/research performance and for suggesting solutions to the student in case of a problematic performance.

1.1.10. Academic mentoring processes are transparent and effective for undergraduate and postgraduate programs and are taken into consideration for the calculation of academic work load.

Considering that such processes are not formally in place it is unclear to the committee how transparency can be applied effectively.

Academic mentoring for graduate students is not considered in the calculation of the academic load according the University of Cyprus regulations. With the Department's initiative, undergraduate students are equally distributed among all faculty members. The same procedure is used for the number of Diploma Thesis students that each faculty member is supervising. For Master students, there is also an effort to be equally distributed among faculty members.

1.1.11. The program of study applies an effective policy for the prevention and detection of plagiarism.

There is no policy that has been formally implemented based on current University regulations to deal with potentially widespread practices of plagiarism in coursework, written exams and research theses. This can be improved by extended use of anti-plagiarism online tools to include a database of coursework submissions and theses over a gradually increasing period of time. Similarly, introduction of standardized calculators uniformly used by everybody could assist with exam plagiarism.

The antiplagiarism online tool *SafeAssign* is available through Blackboard (https://help.blackboard.com/SafeAssign/Instructor/Language_Support), which is accessible to all members of UCY academic staff. Students during exams are only allowed to use "simple" calculators that are not capable of storing information.

1.1.12. The program of study provides satisfactory mechanisms for complaint management and for dispute resolution.

Such mechanism is not clear from the provided information and it is important to develop those in view of future proofing the course in case of legal disputes.

Activities of courses are carried out based on University of Cyprus regulations. For example, the students have access to their exams and in case of a dispute the exam is re-evaluated. Also, in case of plagiarism the students are reported to the "Disciplinary Committee for Student Issues" where the case is thoroughly investigated.

1.3 Teaching Personnel

1.3.1., 1.3.2. and 1.3.11. All members of Academic staff are experts in their field of research and this reflects positively on the support of PhD projects. However, it appears that the students may not get the exact type of project that meets their personal research interest due to the small number of academic staff and the narrow range of research topics on offer, for example total lack of experimental fluid mechanics with advanced diagnostic techniques.

We thank the evaluators for the positive comments regarding the expertise of the faculty members. It is true that owing to small number of academic staff the range of research topics is narrow compared to departments that have a larger number of faculty and this is inevitable. We have to stress, however, the fact that since the evaluation (in February 2019) the department increased the number of faculty from 12 to 13 and within this year the number of faculty will be increased to 16. The addition of 4 more faculty members in the department in research areas that were not sufficiently represented during the evaluation, including the areas of fluid mechanics, manufacturing, biomedical devices/bioengineering, automation, will improve significantly this issue.

1.3.3. The specializations of Visiting Professors adequately support the program of study.

We were not informed of any formal appointments of Visiting Professors to support the program of study.

We apologize if it was not clear during the evaluation, but we would like to inform the Committee that the department has formal appointments of Visiting Professors that support the Master and PhD programs. This is formally done during the summer semester, which makes it easier for the Visiting Professors to come to the department from abroad in order to teach a short-course and interact with the graduate students of the department. The summer of 2018, Prof. Alessio Alexiadis (School of Chemical Engineering, University of Birmingham, UK) served as a Visiting Professor in our department. He taught the short course "A primer on discrete multiphysics" and met with several faculty members and students. The summer of 2017, Dr. Damian Rouson (Sourcery Institute, California, USA) served as a Visiting Professor and taught the short course "Parallel Programming in Modern Fortran". For this summer, we are in the process of contacting established researchers that would be interested in serving as Visiting Professors.

Other examples from previous years include:

- Prof. Andreas Polycarpou, Texas A&M University, U.S.A.
- Dr. Apostolos Korlos, University of Thessaly, Greece.
- Dr. Dimosthenis Michalopoulos, University of Patras, Greece.
- Prof. Panos Charalambides, University of Maryland, Baltimore County (UMBC), U.S.A.

It is noteworthy to mention at this point that although Visiting Professor positions are often announced in the Department, there are difficulties in attracting candidates from abroad due to language restrictions (official language at the undergraduate level is Greek) as well as different term schedule applied at the University of Cyprus (Fall semester: beginning of September – end of December; Spring Semester: mid-January – end of May) compared to Greek and other European Universities. Based on the above, in the future the Department will be targeting in attracting Visiting Professors for the summer semester.

We agree with the committee that the teaching of the whole program in English will definitely enhance the Visiting Professor appointments.

1.3.10 Future redundancies / retirements, expected recruitment and promotions of academic personnel safeguard the unimpeded implementation of the program of study within a five-year span.

Considering the unfortunate event of a member of Academic staff passing away unexpectedly, the Department found itself in a position that safeguarding the program in a particular area was not easy to handle. For planned retirements, redundancies, sabbaticals, etc. it seems that there is a need for a contingency plan that would assist supervised students by smooth transition to a new status. This is of particular importance for graduate students involved with long research projects of high ECTS value (56).

We already established that Master students will formally meet with their thesis committee six months before the expected defense of the Mater thesis. As far as the teaching of courses is concerned, more than one faculty members can teach all compulsory courses of the program. The thermodynamics course can be taught by Professors Stavros Kassinos and Dimokratis Grigoriadis, the fluid mechanics course can be taught by Professors Stavros Kassinos, Dimokratis Grigoriadis and Triantafyllos Stylianopoulos, the continuum mechanics course can be taught by Triantafyllos Stylianopoulos and Vasileios Vavourakis, the Modelling and Analysis of Dynamic Systems course can be taught by Professors Loucas Louca and Denis Politis (a new faculty member of the department) and the Manufacturing Process Automation course can be taught by Professors Denis Politis and Eftychios Christoforou (a new faculty member of the department).

2. Program of study and higher education qualifications

2.1 Purpose and Objectives and learning outcomes of the program of study

2.1.1., 2.1.2., 2.1.4.-2.1.7. On the basis of the masters program document and the discussions that followed the committee felt that the way learning objectives and outcomes had been formulated was not consistent across all courses. The program document needs to be streamlined and harmonized to illustrate better the coherence of the learning outcomes as a whole. It was not clear how the learning outcomes were matched against coursework assessment and written examinations.

We thank the evaluators for pointing this out. We have streamlined and harmonized the description of the graduate level courses (ANNEX I). The program will be regularly reviewed by the Graduate Studies Committee of the department to keep it up-to-date.

2.2 Structure and content of the program of study

2.2.1., 2.2.3., 2.2.5 The purpose and objectives of the program of study are formulated in terms of expected learning outcomes and are consistent with the mission and the strategy of the institution. The purpose and objectives of the program and the learning outcomes are utilized as a guide for the design of the program of study. The program's content, the methods of assessment, the teaching materials and the equipment, lead to the achievement of the program's purpose and objectives and ensure the expected learning outcomes. The learning process is properly designed to achieve the expected learning outcomes. The higher education qualification awarded to the students, corresponds to the purpose and objectives and the learning outcomes of the program.

Considering the wide diversity of student applicants who may come even with no engineering background (for example, biologists) the committee felt that some provision for more basic engineering principles should be made in the syllabus. Discussion with students fortified this point. The committee recommends to the Department to consider the inclusion of some of the courses in the undergraduate program as electives in order to fill gaps in engineering for the nonengineering Master students.

We inform all the graduate students about the content of our graduate programs during the interview process, which is compulsory for all candidates for our programs. We pay particularly attention to the students that do not have an engineering background to explain them the needs of the graduate courses and we also ask them during the interview questions to assess their knowledge in mathematics and engineering. Therefore, nonengineering Master students are screened for their ability to perform studies in mechanical engineering and are well informed about the demands of the program before accepting to enter our program.

When they become accepted to the program, nonengineering students are advised and encouraged by the supervisors to audit undergraduate level courses. Unfortunately, there is no provision by the School of Graduate Studies of the University for the doctoral students to register and get credits for attending undergraduate level courses.

2.3 Quality assurance of the program of study

2.3.1.-2.3.3. The committee felt that the members of the Academic staff safeguard quality by significant individual effort. The committee were not made aware of any clear procedures and detailed information to support quality assurance beyond this individual effort. Considering the lack of clear formal procedures for quality assurance, it is unclear how administrative personnel and students participate effectively in such efforts. Despite this criticism the committee did not observe any quality assurance issues, but it is important to reduce the risk of potential future issues in this area.

We agree with the suggestion of the evaluators and we have assigned to the graduate studies committee of the department to be responsible for the quality assurance of the graduate programs and to make sure that administrative stuff and students participate to the improvement of the educational process. The graduate studies committee will assure that all procedures and regulations of the graduate programs are implemented properly and will formally meet with administrative staff and students once every year to discuss any issues related to the educational process and how they can be improved.

2.4 Management of the program of study

2.4.1.-2.4.4. It is suggested to form a "Teaching Committee" that will meet at least twice per semester, preferably at the start and the end of each semester. This could act as a starting point to harmonize the syllabus documentation in terms of learning objectives and outcomes. Then, it could focus on linking aspects of the master course to the undergraduate course (for example, via shared electives), planning any new courses and responding to student evaluation course feedback.

We agree with the evaluators. We have assigned to the committee of Graduate Studies of the department, consisting of three faculty members, to act also as a "Teaching Committee" and meet on a regular basis – twice per semester – to oversee the teaching procedures and whether the courses have met the teaching objectives and learning outcomes, link graduate courses to each other and with undergraduate courses, plan new courses, particularly in collaboration with the four new faculty members that have joined or will join the department this year and they will have to develop new courses. The committee along with the Department Head will also respond to the student evaluation of the courses.

2.5 International dimension of the program of study

2.5.1. While research collaborations may compare positively with other institutions, it is unclear whether any teaching collaborations are being actively pursued to a high level, like training networks in Europe and overseas.

Our department coordinates the COST action SimInhale (COST Action MP1404) through which several students of the department have visited for a short time other labs abroad. The department also has coordinated the last five years 6 Marie-Curie Individual Fellowships that also included visits of the fellows to labs and companies in Cyprus and abroad. There are also students that have travel for collaboration purposes making use of the Erasmus+ exchange program.

The Department has a specific plan to improve its teaching collaborations through targeted actions such as Erasmus+ exchange programs by offering some undergrad courses in English, Erasmus+ staff mobility for teaching programs, participation of the Department's academic personnel in short Short-Cycle Training Courses (e.g. Erasmus+ Short-Cycle training course on Thermal Analysis in Material Science/SC-ThAnMA), summer short courses offered by visiting professors etc.

2.5.2. There has not been any formal proof of Visiting Professors of high international standing being attracted to the program of study.

We apologize if it was not clear during the evaluation, but we would like to inform the Committee that the department has formal appointments of Visiting Professors that support the Master and PhD programs. This is formally done during the summer semester, which makes it easier for the Visiting Professors to come to the department from abroad in order to teach a short-course and interact with the graduate students of the department. The summer of 2018, Prof. Alessio Alexiadis (School of Chemical Engineering, University of Birmingham, UK) served as a Visiting Professor in our department. He taught the short course "A primer on discrete multiphysics" and met with several faculty members and students. The summer of 2017, Dr. Damian Rouson (Sourcery Institute, California, USA) served as a Visiting Professor and taught the short course "Parallel Programming in Modern Fortran". For this summer, we are in the process of contacting established researchers that would be interested in serving as Visiting Professors.

Other examples from previous years include:

- Prof. Andreas Polycarpou, Texas A&M University, U.S.A.
- Dr. Apostolos Korlos, University of Thessaly, Greece.
- Dr. Dimosthenis Michalopoulos, University of Patras, Greece.
- Prof. Panos Charalambides, University of Maryland, Baltimore County (UMBC), U.S.A.

It is noteworthy to mention at this point that although Visiting Professor positions are often announced in the Department, there are difficulties in attracting candidates from abroad due to language restrictions (official language at the undergraduate level is Greek) as well as different term schedule applied at the University of Cyprus (Fall semester: beginning of September – end of December; Spring Semester: mid-January – end of May) compared to Greek and other European Universities. Based on the above, in the future the Department will be targeting in attracting Visiting Professors for the summer semester.

We agree with the committee that the teaching of the whole program in English will definitely enhance the Visiting Professor appointments.

2.5.3. We were not made aware of specific agreements for students exchange programs at the masters level.

As mentioned in our response to #2.5.1, the department coordinates the COST action SimInhale (COST Action MP1404) through which several graduate students of the department have visited for a short time other labs abroad. We make also efforts to further encourage our students to participate in the ERASMUS program of graduate students exchange.

2.5.4. Teaching the whole program in English would certainly make it more internationally attractive. Invited lectures from Academics abroad and establishing formally Visiting Professorships would also help to broaden the international status of the program and the students would benefit in turn.

We agree with the evaluators. We plan to teach the entire program in English and expand our Visiting Professorship program.

2.6 Connection with the labor market and the society

2.6.1.-2.6.3. Indicators for the employability of PhD students appear positive. There is some room for improvement in terms of effective procedures for career development to be applied formally. Similarly, benefits to the society and industrial processes can be strengthened by industrial involvement in terms of advice and feedback.

We agree with the evaluators for the need of industrial involvement in the PhD research. Our PhD students are benefitted from established collaboration between faculty of the department and external collaborators. Many faculty members have extended collaborations with industrial partners and have received funding from or with them. Examples of such collaborations are the one of Associate Professor Theodora Krasia-Cristoforou with Elysee, a local manufacturer of plastic piping systems and the collaboration of Assistant Professor Triantafyllos Stylianopoulos with Theramir Ltd, a local company specialized on materials for cancer and other diseases.

Associate professor Claus Rebholz has been extensively collaborating with industrial partners in the field of manufacturing in Europe and in Cyprus. Specifically, in Europe:

- Robert Bosch Manufacturing Solutions GmbH (Stuttgart/Germany), part of the bosch group, https://www.bosch.com/: Plasma and Laser Technology; Machine Design...

- encontec GmbH (Schwäbisch Gmünd/Germany), https://www.encontec.de/: Materials Testing; Process Technology

- Perpetuus Advanced Materials (Ammanford/UK), https://perpetuusam.com/: Carbon-based Materials; Plasma Processing

In Cyprus:

- Nikolaides & Kountouris Metal Company Ltd (Nicoais/Cyprus), http://www.nkmetal.com.cy/company_profile_en.html: Polyurethane Panels; Thermal Insulation Mortars; Roll Forming; Metal Roofs/Frames.

- Porfyrios Glass Ltd (Nicosia/Cyprus), http://porfyriosglass.com/: Energy Glass; Safety Glass; Heat & Surface Treatments; Machining.

- Peta Plastics Ltd (Nicosia/Cyprus), http://petaplastics.com/: Plastic Packaging; Product Design; Automation Systems, Mold Design and Manufacture.

Professor Stavros Kassinos has the following collaborations with industrial partners from Europe and USA:

1. MYLAN UK

   Research contract

   http://www.mylan.co.uk

2. Simulations Plus Inc., Los Angeles, USA

   Hosted two undergraduate students for summer internships

   Research collaboration

   https://www.simulations-plus.com

3. ELPEN Pharma Greece

   Research Contract and student training

   https://www.elpen.gr

4. PureIMS, Netherlands

   Research Contract and joint publications

   https://www.pureims.com/en/home/

5. Emmace SE, Sweeden

   Research collaboration and joint publications and student training

   https://www.emmace.se

6. Medspray, Netherlands

   Hosted two undergraduate students for summer internships

   Research collaboration

   http://www.medspray.nl/company.html

7. Aptar Pharma, Germany

   In the process of signing a new contract

www.aptar.com

Furthermore, research funding from Cyprus Research Promotion Foundation and the European Commission supports such collaborations.

It is our continuous effort to have industrial partners involved in the research activities of the department.

In addition, the University of Cyprus has already in place mechanisms to enhance the employability of the undergraduate and graduate students. The Center for Entrepreneurship and the Careers Office of the University train the students on how to prepare their cv and for job interviews and help them be connected with the industry.

3. Research work and synergies with teaching

3.1.1.-3.1.9. There is an excellent synergy between teaching and research, particularly in terms of supporting PhD projects. Research facilities and external/internal funding compare positively to other institutions in Cyprus and abroad.

We thank the evaluation committee for recognizing the research excellence of the department and the ability to train graduate students.

4. Administrative services, student welfare and support of teaching work

4.1.1.-4.1.3. Statutory administrative mechanisms for monitoring and supporting students are sufficient. The efficiency of these mechanisms is assessed on the basis of specific criteria.

Mechanisms are in place for academic and personal matters, yet there is no clear evidence of how these are applied formally and efficiently.

This will be part of the quality assurance that we established. The committee of graduate studies will oversee and assure that all mechanisms for monitoring and supporting the graduate students are applied.

4.2 Infrastructure / Support

4.2.3.,4.2.4. While the research labs are well equipped, there is a need for more focused teaching labs on the graduate program.

We thank the evaluation committee for highlighting the lack of teaching laboratories in some thematic areas and courses including courses related to fluid mechanics and thermodynamics.

As recognized by the Committee members, the current spread of the Department in 4 different sites and the lack of adequate teaching laboratory space prevented the development of teaching labs for core engineering subjects.

The Department has put into force a strategic plan for the development of teaching labs, with emphasis to laboratories linked to fluid mechanics, thermodynamics and solid mechanics.

As a result of this effort, the University of Cyprus has committed to provide to the department an amount of €500,000 within the next 2 years (by 2020) to be spent exclusively for the needs of the department for teaching laboratories and equipment. An amount of €50,000 has already be given to the department for this purpose. The laboratory equipment will be used for both undergraduate and graduate level laboratory exercises.

4.3 Financial Resources

4.3.1. It seems that there could have been better allocation of financial resources to develop the program in terms of practical lab exercises.

As we mention to our response in 4.2, there is already a plan for the development of the program in terms of practical lab exercises.

Final Remarks – Suggestions

- Teaching and supervision sharing between departments is encouraged, for example with Civil Engineering in the area of Solid/Computational Mechanics, and potentially Experimental Fluid Mechanics.

  We agree with this suggestion, we have initiated discussions with the faculty of the civil engineering department to establish common courses on computational mechanics and experimental fluid mechanics.

- The students recommended elective courses in Engineering Mathematics rather than having to take math courses externally that are abstract or purely theoretical.

  We agree with this suggestion, the new course on fluid mechanics “Theory and applications of incompressible Newtonian and non-Newtonian fluids” and the new course on solid mechanics “Nonlinear Mechanics of Solids and Structures” integrates the teaching of the Finite Elements method and computational mechanics into problems of fluid and solid mechanics.

- We encourage course delivery by more than one Academic member of staff.

  Several courses can be taught by different faculty members on a rotation basis. Our plan is to implement such rotations.

- Analysis of student grades needs to be strengthened by inclusion of distributions over several years.

  We agree with this suggestion. The Department Chair will be in charge of performing the analysis of student grades by inclusion of distributions over the years.

- To the benefit of students from diverse backgrounds, it is suggested to include some formal training on technical report writing in engineering and also project planning.

  The department offers an elective course on “Technical writing” under the Master and PhD programs in Advanced Materials and Nanotechnology (4 ECTS). We encourage our students to register to this course and we will continue to do so.

ANNEX I

Course Title	Advanced Engineering Thermodynamics				
Course Code	**MMK 512**				
Course Type	COMPULSORY				
Level	MASTER/PHD				
Year / Semester	SPRING SEMESTER				
Teacher's Name	STAVROS KASINOS				
ECTS	8	Lectures / week	2 X 1,5 AN HOUR	Laboratories / week	NO
Course Purpose and Objectives	The purpose of the course is the teaching of the basic principles of thermodynamics and training of the students to the solution of problems found in industry.				
Learning Outcomes	The students will be able to • perform thermodynamic analysis for the optimization of complex engineering systems, • design thermodynamic systems with the use of software and computers, • prepare professional design analysis reports, • understand the behavior and properties of non-reacting mixtures with emphasis on mixtures of ideal gases, • perform psychrometric analysis of air-conditioning systems, • understand the concepts of subsonic, sonic, supersonic and hypersonic flow and analyze simple compressible flow systems and • compute the change in thermodynamic properties across normal shock waves.				
Prerequisites	NO	Required	NO		
Course Content	The course content involves thermodynamic analysis of engineering systems, emphasizing systematic methodology for application of basic principles and the utilization of modern computational tools and optimization software. Introduction to availability analysis. Thermodynamics of ideal gas mixtures including air and water-vapour mixtures. Thermodynamics of condensed phases, including solutions. Introduction to thermodynamics of compressible flow. Specialized topics depending on the composition of the audience (e.g. thermodynamics of biological systems). The course also involves a series of laboratory exercises.				
Teaching Methodology	Lectures 3 hours per week / Tutorials or lab exercise 1 hour per week Lectures. The teaching methodology is based on the "deductive reasoning" method, which means that the theory and the applications of it are presented first in a general form and subsequently they are specialized for the particular problems. There is continuous communication with the instructor and active participation of the students in the class.				

	During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.
Bibliography	Lecture notes W. C. Reynolds and P. Colonna Thermodynamics: fundamentals and engineering applications Cambridge University Press, 2018.
Assessment	Team design work 60%, written exam 30%, short assignments 10%
Language	GREEK OR ENGLISH

<table>
<tr><td>Course Title</td><td colspan="5">Theory and applications of incompressible Newtonian and non-Newtonian fluids</td></tr>
<tr><td>Course Code</td><td colspan="5">MMK 518</td></tr>
<tr><td>Course Type</td><td colspan="5">COMPULSORY</td></tr>
<tr><td>Level</td><td colspan="5">MASTER/PHD</td></tr>
<tr><td>Year / Semester</td><td colspan="5">WINTER SEMESTER</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">An academic position vacancy has been announced to meet the teaching needs of this field</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>2 X 1,5 AN HOUR</td><td>Laboratories / week</td><td>NO</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of the course is the teaching of the basic principles of incompressible fluid flows kai training of the students to the solution of problems found in industry.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">The students will
• learn the basic principles of incompressible fluid mechanics at the macroscopic and differential level,
• be trained to the analytical and numerical solution of typical problems that often found in a professional career,
• be able to derive the governing equations for fluid flow and pertinent boundary conditions based on the problem of interest,
• find the analytical solution of the flow and
• use the finite elements method to solve numerically flow problems.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">NO</td><td>Required</td><td colspan="2">NO</td></tr>
<tr><td>Course Content</td><td colspan="5">The course covers the basic principles of flow for Newtonian and non-Newtonian fluids as well as methods for solution of standard flow problems. The objective of the course is to cover in depth both the theory of incompressible fluids and the applications in several aspects of the human activity and technology including biological flows (e.g., blood), industrial processes (plastic and food technology), flows involved in hydrocarbons mining (with the use of fluids with special properties).
More specific the materials covered are:</td></tr>
</table>

	(1) Basic physical laws such as conservation of mass, linear momentum and energy for open and closed systems, (2) Application of these laws in differential form to study in detail fluid kinematics, such as flow streamlines, velocity potential, flow deformations, internal stresses, boundary conditions, etc. (3) Constitutive description of Newtonian and non-Newtonian fluids and principles of Rheology, (4) Dimensionless analysis of flow equations and in-depth discussion of important dimensionless numbers, (5) Analytical solution of flows and their applications, (6) Introduction to computational fluid mechanics and general description of basic computational methods such as a) finite differences, b) finite volumes and c) finite elements In depth study of the principles of the finite elements method and its application for the solution of linear and non-linear problems of fluid mechanics with common applications. The course also involves a series of laboratory exercises.
Teaching Methodology	Lectures 3 hours per week / Tutorials or lab exercise 1 hour per week Lectures. The teaching methodology is based on the "deductive reasoning" method, which means that the theory and the applications of it are presented first in a general form and subsequently they are specialized for the particular problems. There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.
Bibliography	A Alexandrou ,Principles of Fluid Dynamics, Prentice Hall J. N. Reddy, An Introduction to the Finite Element Method, McGraw-Hill
Assessment	Homework assignments (10%), midterm exam (30%), final exam (60%)
Language	GREEK OR ENGLISH

Course Title	Modelling and Analysis of Dynamic Systems
Course Code	**MME 524**
Course Type	COMPULSORY
Level	MASTER/PHD
Year / Semester	Spring Semester
Teacher's Name	Loucas Louca

ECTS	8	Lectures / week	2 x 1,5 hours	Laboratories / week	None
Course Purpose and Objectives	The purpose of the course is the teaching of a unified approach for modeling real systems with mechanical, fluid and electrical components and the understanding of the basic principles of modeling multi-energy domain dynamic systems, the derivation and simulation of bond graph models and calculate the behavior of dynamic systems through time and frequency responses.				
Learning Outcomes	The students will be able to: • perform systematic selection of ideal energy elements for modeling real dynamic systems, • represent, lump parameter and multi-energy, dynamic systems with appropriate bond graph models, • use causality and develop state variable differential equations describing the behavior of a dynamic system that its model is developed using bond graphs, • calculate the time response through computer simulation of a system with mechanical, fluid and electrical components, • identify the parameters of a system using the time response and the physical description of a system, • analyze the correctness of the initial modeling assumptions through analysis and • select the complexity of dynamic systems using systematic modeling methodologies such as deduction and reduction.				
Prerequisites	No		Required	No	
Course Content	The course is using a unified approach for abstracting real mechanical, fluid, and electrical systems into appropriate models in bond graph and state equation form to meet engineering design and control system objectives. The emphasis is not on the mechanics of deriving equations but rather on understanding how the engineering task defines the modelling objectives that determine what modelling assumptions are appropriate. The bond graph language, which is a graphical power topology of a dynamic system, is taught to help students easily represent models of multi-energy domain systems. This allows causality, as well as system analysis tools, to be used to determine the correctness of the modelling assumptions. In addition, model complexity is studied using systematic modeling methodologies (deduction and reduction). Problems in the form of homework are required to reinforce the theoretical concepts presented in the lecture. A final project on a topic of the student's research area will reinforce the concepts taught in this course. At the end of the course, students will be able to develop models of dynamic systems for a specific application and given accuracy.				
Teaching Methodology	Lectures 3 hours per week / Tutorials 1 hour per week The teaching methodology includes lectures using the white/black board, demos of 20-SIM software, solving sample problems during lectures. There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.				

Bibliography	Karnopp, D.C., D.L. Margolis, and R.C. Rosenberg, *System Dynamics: Modeling and Simulation of Mechatronic Systems*, 5th Edition, Wiley, 2012, ISBN 978-0470889084.
Assessment	Homework assignments (20%), individual Project (15%), midterm exam (30%), final exam (35%)
Language	GREEK OR ENGLISH

Course Title	Continuum Mechanics				
Course Code	**MMK 531**				
Course Type	COMPULSORY				
Level	MASTER/PHD				
Year / Semester	WINTER SEMESTER				
Teacher's Name	STYLIANOPOULOS TRIANTAFYLLOS				
ECTS	8	Lectures / week	2 X 1,5 HOURS	Laboratories / week	NO
Course Purpose and Objectives	The purpose of the course is the teaching of the mechanical behavior of fluids and solids under the same generalized framework, the familiarization with the methods and measures of stress and strain calculation, the familiarization with basic problems of fluid and solid mechanics and the teaching of the methodologies for solution of continuum mechanics problems.				
Learning Outcomes	The students at the end of the course will be able to • analyze the kinematics of the motion of material elements that obey to the laws of continuum mechanics, • calculate stresses and strains, • apply the conservation of mass, momentum and energy, • select the proper constitutive equations, • solve problems of fluid and solid mechanics				
Prerequisites	NO	Required	NO		
Course Content	The course include a brief review of the symbols and calculations among tensors and vectors and focuses on the study of (1) the kinematics of a continuum, and specifically to the calculation of stress and strain tensors and rates of deformation tensors, (2) the balance laws: conservation of mass, momentum and energy, (3) the constitutive equations for the mechanical behavior of solids, fluids and viscoelastic materials, (4) constitutive theories for ideal fluids, Newtonian fluids and linear elastic solids, (5) analytical solution of fluid and solid mechanics problems.				
Teaching Methodology	Lectures 3 hours per week / Tutorials 1 hour per week				

	Teaching is supported by academic lectures and homework exercises. The instructor does not exclusively use a single book and the lectures are based on the notes and the bibliography given below. All course material (lecture notes, exercises, etc.) are uploaded on the web site of the course in Blackboard. During the semester, additional auxiliary / reading material is posted to BlackBoard if this is necessary. There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.
Bibliography	- P. Chadwick, *Continuum Mechanics*, Dover Publications - L. E. Malvern, *Introduction to the Mechanics of a Continuous Media,* Prentice-Hall - M. E. Gurtin, *An introduction to Continuum Mechanics*, Academic Press - Y. C. Fung, *A First Course in Continuum Mechanics,* Prentice-Hall
Assessment	Homework assignments (10%), midterm exam (30%), final exam (60%)
Language	GREEK OR ENGLISH

Course Title	Manufacturing Process Automation				
Course Code	**MMK 541**				
Course Type	COMPULSORY				
Level	MASTER/PHD				
Year / Semester	WINTER SEMESTER				
Teacher's Name	An academic position vacancy has been announced to meet the teaching needs of this field				
ECTS	8	Lectures / week	2 X 1,5 AN HOUR	Laboratories / week	1
Course Purpose and Objectives	The purpose of this course is to 1) extend and broaden a range of engineering skills, containing a careful blend of mechanical engineering, manufacturing, process engineering and automation, and 2) gain the advanced knowledge necessary to devise innovative solutions and systems in the broad field of manufacturing process automation.				
Learning Outcomes	The students will develop a thorough understanding of the principles of modern manufacturing techniques, automation and production processes. They will be able to identify and review appropriate manufacturing systems for different production requirements and analyse their performance. They will also be able to understand appropriate technology, quality tools and				

	manufacturing methodology to design, re-design and continuously improve manufacturing operations.		
Prerequisites	NO	Required	NO
Course Content	The course involves an in-depth study of the physical dynamics in the wider spectrum of manufacturing processes, assessing their potential for automation. The course reviews the classical background in thermodynamics, fluids and mechanics together with dynamic systems and controls, in the context of analysis and design for automation of individual manufacturing processes. It also involves modelling and control issues examined in comparative studies of metal cutting, forming, bulk deformation, joining, welding, casting, and sintering in processing of ceramic, semiconductor and composite material processing. Emphasis is given on new technologies such as rapid prototyping, microelectronics fabrication and nano-manufacturing, as well as on advanced, nonlinear, adaptive and multivariable control algorithms. Simulation tools (Matlab/Simulink) are taught to allow students assess and optimize the performance of processing systems. Research directions are explored through taxonomy of manufacturing processes, suggesting redesign for automation. Students integrate and demonstrate control of a process experiment in the laboratory, such as part inspection station, automated bottle labelling robotic cell, thermal control of welding with infrared feedback, or automated assembly with machine vision. They also undertake the complete, real-world design of an automated plant such as a bakery.		
Teaching Methodology	Lectures 3 hours per week / Tutorials or laboratory exercises 1 hour per week Class and laboratory lectures; powder point presentations There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.		
Bibliography	Lecture notes; selected articles Mikell P. Groover. Automation, Production Systems, and Computer-integrated Manufacturing. ISBN: 0134605462, 9780134605463		
Assessment	Midterm exam (35%), final exam (35%), homework, lab reports/presentation (30%)		
Language	GREEK OR ENGLISH		

Course Title	Renewable Energy Technology
Course Code	**MMK 516**
Course Type	ELECTIVE

<table>
<tr><td>Level</td><td colspan="5">MASTER/PHD</td></tr>
<tr><td>Year / Semester</td><td colspan="5">WINTER SEMESTER</td></tr>
<tr><td>Teacher's Name</td><td colspan="5">DEMOKRATIS GRIGORIADES</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>2 X 1,5
AN HOUR</td><td>Laboratories / week</td><td>NO</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of the course is the understanding of renewable energy technology, the analysis and solution of pertinent problems and the analysis and design of power conversion systems.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">The students will be able to:
• identify different modes of energy conversion and explain the difference between conventional and renewable energy conversion mechanisms,
• identify, classify and estimate the potential of different renewable energy resources,
• analyse, and report and apply the curves of performance of solar, wind and hydroelectric systems and

• design, plan and inspect renewable and hybrid power systems to meet specific power needs</td></tr>
<tr><td>Prerequisites</td><td colspan="2">NO</td><td>Required</td><td colspan="2">NO</td></tr>
<tr><td>Course Content</td><td colspan="5">The course content includes the energy problem and Renewable Energy Sources (RES) - Historical development of energy technologies & current status: energy sources and energy consumption (worldwide, Europe, Cyprus) - Towards a sustainable energy future - The development of renewable energy in Europe and the world - RES in Cyprus - Short and long term prospects of RES (world, Europe, Cyprus) - Methods of analysis and prolexis: Wind potential - Solar radiation - Biomass - Hydroelectric resources - Sea waves / ocean currents - Wind - Passive & Active solar systems - bioclimatic architecture - Photovoltaics - Small hydroelectric - Geothermal Energy - Hydrogen - fuel Cells</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">Lectures 3 hours per week / Tutorials or laboratory exercises 1 hour per week

Teaching is supported by academic lectures, and demonstration of laboratory exercises. For a correct and complete understanding of the subject matter it is necessary to attend the lectures and laboratory exercises as well as the solution of the exercises / tasks that are assigned. The teacher does not exclusively use a single book and the lectures are based on the notes and the bibliography given below. All course material (lecture notes, exercises, laboratory exercises, etc.) are posted on the web site of the course in Blackboard. During the semester, additional auxiliary / reading material is posted to BlackBoard if this is necessary.</td></tr>
<tr><td>Bibliography</td><td colspan="5">1. Gilbert M. Masters "Renewable and Efficient Electric Power Systems", ISBN 0-471-28060-7, John Wiley & Sons, (2004).
2. Sørensen Bent, *Renewable Energy*, Second Edition, Academic Press, ISBN 0-12-656150-8, (2004).
3. Sørensen Bent et al., *Renewable Energy Focus Handbook*, Academic Press, ISBN: 978-0-12-374705-1 (2009).
4. Markvart Tomas, *Solar Electricity*, John Wiley and Sons, ISBN 047-1941-61-1, (1995).</td></tr>
</table>

	5. Stiebler Manfred, *Wind Energy Systems for Electric Power Generation* Springer Series in Green Energy and Technology, ISBN: 978-3-540-68762-7, e-ISBN: 978-3-540-68765-8 (2008). 6. Μοσχάτος Ανδρέας Ε., *Ηλιακή ενέργεια*, έκδοση τεχνικού επιμελητηρίου Ελλάδος, ISBN 960-7018-26-5 (1992). 7. Decher Reiner, *Direct Energy Conversion: Fundamentals of Electric Power Production*, Oxford University press, ISBN-10: 0195095723 (1996). 8. Yogi D. Goswami & Frank Kreith, “Energy Conversion” (Mechanical Engineering Series), CRC Press. 9. Archie W. Culp, *Principles of Energy Conversion*, Mcgraw-Hill.
Assessment	One midterm exam (40%), assignment & presentation (50%)
Language	GREEK OR ENGLISH

Course Title	SOLAR ENERGY SYSTEMS				
Course Code	**MMK 517**				
Course Type	ELECTIVE				
Level	MASTER/PHD				
Year / Semester	WINTER SEMESTER				
Teacher’s Name	SPECIAL SCIENTIST				
ECTS	8	Lectures / week	3 hours weekly	Laboratories / week	NO
Course Purpose and Objectives	The purpose of the course is the acquisition of knowledge and techniques to analyse solar thermal systems and their characteristics. Emphasis is given on the solar characteristics of Cyprus as well as on the passive and thermal methods of exploiting solar radiation.				
Learning Outcomes	The students will be able to • identify, understand and estimate solar geometry and solar potential. • understand and estimate the operation of active and passive solar systems. • analyse and report the performance of solar systems. • suggest appropriate and feasible solar systems to meet specific needs. • familiarise, estimate and report the energy yield of solar installations using different calculation methods. • perform the financial assessment and examine the financial sustainability of solar installations.				
Prerequisites	NO		Required	NO	

Course Content	The course content includes lectures on the following thematic areas: • Solar radiation (basic concepts and features, angles, direct and diffuse radiation in horizontal - inclined - moving levels, measurement of solar radiation). • Passive and Active Solar Systems (basic concepts, typology, features and capabilities, modes of exploitation and optimization of systems). • Thermal production of solar collector technologies (typology, thermal analysis, temperature distribution in the absorber, efficiency factor, thermal gain, flow, efficiency, performance measurement). • Solar installations of thermal energy (calculation methods, curves f, F-f curves, storage and rate of solar energy use). • Financial assessment and sustainability features.
Teaching Methodology	• Lectures (3 hours per week) • Tutorials (1 hour per week) • Assignments / homework • Demonstrations & visits
Bibliography	• Lecture notes • «Συμβατικές & Ήπιες Μορφές Ενέργειας», Μπαλαράς, Αργυρίου, Καραγιάννης, 2006, Εκδόσεις Τεκδοτική, ISBN: 960-8257-23-9.
Assessment	Midterm examination (30%), homework (30%), final examination (40%)
Language	GREEK OR ENGLISH

Course Title	Signal Processing				
Course Code	**MMK 523**				
Course Type	ELECTIVE				
Level	MASTER/PHD				
Year / Semester	WINTER SEMESTER				
Teacher's Name	Andreas Kyprianou				
ECTS	8	Lectures / week	2 X 1,5 AN HOUR	Laboratories / week	NO
Course Purpose and Objectives	The purpose of the course is the teaching of signal processing in Mechanical and Manufacturing Engineering and the understanding of the basic principles of sampling, digitization, analysis of digital systems and filters focusing on real applications.				
Learning Outcomes	• To understand the notion of sampling and its importance in experimental testing • To understand the underlying process of quantization of transforming an analogue signal to digital • To familiarize themselves with discrete time systems				

	• To develop a basic understanding of Fourier transform and z-transform • to apply techniques of signal analysis and synthesis based on Fourier Transform and z-transform in order to understand the workings of an engineering system • to learn how to do a systematic literature survey on signal processing theory and its applications		
Prerequisites	NO	Required	NO
Course Content	The course covers the following topics: Sampling. Analogue signals. Sampling Theorem its importance and applications. Sampling of sinusoids. Quantization. Quantization process. Oversampling. Analogue to digital converters. Discrete time systems. Linearity. Impulse response. Filters: finite impulse response, infinite impulse response. Finite impulse response filters and convolution. Block processing methods. Sample by sample processing methods. z - Transforms. Properties. Convergence. Frequency spectrum. Transfer Functions. Sinusoidal response. Design based on poles and zeros. Digital filters. Normal form. Cascade form. Influence of quantization. Digital Fourier Transform. Finite impulse response digital filter design. Infinite impulse response digital filter design. First order low and high pass filters.		
Teaching Methodology	Lectures 3 hours per week / Tutorials 1 hour per week There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours. Biweekly tutorials where the problem sets and computational assignments given for each topic are further discussed and explained.		
Bibliography	Introduction to Signal Processing, S J Orfanidis. Rutgers University		
Assessment	Tutorials (5%), computational tutorials (10%), literature survey essay (25%), midterm exam (25%), final exam (35%)		
Language	GREEK OR ENGLISH		

Course Title	Biomedical and Industrial Applications of Engineering Acoustics
Course Code	**MMK 533**
Course Type	ELECTIVE
Level	MASTER/PHD

Year / Semester	WINTER SEMESTER				
Teacher's Name	MICHALIS AVERKIOU				
ECTS	8	Lectures / week	3 hours weekly	Laboratories / week	4 total per sem.
Course Purpose and Objectives	The purpose of the course is the teaching of the acoustics involved in biomedical ultrasound.				
Learning Outcomes	The students will be able to • to explain the physical phenomena involved in ultrasound propagation in the body. • to explain sound dissipation in fluids and tissue • know how to use function generators and oscilloscopes to digitize waveforms. • create and measure ultrasound waves. • solve graphically initial and boundary value problems of waves. • measure ambient sound with sound pressure level meters.				
Prerequisites	NO	Required	NO		
Course Content	This course is an introduction to physical acoustics for engineering and science majors. It gives the physical basis for problems found in many engineering applications including biomedical ultrasound, room acoustics, noise control and sonar. This course covers: plane waves in fluids, transient and steady-state reflection and transmission, refraction, strings and membranes, rooms, absorption and dispersion, spherical and cylindrical waves, radiation from baffled piston, and medical ultrasound arrays. The course includes laboratory sessions on ultrasound beams with usage of related equipment such as function generator, digital oscilloscope, power amplifier, and micropositioners. Sound pressure level measurements for noise control are also taken with an SPL meter				
Teaching Methodology	Lectures 3 hours per week / Tutorials or laboratory exercises 1 hour per week Weekly lectures, homework, and laboratory exercises at the Biomedical Ultrasound Laboratory of the department. There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.				
Bibliography	D. T. Blackstock, Fundamentals of Physical Acoustics, Wiley-Interscience, New York, 2000.				
Assessment	Homework/projects (20%), midterm exam (35%), final exam (45%)				
Language	GREEK OR ENGLISH				

<table>
<tr><td>Course Title</td><td colspan="5">Medical Imaging - Diagnostic Ultrasound</td></tr>
<tr><td>Course Code</td><td colspan="5">MMK 535</td></tr>
<tr><td>Course Type</td><td colspan="5">ELECTIVE</td></tr>
<tr><td>Level</td><td colspan="5">MASTER/PHD</td></tr>
<tr><td>Year / Semester</td><td colspan="5">WINTER SEMESTER</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">MICHALIS AVERKIOU</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>3 hours weekly</td><td>Laboratories / week</td><td>4 total per sem.</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of the course is to introduce students to diagnostic ultrasound and teach basic physical principles of ultrasound imaging. It also aims to explain imaging modalities of modern ultrasound scanners.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">The students will be able to
• explain the physical principles behind diagnostic ultrasound.
• create ultrasound beams in water
• perform ultrasound hydrophone measurements
• read and understand ultrasound images
• identify and interpret b-mode, color flow, pulsed wave Doppler, and color power angio images
• measure flow velocity with the Doppler technique</td></tr>
<tr><td>Prerequisites</td><td colspan="2">NO</td><td>Required</td><td colspan="2">NO</td></tr>
<tr><td>Course Content</td><td colspan="5">This course covers the basic science and physics of diagnostic ultrasound. A short introduction to the relevant acoustics needed for ultrasound imaging is given first. It includes reflection and transmission, refraction, acoustic impedance, sound beams, arrays, beamforming, ultrasound propagation through tissue and blood, attenuation, scattering, and nonlinear properties of tissues. The current equipment technology is presented and explained. The following modes of imaging are covered: M-mode, B-mode, Doppler, Harmonic Imaging, and 3D imaging. Emphasis is also placed on ultrasound contrast agents and specifically imaging and quantification of tumor angiogenesis. The course includes a laboratory component that covers some of the topics above. In laboratory exercises, students use a modern diagnostic ultrasound scanner and also observe clinical examinations.</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">Lectures 3 hours per week / Tutorials or laboratory exercises 1 hour per week

Weekly lectures, homework, and laboratory exercises at the Biomedical Ultrasound Laboratory of the department.

There is continuous communication with the instructor and active participation of the students in the class.

During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.</td></tr>
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Bibliography	T. L. Szabo, Diagnostic Ultrasound Imaging – Inside Out, Elsevier
Assessment	Homework/projects (25%), midterm exam (35%), final exam (40%)
Language	GREEK OR ENGLISH

Course Title	Nonlinear Mechanics of Solids and Structures				
Course Code	**MMK 551**				
Course Type	ELECTIVE				
Level	MASTER/PHD				
Year / Semester	SPRING SEMESTER				
Teacher's Name	VASILEIOS VAVOURAKIS				
ECTS	8	Lectures / week	2 X 1.5 AN HOUR	Laboratories / week	NO
Course Purpose and Objectives	The purpose of this course is to cover a particular area in applied solid mechanics and biomechanics: nonlinear mechanics of solid matter using a continuum-based approach.				
Learning Outcomes	Successful completion of the course will enable students • to consolidate theoretical background in continuum solid mechanics, • to use and evaluate the most common stress, strain and deformation measures, • to model rubber-like materials, biological tissues, elastomers, poroelastic and viscoelastic materials, and (small/large) plastic deformations in metallic materials, • to calibrate constitutive models using experimental data, • to apply analytical methods for the calculation of stresses and strains in simple geometries of structures and loading conditions, • to build nonlinear finite element models and analyze the mechanics of simple structural problems using the commercial software ABAQUS®, • to read and understand scientific publications of nonlinear material models in applied mechanics and biomechanics.				
Prerequisites	MMK 531	Required	NO		
Course Content	The course briefly presents the fundamentals in continuum solid mechanics, i.e. stress/strain measures, equations of motion and equilibrium for deformable solids, while it also gives an outline to variational principles. Subsequently, the constitutive equations that describe the mechanical behavior on a wide range of elastic solids is presented: spanning from linear elastic (isotropic and anisotropic) materials to hypo- and hyperelastic, viscoelastic, and elastoplastic solids. Finally, analytical solutions to axially and spherically symmetric solutions for linear elastic and elastoplastic solids under quasi-static loading is outlined. Students will also receive specialized hands-on training on ABAQUS® to simulate and analyze nonlinear elasticity problems in applied mechanics or/and biomechanics.				

Teaching Methodology	• Communicative, Collaborative • Class lectures (PowerPoint, Socrative, Screencast-o-matic), and computer-lab sessions at the School computing center • During the first week of the semester, the Syllabus of the course is given by the course tutor, which includes information on the course content, expected learning outcomes, assessment and office hours.
Bibliography	Lawrence E. Malvern. Introduction to the Mechanics of a Continuous Medium. ISBN-13: 978-0134876030 G.A. Holzapfel. Nonlinear Solid Mechanics: A Continuum Approach for Engineering. ISBN-13: 978-0471823193 Ray W. Ogden. Non-linear Elastic Deformations. ISBN-13: 978-0486696485 Yuen-Cheng Fung. Classical and Computational Solid Mechanics. ISBN-13: 978-9810241247 G.T. Mase, G.E. Mase. Continuum mechanics for engineers. ISBN-13: 978-0849388309 A.J.M. Spencer. Continuum Mechanics. ISBN-13: 978-0486435947 Vlado A. Lubarda. Elastoplasticity Theory. ISBN-13: 978-1420040784 Aleksey D. Drozdov. Finite Elasticity and Viscoelasticity: A Course in the Nonlinear Mechanics of Solids. ISBN-13: 978-9810224332
Assessment	Bi-weekly homework assignments (40% total) Course project assignment (30%) One (1) final exam (30%)
Language	GREEK OR ENGLISH

RESPONSE TO THE COMMENTS OF THE EVALUATION COMMITTEE FOR THE PHD PROGRAM IN MECHANICAL AND MANUFACTURING ENGINEERING

1. Effectiveness of teaching work

1.1 Organization of teaching work

1.1.2 The number of students in each class allows for constructive teaching and communication, and it compares positively to the current international standards and/or practices. Additional comments: On one hand, the currently low number of students allows for constructive teaching and communication even on a one-to-one basis. However, the committee felt that this is not necessarily sustainable in case of plans for future expansion of student numbers.

No significant expansion in student numbers is expected in the future. More precisely, the planned number of students to be admitted in the PhD program of MME Department in the next years is 8-10 annually.

1.1.3.5. The procedures for the conduct and the format of the examinations and for student assessment.

The procedures for the conduct and the format of the examinations is not part of a formal process of setting exams and moderating those on a departmental level, but organized and applied individually by each Academic ad-hoc.

The formatting of the examination procedures followed in the Department of Mechanical and Manufacturing Engineering are in line with the general examination rules and procedures set at the University of Cyprus. The latter are consistently applied in all Departments of the University of Cyprus. These include among others the following:

“The University of Cyprus applies the principle of continuous assessment to each course. Specifically, the student's performance on a particular subject is assessed, at the discretion of the lecturer and with the approval of the Department, in at least two different ways. One must be the final written examination. The percentage of participation in the final written examination in the final score cannot exceed 60% of the final score. The allocation of the percentages for each exam, as determined by the curriculum, is independent of the degree the student achieves in each exam. The final written exam does not apply only in the case of the diploma thesis, screenwriting lessons, study or teamwork”.

In an effort to develop a more uniform process of setting examination papers on an individual basis thus maintaining the quality assurance in all graduate courses as per the Committee’s suggestion, the Department Chair will be responsible for the statistical analysis of students’ grades and will discuss the evaluation outcome with each Academic.

1.1.3.6. The effective provision of information to the students and the enhancement of their participation in the procedures for the improvement of the educational process.

It is not entirely clear how the students participate and contribute to the improvement of the educational process on a fundamental level to make it more effective.

Based on the comments of the evaluators, the department has assigned to the graduate studies committee to act also as a teaching committee to be in charge of the quality assurance of the graduate studies and make sure that administrative stuff and students participate to the improvement of the educational process. The graduate studies committee will assure that all procedures and regulations of the graduate programs are implemented properly and will formally meet with administrative staff and students once every year to discuss any issues related to the educational process and how they can be improved.

1.1.4.3 Infrastructure

We thank the evaluation committee for highlighting the lack of teaching laboratories in some thematic areas and courses including courses related to fluid mechanics and thermodynamics.

As recognized by the Committee members, the current spread of the Department in 4 different sites and the lack of adequate teaching laboratory space prevented the development of teaching labs for core engineering subjects.

The Department has put into force a strategic plan for the development of teaching labs, with emphasis to laboratories linked to fluid mechanics, thermodynamics and solid mechanics.

As a result of this effort, the University of Cyprus has committed to provide to the department an amount of €500,000 within the next 2 years (by 2020) to be spent exclusively for the needs of the department for teaching laboratories and equipment. An amount of €50,000 has already be given to the department for this purpose. The laboratory equipment will be used for both undergraduate and graduate level laboratory exercises.

1.1.5. A policy for regular and effective communication, between the teaching personnel and the students, is applied.

There is no formal policy in place outside of one-to-one interactions by individual initiative by Academic staff and students.

As far as the graduate courses are concerned every academic instructor assigns weekly office hours for effective communication with the students. For the supervision of the graduate students at the PhD level and following the suggestions of the evaluators, the department established the "thesis committee meetings" on an annual basis. When the PhD students succeed in the written qualification exams, the department assigns the three internal members of the PhD committee, consisting of the academic advisor and two other faculty members of the department whose research interests are close to the research of the student. The student will meet with this committee every year and will present the progress of his/her research and propose a research plan for the remaining of his/her studies. The role of the committee will be to assess the progress and performance of the student, support the student's research activities by providing advice, identify potential problematic performances and find ways to improve them.

1.1.7.-1.1.9. Statutory mechanisms, for the support of students and the communication with the teaching personnel, are effective.

Control mechanisms for student performance are effective.

Support mechanisms for students with problematic academic performance are effective.

No clear mechanisms were demonstrated to the committee in terms of control, support and effectiveness.

The thesis committee meetings described in our response to the comment #1.1.5 above will be an sufficient and effective mechanism for the support of the PhD students, for assessing of their academic/research performance and for suggesting solutions to the student in case of a problematic performance.

1.1.10. Academic mentoring processes are transparent and effective for undergraduate and postgraduate programs and are taken into consideration for the calculation of academic work load

Considering that such processes are not formally in place it is unclear to the committee how transparency can be applied effectively.

Academic mentoring for graduate students is not considered in the calculation of the academic load according the University of Cyprus regulations. With the Department's initiative, undergraduate students are equally distributed among all faculty members. The same procedure is used for the number of Diploma Thesis students that each faculty member is supervising. For Master students, there is also an effort to be equally distributed among faculty members. For the PhD students such a distribution cannot be made because the number of PhD students per faculty is largely determined by the funded research programs of the faculty members.

1.1.11. The program of study applies an effective policy for the prevention and detection of plagiarism.

Although there are University regulations related to plagiarism, there is no evidence for their implementation in cases of potential widespread Academic offences and we have made specific suggestions to improve on that.

The antiplagiarism online tool *SafeAssign* is available through Blackboard (https://help.blackboard.com/SafeAssign/Instructor/Language_Support), which is accessible to all members of UCY academic staff. Students during exams are only allowed to use "simple" calculators that are not capable of storing information.

1.1.12. The program of study provides satisfactory mechanisms for complaint management and for dispute resolution.

Such mechanism is not clear from the provided information and it is important to develop those in view of future proofing the course in case of legal disputes.

Activities of courses are carried out based on University of Cyprus regulations. For example, the students have access to their exams and in case of a dispute the exam is re-evaluated. Also, in case of plagiarism the students are reported to the "Disciplinary Committee for Student Issues" where the case is thoroughly investigated.

1.3 Teaching Personnel

1.3.1., 1.3.2. and 1.3.11. All members of Academic staff are experts in their field of research and this reflects positively on the support of PhD projects. However, it appears that the students may not get the exact type of project that meets their personal research interest due to the small number of academic staff and the narrow range of research topics on offer, for example total lack of experimental fluid mechanics with advanced diagnostic techniques.

We thank the evaluators for the positive comments regarding the expertise of the faculty members. It is true that owing to small number of academic staff the range of research topics is narrow compared to departments that have a larger number of faculty and this is inevitable. We have to stress, however, the fact that since the evaluation (in February 2019) the department increased the number of faculty from 12 to 13 and within this year the number of faculty will be increased to 16. The addition of 4 more faculty members in the department in research areas that were not sufficiently represented during the evaluation, including the areas of fluid mechanics, manufacturing, biomedical devices/bioengineering, automation, will improve significantly this issue.

1.3.3. The specializations of Visiting Professors adequately support the program of study.

We were not informed of any formal appointments of Visiting Professors to support the program of study.

We apologize if it was not clear during the evaluation, but we would like to inform the Committee that the department has formal appointments of Visiting Professors that support the Master and PhD programs. This is formally done during the summer semester, which makes it easier for the Visiting Professors to come to the department from abroad in order to teach a short-course and interact with the graduate students of the department. The summer of 2018, Prof. Alessio Alexiadis (School of Chemical Engineering, University of Birmingham, UK) served as a Visiting Professor in our department. He taught the short course "A primer on discrete multiphysics" and met with several faculty members and students. The summer of 2017, Dr. Damian Rouson (Sourcery Institute, California, USA) served as a Visiting Professor and taught the short course "Parallel Programming in Modern Fortran". For this summer, we are in the process of contacting established researchers that would be interested in serving as Visiting Professors.

Other examples from previous years include:

- Prof. Andreas Polycarpou, Texas A&M University, U.S.A.
- Dr. Apostolos Korlos, University of Thessaly, Greece.
- Dr. Dimosthenis Michalopoulos, University of Patras, Greece.
- Prof. Panos Charalambides, University of Maryland, Baltimore County (UMBC), U.S.A.

It is noteworthy to mention at this point that although Visiting Professor positions are often announced in the Department, there are difficulties in attracting candidates from abroad due to language restrictions (official language at the undergraduate level is Greek) as well as different term schedule applied at the University of Cyprus (Fall semester: beginning of September – end of December; Spring Semester: mid-January – end of May) compared to Greek and other European Universities. Based on the above, in the future the Department will be targeting in attracting Visiting Professors for the summer semester.

We agree with the committee that the teaching of the whole program in English will definitely enhance the Visiting Professor appointments.

1.3.10 Future redundancies / retirements, expected recruitment and promotions of academic personnel safeguard the unimpeded implementation of the program of study within a five-year span.

For planned retirements, redundancies, sabbaticals, etc. it seems that there is a need for a contingency plan that would assist supervised students by smooth transition to a new status. This is of particular importance for PhD students involved with long research projects. For this reason, the committee recommends the allocation of a second supervisor from the beginning of the doctoral program.

We agree with the recommendation of the committee and we already established that every PhD student will have the thesis committee which consist of the PhD advisor and two other faculty of the department from the beginning of the doctoral program to ensure the smooth continuation of the thesis in the case of planned retirements, redundancies, sabbaticals, etc.

2. Program of study and higher education qualifications

2.1 Purpose and Objectives and learning outcomes of the program of study

2.1.1., 2.1.2., 2.1.4.-2.1.7. On the basis of the PhD program document and the discussions that followed the committee felt that the way learning objectives and outcomes had been formulated was not consistent across all courses. The program document needs to be streamlined and harmonized to illustrate better the coherence of the learning outcomes as a whole. It was not clear how the learning outcomes were matched against coursework assessment and written examinations.

We thank the evaluators for pointing this out. We have streamlined and harmonized the description of the graduate level courses (ANNEX I). The program will be regularly reviewed by the Graduate Studies Committee of the department to keep it up-to-date.

2.2 Structure and content of the program of study

2.2.1., 2.2.3., 2.2.5 The purpose and objectives of the program of study are formulated in terms of expected learning outcomes and are consistent with the mission and the strategy of the institution. The purpose and objectives of the program and the learning outcomes are utilized as a guide for the design of the program of study. The program's content, the methods of assessment, the teaching materials and the equipment, lead to the achievement of the program's purpose and objectives and ensure the expected learning outcomes. The learning process is properly designed to achieve the expected learning outcomes. The higher education qualification awarded to the students, corresponds to the purpose and objectives and the learning outcomes of the program.

Considering the wide diversity of student applicants who may come even with no engineering background (for example, biologists) the committee felt that some provision for more basic engineering principles should be made in the syllabus. Discussion with students fortified this point. The committee recommends to the Department to consider the inclusion of some of the courses in the undergraduate program as electives in order to fill gaps in engineering for the nonengineering PhD students.

We inform all the graduate students about the content of our graduate programs during the interview process, which is compulsory for all candidates for our programs. We pay particularly attention to the students that do not have an engineering background to explain them the needs of the graduate courses and we also ask them during the interview questions to assess their knowledge in mathematics and engineering. For the PhD students in particular, we further notify them that they might have to audit undergraduate level classes to enhance their engineering background so that they are better prepared to take the qualification exams that is a requirement for the doctoral program. Therefore, nonengineering PhD students are screened for their ability to perform doctoral studies in mechanical engineering and are well informed about the demands of the program before accepting to enter our program.

When they become accepted to the program, nonengineering students are advised and encouraged by the supervisors to audit undergraduate level courses. Unfortunately, there is no provision by the School of Graduate Studies of the University for the doctoral students to register and get credits for attending undergraduate level courses. However, the qualification exams are based on the undergraduate courses and thus, any doctoral student can audit any undergraduate class in order to get prepared for the exams.

2.3 Quality assurance of the program of study

2.3.1.-2.3.3. The committee felt that the members of the Academic staff safeguard quality by significant individual effort. The committee were not made aware of any clear procedures and detailed information to support quality assurance beyond this individual effort. Considering the lack of clear formal procedures for quality assurance, it is unclear how administrative personnel and students participate effectively in such efforts. Despite this criticism the committee did not observe any quality assurance issues, but it is important to reduce the risk of potential future issues in this area.

We agree with the suggestion of the evaluators and we have assigned to the graduate studies committee of the department to be responsible for the quality assurance of the graduate programs and to make sure that administrative stuff and students participate to the improvement of the educational process. The graduate studies committee will assure that all procedures and regulations of the graduate programs are implemented properly and will formally meet with administrative staff and students once every year to discuss any issues related to the educational process and how they can be improved.

2.4 Management of the program of study

2.4.1.-2.4.4. It is suggested to introduce a formal procedure of annual assessment of progress in the PhD program conducted by an independent staff member not directly involved in the supervision of the student. This will identify early on weak candidates so that they do not spend up to 8 years to complete their PhD degree.

We agree with the evaluators. We have established the “thesis committee meetings”, the PhD students will meet every year with the internal members of the thesis committee, which consist of the PhD advisor and two other faculty of the department. The student will present the progress of the research and propose the future plans for the next year. In the meetings, the committee will assess the progress of the research project, the performance of the student and will provide advice to the student.

2.5 International dimension of the program of study

2.5.1. While research collaborations may compare positively with other institutions, it is unclear whether any teaching collaborations are being actively pursued to a high level, like training networks in Europe and overseas.

Our department coordinates the COST action SimInhale (COST Action MP1404) through which several students of the department have visited for a short time other labs abroad. The department also has coordinated the last five years 6 Marie-Curie Individual Fellowships that also included visits of the fellows to labs and companies in Cyprus and abroad. There are also students that have travel for collaboration purposes making use of the Erasmus+ exchange program.

The Department has a specific plan to improve its teaching collaborations through targeted actions such as Erasmus+ exchange programs by offering some undergrad courses in English, Erasmus+ staff mobility for teaching programs, participation of the Department's academic personnel in short Short-Cycle Training Courses (e.g. Erasmus+ Short-Cycle training course on Thermal Analysis in Material Science/SC-ThAnMA), summer short courses offered by visiting professors etc.

2.5.2. There has not been any formal proof of Visiting Professors of high international standing being attracted to the program of study. Invited lectures from Academics abroad and establishing formally Visiting Professorships would also help to broaden the international status of the program and the students would benefit. In turn, by interacting with the Visiting Professor on their research project and by his independent formal or informal advice and assessment of the conducted work.

We apologize if it was not clear during the evaluation, but we would like to inform the committee that the department has formal appointments of Visiting Professors that support the Master and PhD programs. This is formally done during the summer semester, which makes it easier for the Visiting Professors to come to the department from abroad in order to teach a short-course and interact with the graduate students of the department. The summer of 2018, Prof. Alessio Alexiadis (School of Chemical Engineering, University of Birmingham, UK) served as a Visiting Professor in our department. He taught the short course "A primer on discrete multiphysics" and met with several faculty members and students. The summer of 2017, Dr. Damian Rouson (Sourcery Institute, California, USA) served as a Visiting Professor and taught the short course "Parallel Programming in Modern Fortran". For this summer, we are in the process of contacting established researchers that would be interested in serving as Visiting Professors.

Other examples from previous years include:

- Prof. Andreas Polycarpou, Texas A&M University, U.S.A.
- Dr. Apostolos Korlos, University of Thessaly, Greece.
- Dr. Dimosthenis Michalopoulos, University of Patras, Greece.
- Prof. Panos Charalambides, University of Maryland, Baltimore County (UMBC), U.S.A.

It is noteworthy to mention at this point that although Visiting Professor positions are often announced in the Department, there are difficulties in attracting candidates from abroad due to language restrictions (official language at the undergraduate level is Greek) as well as different term schedule applied at the University of Cyprus (Fall semester: beginning of September – end of December; Spring Semester: mid-January – end of May) compared to Greek and other European Universities. Based on the above, in the future the Department will be targeting in attracting Visiting Professors for the summer semester.

We agree with the committee that the teaching of the whole program in English will definitely enhance the Visiting Professor appointments.

2.5.3. We were not made aware of specific agreements for students exchange programs at the PhD level.

As mentioned in our response to #2.5.1, the department coordinates the COST action SimInhale (COST Action MP1404) through which several graduate students of the department have visited for a short time other labs abroad. We make also efforts to further encourage our students to participate in the ERASMUS program of graduate students exchange.

2.5.4. Teaching the whole program in English would certainly make it more internationally attractive. Invited lectures from Academics abroad and establishing formally Visiting Professorships would also help to broaden the international status of the program and the students would benefit in turn.

We agree with the evaluators. We plan to teach the entire program in English and expand our Visiting Professorship program beyond the summer semester.

2.6 Connection with the labor market and the society

2.6.1.-2.6.3. Indicators for the employability of PhD students appear positive. There is some room for improvement in terms of effective procedures for career development to be applied formally. Similarly, benefits to the society and industrial processes can be strengthened by industrial involvement in the PhD, especially in terms of advice and feedback given by a suitably qualified Professional Engineer educated to PhD level.

We agree with the evaluators for the need of industrial involvement in the PhD research. Our PhD students are benefitted from established collaboration between faculty of the department and external collaborators. Many faculty members have extended collaborations with industrial partners and have received funding from or with them. Examples of such collaborations are the one of Associate Professor Theodora Krasia-Cristoforou with Elysee, a local manufacturer of plastic piping systems and the collaboration of Assistant Professor Triantafyllos Stylianopoulos with Theramir Ltd, a local company specialized on materials for cancer and other diseases.

Associate professor Claus Rebholz has been extensively collaborating with industrial partners in the field of manufacturing in Europe and in Cyprus. Specifically, in Europe:

- Robert Bosch Manufacturing Solutions GmbH (Stuttgart/Germany), part of the bosch group, https://www.bosch.com/: Plasma and Laser Technology; Machine Design...

- encontec GmbH (Schwäbisch Gmünd/Germany), https://www.encontec.de/: Materials Testing; Process Technology

- Perpetuus Advanced Materials (Ammanford/UK), https://perpetuusam.com/: Carbon-based Materials; Plasma Processing

In Cyprus:

-Nikolaides & Kountouris Metal Company Ltd (Nicoais/Cyprus), http://www.nkmetal.com.cy/company_profile_en.html: Polyurethane Panels; Thermal Insulation Mortars; Roll Forming; Metal Roofs/Frames.

- Porfyrios Glass Ltd (Nicosia/Cyprus), http://porfyriosglass.com/: Energy Glass; Safety Glass; Heat & Surface Treatments; Machining.

- Peta Plastics Ltd (Nicosia/Cyprus), http://petaplastics.com/: Plastic Packaging; Product Design; Automation Systems, Mold Design and Manufacture.

Professor Stavros Kassinos has the following collaborations with industrial partners from Europe and USA:

1. MYLAN UK

Research contract

http://www.mylan.co.uk

2. Simulations Plus Inc., Los Angeles, USA

Hosted two undergraduate students for summer internships

Research collaboration

https://www.simulations-plus.com

3. ELPEN Pharma Greece

Research Contract and student training

https://www.elpen.gr

4. PureIMS, Netherlands

Research Contract and joint publications

https://www.pureims.com/en/home/

5. Emmace SE, Sweeden

Research collaboration and joint publications and student training

https://www.emmace.se

6. Medspray, Netherlands

Hosted two undergraduate students for summer internships

Research collaboration

http://www.medspray.nl/company.html

7. Aptar Pharma, Germany

In the process of signing a new contract

www.aptar.com

Furthermore, research funding from Cyprus Research Promotion Foundation, the Cypriot authority for funding research, and the European Commission supports such collaborations.

It is our continuous effort to have industrial partners involved in the research activities of the department.

In addition, the University of Cyprus has already in place mechanisms to enhance the employability of the undergraduate and graduate students. The Center for Entrepreneurship and the Careers Office of the University train the students on how to prepare their cv and for job interviews and help them be connected with the industry.

3. Research work and synergies with teaching

3.1.1.-3.1.9. There is an excellent synergy between teaching and research, particularly in terms of supporting PhD projects. Research facilities and external/internal funding compare positively to other institutions in Cyprus and abroad.

We thank the evaluation committee for recognizing the research excellence of the department and the ability to train PhD students.

4. Administrative services, student welfare and support of teaching work

4.1.1.-4.1.3. Statutory administrative mechanisms for monitoring and supporting students are sufficient. The efficiency of these mechanisms is assessed on the basis of specific criteria. Mechanisms are in place for academic and personal matters, yet there is no clear evidence of how these are applied formally and efficiently.

This will be part of the quality assurance that we established. The committee of graduate studies will oversee and assure that all mechanisms for monitoring and supporting the graduate students are applied.

4.2 Infrastructure / Support

4.2.3.,4.2.4. While the research labs are well equipped, there is a need for more focused teaching labs on the graduate program.

We thank the evaluation committee for highlighting the lack of teaching laboratories in some thematic areas and courses including courses related to fluid mechanics and thermodynamics.

As recognized by the Committee members, the current spread of the Department in 4 different sites and the lack of adequate teaching laboratory space prevented the development of teaching labs for core engineering subjects.

The Department has put into force a strategic plan for the development of teaching labs, with emphasis to laboratories linked to fluid mechanics, thermodynamics and solid mechanics.

As a result of this effort, the University of Cyprus has committed to provide to the department an amount of €500,000 within the next 2 years (by 2020) to be spent exclusively for the needs of the department for teaching laboratories and equipment. An amount of €50,000 has already be given to the department for this purpose. The laboratory equipment will be used for both undergraduate and graduate level laboratory exercises.

4.3 Financial Resources

4.3.1. It seems that there could have been better allocation of financial resources to develop the program in terms of practical lab exercises.

As we mention to our response in 4.2, there is already a plan for the development of the program in terms of practical lab exercises.

6. Doctoral programs of study

6.3., 6.7. The committee suggest increasing the number of Academics involved in the supervision of the PhD students by also extending the range of the thematic areas of research.

We have incorporated the suggestion of the evaluation committee to our program and we have established that every graduate student will have the primary advisor and a second advisor who will be involved in the supervision of the student. The second supervisor will be a member of the internal PhD committee of the student and will participate in the annual thesis committee meetings.

Note: It was felt from discussions that there is no equitable split of PhD students over all members of Academic staff. Some thematic areas are favorably represented, whilst others are not represented at all.

The number of PhD students per academic stuff depends a lot on the funding opportunities and research grants of the faculty of the department. As a result, it is possible for some periods of time, some academic stuff to have a larger number of graduate students than others. With the establishment by the Graduate School of the University of the 3-year doctoral fellowship for new comer students and the significant growth of the department in terms of faculty members (from 12 to 16) within 2019, it is expected that most thematic areas will be represented, the number of PhD students will be increased and they will be better distributed among faculty.

Final Remarks – Suggestions

- Teaching and supervision sharing between departments is encouraged, for example with Civil Engineering in the area of Solid/Computational Mechanics, and potentially Experimental Fluid Mechanics.

We agree with this suggestion, we have initiated discussions with the faculty of the civil engineering department to establish common courses on computational mechanics and experimental fluid mechanics.

- We encourage course delivery by more than one Academic member of staff.

Several courses can be taught by different faculty members on a rotation basis. Our plan is to implement such rotations.

- To the benefit of students from diverse backgrounds, it is suggested to include some formal training on technical report writing in engineering and also project planning.

The department offers an elective course on "Technical writing" under the Master and PhD programs in Advanced Materials and Nanotechnology (4 ECTS). We encourage our students to register to this course and we will continue to do so.

ANNEX I

Course Title	Advanced Engineering Thermodynamics				
Course Code	**MMK 512**				
Course Type	COMPULSORY				
Level	MASTER/PHD				
Year / Semester	SPRING SEMESTER				
Teacher's Name	STAVROS KASINOS				
ECTS	8	Lectures / week	2 X 1,5 AN HOUR	Laboratories / week	NO
Course Purpose and Objectives	The purpose of the course is the teaching of the basic principles of thermodynamics and training of the students to the solution of problems found in industry.				
Learning Outcomes	The students will be able to • perform thermodynamic analysis for the optimization of complex engineering systems, • design thermodynamic systems with the use of software and computers, • prepare professional design analysis reports, • understand the behavior and properties of non-reacting mixtures with emphasis on mixtures of ideal gases, • perform psychrometric analysis of air-conditioning systems, • understand the concepts of subsonic, sonic, supersonic and hypersonic flow and analyze simple compressible flow systems and • compute the change in thermodynamic properties across normal shock waves.				
Prerequisites	NO	Required	NO		
Course Content	The course content involves thermodynamic analysis of engineering systems, emphasizing systematic methodology for application of basic principles and the utilization of modern computational tools and optimization software. Introduction to availability analysis. Thermodynamics of ideal gas mixtures including air and water-vapour mixtures. Thermodynamics of condensed phases, including solutions. Introduction to thermodynamics of compressible flow. Specialized topics depending on the composition of the audience (e.g. thermodynamics of biological systems). The course also involves a series of laboratory exercises.				
Teaching Methodology	Lectures 3 hours per week / Tutorials or lab exercise 1 hour per week Lectures. The teaching methodology is based on the "deductive reasoning" method, which means that the theory and the applications of it are presented first in a general form and subsequently they are specialized for the particular problems.				

	There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.
Bibliography	Lecture notes W. C. Reynolds and P. Colonna Thermodynamics: fundamentals and engineering applications Cambridge University Press, 2018.
Assessment	Team design work 60%, written exam 30%, short assignments 10%
Language	GREEK OR ENGLISH

Course Title	Theory and applications of incompressible Newtonian and non-Newtonian fluids				
Course Code	**MMK 518**				
Course Type	COMPULSORY				
Level	MASTER/PHD				
Year / Semester	WINTER SEMESTER				
Teacher's Name	An academic position vacancy has been announced to meet the teaching needs of this field				
ECTS	8	Lectures / week	2 X 1,5 AN HOUR	Laboratories / week	NO
Course Purpose and Objectives	The purpose of the course is the teaching of the basic principles of incompressible fluid flows kai training of the students to the solution of problems found in industry.				
Learning Outcomes	The students will • learn the basic principles of incompressible fluid mechanics at the macroscopic and differential level, • be trained to the analytical and numerical solution of typical problems that often found in a professional career, • be able to derive the governing equations for fluid flow and pertinent boundary conditions based on the problem of interest, • find the analytical solution of the flow and • use the finite elements method to solve numerically flow problems.				
Prerequisites	NO	Required	NO		
Course Content	The course covers the basic principles of flow for Newtonian and non-Newtonian fluids as well as methods for solution of standard flow problems. The objective of the course is to cover in depth both the theory of				

	incompressible fluids and the applications in several aspects of the human activity and technology including biological flows (e.g., blood), industrial processes (plastic and food technology), flows involved in hydrocarbons mining (with the use of fluids with special properties). More specific the materials covered are: (1) Basic physical laws such as conservation of mass, linear momentum and energy for open and closed systems, (2) Application of these laws in differential form to study in detail fluid kinematics, such as flow streamlines, velocity potential, flow deformations, internal stresses, boundary conditions, etc. (3) Constitutive description of Newtonian and non-Newtonian fluids and principles of Rheology, (4) Dimensionless analysis of flow equations and in-depth discussion of important dimensionless numbers, (5) Analytical solution of flows and their applications, (6) Introduction to computational fluid mechanics and general description of basic computational methods such as a) finite differences, b) finite volumes and c) finite elements In depth study of the principles of the finite elements method and its application for the solution of linear and non-linear problems of fluid mechanics with common applications. The course also involves a series of laboratory exercises.
Teaching Methodology	Lectures 3 hours per week / Tutorials or lab exercise 1 hour per week Lectures. The teaching methodology is based on the "deductive reasoning" method, which means that the theory and the applications of it are presented first in a general form and subsequently they are specialized for the particular problems. There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.
Bibliography	A Alexandrou ,Principles of Fluid Dynamics, Prentice Hall J. N. Reddy, An Introduction to the Finite Element Method, McGraw-Hill
Assessment	Homework assignments (10%), midterm exam (30%), final exam (60%)
Language	GREEK OR ENGLISH

Course Title	Signal Processing
Course Code	**MMK 523**
Course Type	ELECTIVE
Level	MASTER/PHD

<table>
<tr><td>Year / Semester</td><td colspan="5">WINTER SEMESTER</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Andreas Kyprianou</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>2 X 1,5 AN HOUR</td><td>Laboratories / week</td><td>NO</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of the course is the teaching of signal processing in Mechanical and Manufacturing Engineering and the understanding of the basic principles of sampling, digitization, analysis of digital systems and filters focusing on real applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">• To understand the notion of sampling and its importance in experimental testing
• To understand the underlying process of quantization of transforming an analogue signal to digital
• To familiarize themselves with discrete time systems
• To develop a basic understanding of Fourier transform and z-transform
• to apply techniques of signal analysis and synthesis based on Fourier Transform and z-transform in order to understand the workings of an engineering system
• to learn how to do a systematic literature survey on signal processing theory and its applications</td></tr>
<tr><td>Prerequisites</td><td colspan="2">NO</td><td>Required</td><td colspan="2">NO</td></tr>
<tr><td>Course Content</td><td colspan="5">The course covers the following topics:
Sampling. Analogue signals. Sampling Theorem its importance and applications. Sampling of sinusoids.
Quantization. Quantization process. Oversampling. Analogue to digital converters.
Discrete time systems. Linearity. Impulse response. Filters: finite impulse response, infinite impulse response.
Finite impulse response filters and convolution. Block processing methods. Sample by sample processing methods.
z - Transforms. Properties. Convergence. Frequency spectrum.
Transfer Functions. Sinusoidal response. Design based on poles and zeros.
Digital filters. Normal form. Cascade form. Influence of quantization.
Digital Fourier Transform. Finite impulse response digital filter design.
Infinite impulse response digital filter design. First order low and high pass filters.</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">Lectures 3 hours per week / Tutorials 1 hour per week

There is continuous communication with the instructor and active participation of the students in the class.

During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.

Biweekly tutorials where the problem sets and computational assignments given for each topic are further discussed and explained.</td></tr>
</table>

Bibliography	Introduction to Signal Processing, S J Orfanidis. Rutgers University
Assessment	Tutorials (5%), computational tutorials (10%), literature survey essay (25%), midterm exam (25%), final exam (35%)
Language	GREEK OR ENGLISH

<table>
<tr><td>Course Title</td><td colspan="5">Modelling and Analysis of Dynamic Systems</td></tr>
<tr><td>Course Code</td><td colspan="5">MME 524</td></tr>
<tr><td>Course Type</td><td colspan="5">COMPULSORY</td></tr>
<tr><td>Level</td><td colspan="5">MASTER/PHD</td></tr>
<tr><td>Year / Semester</td><td colspan="5">Spring Semester</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Loucas Louca</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>2 x 1,5 hours</td><td>Laboratories / week</td><td>None</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of the course is the teaching of a unified approach for modeling real systems with mechanical, fluid and electrical components and the understanding of the basic principles of modeling multi-energy domain dynamic systems, the derivation and simulation of bond graph models and calculate the behavior of dynamic systems through time and frequency responses.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">The students will be able to:
perform systematic selection of ideal energy elements for modeling real dynamic systems,
represent, lump parameter and multi-energy, dynamic systems with appropriate bond graph models,
use causality and develop state variable differential equations describing the behavior of a dynamic system that its model is developed using bond graphs,
calculate the time response through computer simulation of a system with mechanical, fluid and electrical components,
identify the parameters of a system using the time response and the physical description of a system,
analyze the correctness of the initial modeling assumptions through analysis and
select the complexity of dynamic systems using systematic modeling methodologies such as deduction and reduction.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">No</td><td>Required</td><td colspan="2">No</td></tr>
<tr><td>Course Content</td><td colspan="5">The course is using a unified approach for abstracting real mechanical, fluid, and electrical systems into appropriate models in bond graph and state equation form to meet engineering design and control system objectives. The emphasis is not on the mechanics of deriving equations but rather on understanding how the engineering task defines the modelling objectives that determine what modelling assumptions are appropriate. The bond graph</td></tr>
</table>

	language, which is a graphical power topology of a dynamic system, is taught to help students easily represent models of multi-energy domain systems. This allows causality, as well as system analysis tools, to be used to determine the correctness of the modelling assumptions. In addition, model complexity is studied using systematic modeling methodologies (deduction and reduction). Problems in the form of homework are required to reinforce the theoretical concepts presented in the lecture. A final project on a topic of the student's research area will reinforce the concepts taught in this course. At the end of the course, students will be able to develop models of dynamic systems for a specific application and given accuracy.
Teaching Methodology	Lectures 3 hours per week / Tutorials 1 hour per week The teaching methodology includes lectures using the white/black board, demos of 20-SIM software, solving sample problems during lectures. There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.
Bibliography	Karnopp, D.C., D.L. Margolis, and R.C. Rosenberg, *System Dynamics: Modeling and Simulation of Mechatronic Systems*, 5th Edition, Wiley, 2012, ISBN 978-0470889084.
Assessment	Homework assignments (20%), individual Project (15%), midterm exam (30%), final exam (35%)
Language	GREEK OR ENGLISH

Course Title	Continuum Mechanics				
Course Code	**MMK 531**				
Course Type	COMPULSORY				
Level	MASTER/PHD				
Year / Semester	WINTER SEMESTER				
Teacher's Name	STYLIANOPOULOS TRIANTAFYLLOS				
ECTS	8	Lectures / week	2 X 1,5 HOURS	Laboratories / week	NO
Course Purpose and Objectives	The purpose of the course is the teaching of the mechanical behavior of fluids and solids under the same generalized framework, the familiarization with the methods and measures of stress and strain calculation, the familiarization with basic problems of fluid and solid mechanics and the teaching of the methodologies for solution of continuum mechanics problems.				

Learning Outcomes	The students at the end of the course will be able to • analyze the kinematics of the motion of material elements that obey to the laws of continuum mechanics, • calculate stresses and strains, • apply the conservation of mass, momentum and energy, • select the proper constitutive equations, • solve problems of fluid and solid mechanics

Prerequisites	NO	Required	NO

Course Content	The course include a brief review of the symbols and calculations among tensors and vectors and focuses on the study of (1) the kinematics of a continuum, and specifically to the calculation of stress and strain tensors and rates of deformation tensors, (2) the balance laws: conservation of mass, momentum and energy, (3) the constitutive equations for the mechanical behavior of solids, fluids and viscoelastic materials, (4) constitutive theories for ideal fluids, Newtonian fluids and linear elastic solids, (5) analytical solution of fluid and solid mechanics problems.
Teaching Methodology	Lectures 3 hours per week / Tutorials 1 hour per week Teaching is supported by academic lectures and homework exercises. The instructor does not exclusively use a single book and the lectures are based on the notes and the bibliography given below. All course material (lecture notes, exercises, etc.) are uploaded on the web site of the course in Blackboard. During the semester, additional auxiliary / reading material is posted to BlackBoard if this is necessary. There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.
Bibliography	- P. Chadwick, *Continuum Mechanics*, Dover Publications - L. E. Malvern, *Introduction to the Mechanics of a Continuous Media,* Prentice-Hall - M. E. Gurtin, *An introduction to Continuum Mechanics*, Academic Press - Y. C. Fung, *A First Course in Continuum Mechanics,* Prentice-Hall
Assessment	Homework assignments (10%), midterm exam (30%), final exam (60%)
Language	GREEK OR ENGLISH

Course Title	Manufacturing Process Automation
Course Code	**MMK 541**
Course Type	COMPULSORY
Level	MASTER/PHD

<table>
<tr><td>Year / Semester</td><td colspan="5">WINTER SEMESTER</td></tr>
<tr><td>Teacher's Name</td><td colspan="5">An academic position vacancy has been announced to meet the teaching needs of this field</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>2 X 1,5 AN HOUR</td><td>Laboratories / week</td><td>1</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of this course is to 1) extend and broaden a range of engineering skills, containing a careful blend of mechanical engineering, manufacturing, process engineering and automation, and 2) gain the advanced knowledge necessary to devise innovative solutions and systems in the broad field of manufacturing process automation.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">The students will develop a thorough understanding of the principles of modern manufacturing techniques, automation and production processes.

They will be able to identify and review appropriate manufacturing systems for different production requirements and analyse their performance. They will also be able to understand appropriate technology, quality tools and manufacturing methodology to design, re-design and continuously improve manufacturing operations.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">NO</td><td>Required</td><td colspan="2">NO</td></tr>
<tr><td>Course Content</td><td colspan="5">The course involves an in-depth study of the physical dynamics in the wider spectrum of manufacturing processes, assessing their potential for automation. The course reviews the classical background in thermodynamics, fluids and mechanics together with dynamic systems and controls, in the context of analysis and design for automation of individual manufacturing processes. It also involves modelling and control issues examined in comparative studies of metal cutting, forming, bulk deformation, joining, welding, casting, and sintering in processing of ceramic, semiconductor and composite material processing. Emphasis is given on new technologies such as rapid prototyping, microelectronics fabrication and nano-manufacturing, as well as on advanced, nonlinear, adaptive and multivariable control algorithms. Simulation tools (Matlab/Simulink) are taught to allow students assess and optimize the performance of processing systems. Research directions are explored through taxonomy of manufacturing processes, suggesting redesign for automation. Students integrate and demonstrate control of a process experiment in the laboratory, such as part inspection station, automated bottle labelling robotic cell, thermal control of welding with infrared feedback, or automated assembly with machine vision. They also undertake the complete, real-world design of an automated plant such as a bakery.</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">Lectures 3 hours per week / Tutorials or laboratory exercises 1 hour per week

Class and laboratory lectures; powder point presentations

There is continuous communication with the instructor and active participation of the students in the class.

During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.</td></tr>
</table>

Bibliography	Lecture notes; selected articles Mikell P. Groover. Automation, Production Systems, and Computer-integrated Manufacturing. ISBN: 0134605462, 9780134605463
Assessment	Midterm exam (35%), final exam (35%), homework, lab reports/presentation (30%)
Language	GREEK OR ENGLISH

<table>
<tr><td>Course Title</td><td colspan="5">Nonlinear Mechanics of Solids and Structures</td></tr>
<tr><td>Course Code</td><td colspan="5">MMK 551</td></tr>
<tr><td>Course Type</td><td colspan="5">COMPULSORY</td></tr>
<tr><td>Level</td><td colspan="5">MASTER/PHD</td></tr>
<tr><td>Year / Semester</td><td colspan="5">SPRING SEMESTER</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">VASILEIOS VAVOURAKIS</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>3 hours weekly</td><td>Laboratories / week</td><td>NO</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of this course is to cover a particular area in applied solid mechanics and biomechanics: nonlinear mechanics of solid matter using a continuum-based approach.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">Successful completion of the course will enable students
• to consolidate theoretical background in continuum solid mechanics,
• to use and evaluate the most common stress, strain and deformation measures,
• to model rubber-like materials, biological tissues, elastomers, poroelastic and viscoelastic materials, and (small/large) plastic deformations in metallic materials,
• to calibrate constitutive models using experimental data,
• to apply analytical methods for the calculation of stresses and strains in simple geometries of structures and loading conditions,
• to build nonlinear finite element models and analyze the mechanics of simple structural problems using the commercial software ABAQUS®,
• to read and understand scientific publications of nonlinear material models in applied mechanics and biomechanics.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">MMK 531</td><td colspan="2">Required</td><td>NO</td></tr>
<tr><td>Course Content</td><td colspan="5">The course briefly presents the fundamentals in continuum solid mechanics, i.e. stress/strain measures, equations of motion and equilibrium for deformable solids, while it also gives an outline to variational principles. Subsequently, the constitutive equations that describe the mechanical behavior on a wide range of elastic solids is presented: spanning from linear elastic (isotropic and anisotropic) materials to hypo- and hyperelastic, viscoelastic, and elastoplastic solids. Finally, analytical solutions to axially and spherically symmetric solutions for linear elastic and elastoplastic solids</td></tr>
</table>

	under quasi-static loading is outlined. Students will also receive specialized hands-on training on ABAQUS® to simulate and analyze nonlinear elasticity problems in applied mechanics or/and biomechanics.
Teaching Methodology	• Communicative, Collaborative • Class lectures (PowerPoint, Socrative, Screencast-o-matic), and computer-lab sessions at the School computing center • During the first week of the semester, the Syllabus of the course is given by the course tutor, which includes information on the course content, expected learning outcomes, assessment and office hours.
Bibliography	Lawrence E. Malvern. Introduction to the Mechanics of a Continuous Medium. ISBN-13: 978-0134876030 G.A. Holzapfel. Nonlinear Solid Mechanics: A Continuum Approach for Engineering. ISBN-13: 978-0471823193 Ray W. Ogden. Non-linear Elastic Deformations. ISBN-13: 978-0486696485 Yuen-Cheng Fung. Classical and Computational Solid Mechanics. ISBN-13: 978-9810241247 G.T. Mase, G.E. Mase. Continuum mechanics for engineers. ISBN-13: 978-0849388309 A.J.M. Spencer. Continuum Mechanics. ISBN-13: 978-0486435947 Vlado A. Lubarda. Elastoplasticity Theory. ISBN-13: 978-1420040784 Aleksey D. Drozdov. Finite Elasticity and Viscoelasticity: A Course in the Nonlinear Mechanics of Solids. ISBN-13: 978-9810224332
Assessment	Bi-weekly homework assignments (40% total) Course project assignment (30%) One (1) final exam (30%)
Language	GREEK OR ENGLISH

Course Title	Renewable energy technology				
Course Code	**MMK 516**				
Course Type	ELECTIVE				
Level	MASTER/PHD				
Year / Semester	WINTER SEMESTER				
Teacher's Name	DEMOKRATIS GRIGORIADES				
ECTS	8	Lectures / week	2 X 1,5 AN HOUR	Laboratories / week	NO
Course Purpose and Objectives	The purpose of the course is the understanding of renewable energy technology, the analysis and solution of pertinent problems and the analysis and design of power conversion systems.				

Learning Outcomes	The students will be able to: 1) identify different modes of energy conversion and explain the difference between conventional and renewable energy conversion mechanisms, 2) identify, classify and estimate the potential of different renewable energy resources, 3) analyse, and report and apply the curves of performance of solar, wind and hydroelectric systems and 4) design, plan and inspect renewable and hybrid power systems to meet specific power needs		
Prerequisites	NO	Required	NO
Course Content	The course content includes the energy problem and Renewable Energy Sources (RES) - Historical development of energy technologies & current status: energy sources and energy consumption (worldwide, Europe, Cyprus) - Towards a sustainable energy future - The development of renewable energy in Europe and the world - RES in Cyprus - Short and long term prospects of RES (world, Europe, Cyprus) - Methods of analysis and prolexis: Wind potential - Solar radiation - Biomass - Hydroelectric resources - Sea waves / ocean currents - Wind - Passive & Active solar systems - bioclimatic architecture - Photovoltaics - Small hydroelectric - Geothermal Energy - Hydrogen - fuel Cells		
Teaching Methodology	Lectures 3 hours per week / Tutorials or laboratory exercises 1 hour per week Teaching is supported by academic lectures, and demonstration of laboratory exercises. For a correct and complete understanding of the subject matter it is necessary to attend the lectures and laboratory exercises as well as the solution of the exercises / tasks that are assigned. The teacher does not exclusively use a single book and the lectures are based on the notes and the bibliography given below. All course material (lecture notes, exercises, laboratory exercises, etc.) are posted on the web site of the course in Blackboard. During the semester, additional auxiliary / reading material is posted to BlackBoard if this is necessary.		
Bibliography	1. Gilbert M. Masters "Renewable and Efficient Electric Power Systems", ISBN 0-471-28060-7, John Wiley & Sons, (2004). 2. Sørensen Bent, *Renewable Energy*, Second Edition, Academic Press, ISBN 0-12-656150-8, (2004). 3. Sørensen Bent et al., *Renewable Energy Focus Handbook*, Academic Press, ISBN: 978-0-12-374705-1 (2009). 4. Markvart Tomas, *Solar Electricity*, John Wiley and Sons, ISBN 047-1941-61-1, (1995). 5. Stiebler Manfred, *Wind Energy Systems for Electric Power Generation* Springer Series in Green Energy and Technology, ISBN: 978-3-540-68762-7, e-ISBN: 978-3-540-68765-8 (2008). 6. Μοσχάτος Ανδρέας Ε., *Ηλιακή ενέργεια*, έκδοση τεχνικού επιμελητηρίου Ελλάδος, ISBN 960-7018-26-5 (1992). 7. Decher Reiner, *Direct Energy Conversion: Fundamentals of Electric Power Production*, Oxford University press, ISBN-10: 0195095723 (1996). 8. Yogi D. Goswami & Frank Kreith, "Energy Conversion" (Mechanical Engineering Series), CRC Press. 9. Archie W. Culp, *Principles of Energy Conversion*, Mcgraw-Hill.		
Assessment	One midterm exam (40%), assignment & presentation (50%)		
Language	GREEK OR ENGLISH		

<table>
<tr><td>Course Title</td><td colspan="5">SOLAR ENERGY SYSTEMS</td></tr>
<tr><td>Course Code</td><td colspan="5">MMK 517</td></tr>
<tr><td>Course Type</td><td colspan="5">ELECTIVE</td></tr>
<tr><td>Level</td><td colspan="5">MASTER/PHD</td></tr>
<tr><td>Year / Semester</td><td colspan="5">WINTER SEMESTER</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">SPECIAL SCIENTIST</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>3 hours weekly</td><td>Laboratories / week</td><td>NO</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of the course is the acquisition of knowledge and techniques to analyse solar thermal systems and their characteristics. Emphasis is given on the solar characteristics of Cyprus as well as on the passive and thermal methods of exploiting solar radiation.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">• Identify, understand and estimate solar geometry and solar potential.
• Understand and estimate the operation of active and passive solar systems.
• Analyse and report the performance of solar systems.
• Suggest appropriate and feasible solar systems to meet specific needs.
• Familiarise, estimate and report the energy yield of solar installations using different calculation methods.
• Perform the financial assessment and examine the financial sustainability of solar installations.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">NO</td><td>Required</td><td colspan="2">NO</td></tr>
<tr><td>Course Content</td><td colspan="5">The course content includes lectures on the following thematic areas:
• Solar radiation (basic concepts and features, angles, direct and diffuse radiation in horizontal - inclined - moving levels, measurement of solar radiation).
• Passive and Active Solar Systems (basic concepts, typology, features and capabilities, modes of exploitation and optimization of systems).
• Thermal production of solar collector technologies (typology, thermal analysis, temperature distribution in the absorber, efficiency factor, thermal gain, flow, efficiency, performance measurement).
• Solar installations of thermal energy (calculation methods, curves f, F-f curves, storage and rate of solar energy use).
• Financial assessment and sustainability features.</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">• Lectures (3 hours per week)
• Tutorials (1 hour per week)
• Assignments / homework
• Demonstrations & visits</td></tr>
<tr><td>Bibliography</td><td colspan="5">• Lecture notes</td></tr>
</table>

	• «Συμβατικές & Ήπιες Μορφές Ενέργειας», Μπαλαράς, Αργυρίου, Καραγιάννης, 2006, Εκδόσεις Τεκδοτική, ISBN: 960-8257-23-9.
Assessment	Midterm examination (30%), homework (30%), final examination (40%)
Language	GREEK OR ENGLISH

Course Title	Biomedical and Industrial Applications of Engineering Acoustics				
Course Code	**MMK 533**				
Course Type	ELECTIVE				
Level	MASTER/PHD				
Year / Semester	WINTER SEMESTER				
Teacher's Name	MICHALIS AVERKIOU				
ECTS	8	Lectures / week	3 hours weekly	Laboratories / week	4 total per sem.
Course Purpose and Objectives	The purpose of the course is the teaching of the acoustics involved in biomedical ultrasound.				
Learning Outcomes	The students will be able to • explain the physical phenomena involved in ultrasound propagation in the body. • explain sound dissipation in fluids and tissue • know how to use function generators and oscilloscopes to digitize waveforms. • create and measure ultrasound waves. • solve graphically initial and boundary value problems of waves. • measure ambient sound with sound pressure level meters.				
Prerequisites	NO	Required	NO		
Course Content	This course is an introduction to physical acoustics for engineering and science majors. It gives the physical basis for problems found in many engineering applications including biomedical ultrasound, room acoustics, noise control and sonar. This course covers: plane waves in fluids, transient and steady-state reflection and transmission, refraction, strings and membranes, rooms, absorption and dispersion, spherical and cylindrical waves, radiation from baffled piston, and medical ultrasound arrays. The course includes laboratory sessions on ultrasound beams with usage of related equipment such as function generator, digital oscilloscope, power amplifier, and micropositioners. Sound pressure level measurements for noise control are also taken with an SPL meter				

Teaching Methodology	Lectures 3 hours per week / Tutorials or laboratory exercises 1 hour per week Weekly lectures, homework, and laboratory exercises at the Biomedical Ultrasound Laboratory of the department. There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.
Bibliography	D. T. Blackstock, Fundamentals of Physical Acoustics, Wiley-Interscience, New York, 2000.
Assessment	Homework/projects (20%), midterm exam (35%), final exam (45%)
Language	GREEK OR ENGLISH

Course Title	Medical Imaging - Diagnostic Ultrasound				
Course Code	**MMK 535**				
Course Type	ELECTIVE				
Level	MASTER/PHD				
Year / Semester	WINTER SEMESTER				
Teacher's Name	MICHALIS AVERKIOU				
ECTS	8	Lectures / week	3 hours weekly	Laboratories / week	4 total per sem.
Course Purpose and Objectives	The purpose of the course is to introduce students to diagnostic ultrasound and teach basic physical principles of ultrasound imaging. It also aims to explain imaging modalities of modern ultrasound scanners.				
Learning Outcomes	The students will be able to • explain the physical principles behind diagnostic ultrasound. • create ultrasound beams in water • perform ultrasound hydrophone measurements • read and understand ultrasound images • identify and interpret b-mode, color flow, pulsed wave Doppler, and color power angio images • measure flow velocity with the Doppler technique				
Prerequisites	NO	Required	NO		
Course Content	This course covers the basic science and physics of diagnostic ultrasound. A short introduction to the relevant acoustics needed for ultrasound imaging is given first. It includes reflection and transmission, refraction, acoustic impedance, sound beams, arrays, beamforming, ultrasound propagation				

	through tissue and blood, attenuation, scattering, and nonlinear properties of tissues. The current equipment technology is presented and explained. The following modes of imaging are covered: M-mode, B-mode, Doppler, Harmonic Imaging, and 3D imaging. Emphasis is also placed on ultrasound contrast agents and specifically imaging and quantification of tumor angiogenesis. The course includes a laboratory component that covers some of the topics above. In laboratory exercises, students use a modern diagnostic ultrasound scanner and also observe clinical examinations.
Teaching Methodology	Lectures 3 hours per week / Tutorials or laboratory exercises 1 hour per week Weekly lectures, homework, and laboratory exercises at the Biomedical Ultrasound Laboratory of the department. There is continuous communication with the instructor and active participation of the students in the class. During the first week of the semester the instructor hands in the Syllabus of the course to the students, which includes all information about the materials covered by the course, the learning outcomes, the evaluation and the office hours.
Bibliography	T. L. Szabo, Diagnostic Ultrasound Imaging – Inside Out, Elsevier
Assessment	Homework/projects (25%), midterm exam (35%), final exam (40%)
Language	GREEK OR ENGLISH