ΦΟΡΕΑΣ ΔΙΑΣΦΑΛΙΣΗΣ ΚΑΙ ΠΙΣΤΟΠΟΙΗΣΗΣ ΤΗΣ ΠΟΙΟΤΗΤΑΣ ΤΗΣ ΑΝΩΤΕΡΗΣ ΕΚΠΑΙΔΕΥΣΗΣ
THE CYPRUS AGENCY OF QUALITY ASSURANCE AND ACCREDITATION IN HIGHER EDUCATION

Doc. 300.1.2

Date: 20/06/2019

Higher Education Institution's response

- **Higher education institution:**

  University of Cyprus

- **Town:** Nicosia

- **Programme of study (Name, ECTS, duration, cycle)**

  In Greek: Μάστερ Προηγμένα Υλικά και Νανοτεχνολογία

  In English: MSc Advanced Materials and Nanotechnology

- **Language of instruction:** English

- **Programme's status**
  New programme: ....
  Currently operating: ✓

ΚΥΠΡΙΑΚΗ ΔΗΜΟΚΡΑΤΙΑ
REPUBLIC OF CYPRUS

The present document has been prepared within the framework of the authority and competencies of the Cyprus Agency of Quality Assurance and Accreditation in Higher Education, according to the provisions of the "Quality Assurance and Accreditation of Higher Education and the Establishment and Operation of an Agency on Related Matters Laws of 2015 and 2016" [N. 136 (I)/2015 and N. 47(I)/2016].

A. Guidelines on content and structure of the report

- *The Higher Education Institution (HEI) based on the External Evaluation Committee's (EEC's) evaluation report (Doc.300.1.1) must justify whether actions have been taken in improving the quality of the programme of study in each assessment area.*

- *In particular, under each assessment area, the HEI must respond on, without changing the format of the report:*

  - *the findings, strengths, areas of improvement and recommendations of the EEC*
  - *the deficiencies noted under the quality indicators (criteria)*
  - *the conclusions and final remarks noted by the EEC*

- *The HEI's response must follow below the EEC's comments, which must be copied from the external evaluation report (Doc. 300.1.1).*

- *In case of annexes, those should be attached and sent on a separate document.*

1. Study programme and study programme's design and development
(*ESG 1.1, 1.2, 1.8, 1.9*)

Response marked in blue/italic below.

Findings

1. The policy for quality assurance of the program reflects the above standards.
2. The learning outcomes are known.
3. All the information including assessment processes and methodologies are available to the students and teaching staff.
4. The master's program is typical of a program of study in other high-quality European Universities.

Thank you for the positive comments.

Strengths

1. There is a strong support by the administrative staff and the technical staff to achieve the objectives of the program study.
2. The academic staff is highly qualified and established in the international research community and is within the vision of the University of Cyprus according to research, innovation and creativity.
3. The available infrastructure (e.g., equipment) is sufficient and supports the achievements of the program.

Thank you for the positive comments.

Areas of improvement and recommendations

1. Interaction with stakeholders should be improved perhaps by increasing the interaction with the industry and other institutions abroad considering the limitation of industrial development in Cyprus.

   Efforts are under way to increase the interactions with stakeholders in Cyprus and abroad. The contacts and relations with industry and other institutions abroad are continuously being improved by signing ERASMUS agreements (for example, with the Department of Materials Science at the Montanuniversität Leoben/Austria) or collaboration agreements with industrial partners (for example, the Robert Bosch Group) for placements and/or the supervision of joint research theses.

2. The learning outcomes although known, they need to be clearly defined. The learning outcomes are not fully satisfied by the program design, specifically the learning outcomes 1 and 3 in section B of the program content, point 2. Consequently, improvement is necessary.

   The learning outcomes have been rewritten and clarified, especially outcomes 1 and 3 in section B of the program content, point 2, as requested. In addition, the new structure of the program (with compulsory courses) as well as the updated list of elective courses satisfy the learning outcomes.

Outcome 1. was changed from
"Gain a strong background in the fundamentals of the field, creativity, societal sensitivity and the independence of thought required for a successful career in Advance Materials and Nanotechnology." *to*
"Gain a strong background in the fundamentals of the field and the independence of thought required for a successful career in Advanced Materials and Nanotechnology."

Outcome 3. was changed from
"As successful Materials Scientists and Engineers, identify, describe, use and understand the basic science behind the properties of materials at the nanometre scale and the principles behind advanced experimental and computational techniques for studying advanced materials." *to*
"Identify, describe, use and understand the basic science behind the properties of materials at the nanometre scale and the principles behind advanced experimental and computational techniques for studying advanced materials."

Furthermore, the learning outcomes of all courses have been revised and can be found in the attachment "Attachment AMN MSc program response".

3. The structure of the program is too specialised for a master's program study and an improvement should be expected through the introduction of the English language as well as the new recruitment of the academic staff.

   The program of study has been revised, including the purpose and objectives, learning outcome and contents of all courses. More details can be found in the attachment "Attachment AMN MSc program response". Further improvements are expected with the introduction to the English language and as well as the new recruitment of academic staff and therefore the availability of more elective courses.

4. The structure of the program does not follow a progressive development from the fundamentals to more advanced and complex concepts with the consequence to become very challenging for students especially those with a non-engineering background. The program should be accessible to all science, technology and engineering backgrounds, in order to attract a larger number of high-quality students from abroad.

   The program of study and all courses have been revised. Five previously constrained elective courses (MME 553 - Surface Engineering, MME 554 - Characterization Techniques of Bulk and Nano-Materials, MME 557 - Polymer Nanocomposites, MME 563 - Materials Physics and MME 566 - Advanced Semiconductor Materials and Devices) are now included as compulsory courses and five new elective course have been added to the program (MME 532 - Biomaterials in Tissue Engineering and Regenerative Medicine, MME 558 - Fundamentals of Ceramics I, MME 559 - Fundamentals of Ceramics II, MME 564 - Nanomechanics and MME 564 - Physical Principles, Design and Fabrication of MEMS); for more details, see attachment "Attachment AMN MSc program response". More elective courses should be available after the recruitment of new academic staff members. Furthermore, in an effort to help students from all science, technology and engineering backgrounds to strengthen their knowledge, they are allowed to follow other courses outside the program on a voluntary basis, either within the Department of Mechanical and Manufacturing Engineering (for example, MME 452 - Introduction to Nanoscience and Nanotechnology; a new senior undergraduate course developed for *this purpose) or other departments involved in materials science and nanotechnology (for example, from the Departments of Physics or Chemistry).*

5. The choice of course is limited and is apparent that this is related to the number of available teaching staff. Recruitment of new academic staff should improve the situation.

   Five (5) new elective courses have already been added to the program (MME 532 - Biomaterials in Tissue Engineering and Regenerative Medicine, MME 558 - Fundamentals of Ceramics I, MME 559 - Fundamentals of Ceramics II, MME 564 - Nanomechanics and MME 565 - Physical Principles, Design and Fabrication of MEMS), and more elective courses should be available after the recruitment of new academic staff members.

6. Although the labs are currently located in different areas within the University, it is expected that the relocation of the labs to the new building in the new University Campus will improve significantly the integration of the program in the context of the Department of Mechanical Engineering and the research activities.

   The with the program associated labs will be relocated to the new facilities of the Department of Mechanical and Manufacturing Engineering (together with the other departments in the School of Engineering) within 2020.

Quality indicators/criteria

Response below for quality indicators/criteria with scores of "5 or 6: Partially compliant".

1.7	The purpose and objectives of the program and the learning outcomes are utilized as a guide for the design of the program of study.	5

The purpose and the objectives of the program and the learning outcomes 1 and 3 in section B of the program content have been rewritten.

The 1. Program's purpose and objectives was changed from

"The Department of Mechanical and Manufacturing Engineering is one of the four departments in the newly established Faculty of Engineering at the University of Cyprus. The first undergraduate students were accepted in September 2003, while the graduate program started in January 2005.

The Department of Mechanical and Manufacturing Engineering offers a high-quality graduate program both at the Master and Ph.D. level. This program emphasizes fundamental principles that prepare students for leadership roles in a challenging and rapidly changing technological world. Research and innovation are encouraged in an environment that fosters cooperation among faculty, students, industry and research organizations. The faculty in the Department of Mechanical and Manufacturing Engineering is comprised of experienced and distinguished academicians with expertise in a wide range of research fields pertinent to Mechanical and Manufacturing Engineering and Materials Science and Engineering.

The objective of the Ph.D. program is to train young scientists with up-to-date knowledge and techniques in the fast growing (and of particular importance for the society) field of Advanced Materials and Nanotechnology. The students are specialized in one of the research areas of the program with the aim to create proper conditions for a successful professional career in the public or private sector, in industry or in research organizations."

to

"The program of study is structured to offer students a comprehensive education in Materials Science and Engineering and equip them for successful careers in the fields of Advanced Materials and Nanotechnology. The courses, taught by renowned faculty members with backgrounds in materials science, chemistry, physics and electrical, mechanical and manufacturing engineering, are designed to not only teach fundamentals but also to prepare students to apply modern day approaches to materials problems, in order to enable them to synthesise improved materials in response to challenges in the areas of energy, the environment and manufacturing. Collaborating with industry, the government and other departments and institutions, the research contributes to a broad range of fields and allows the exploration of relationships between processing, structure and properties in all classes of materials, including metals, ceramics, polymers, electronic and biomaterials.

The curriculum consists of a carefully selected set of compulsory courses, accompanied by elective courses, enabling the students to excel in a sub-discipline of their choice. Having access to state-of-the-art processing, characterisation, analytical and computational facilities, the students have all tools available to embark into high-impact research through discussions with their advisors and tackle some of the world's biggest problems, including energy and health.

The overall objective of this program is to train young scientists with up-to-date knowledge and techniques in the fast growing (and of particular importance for the society) fields of Advanced Materials and Nanotechnology. Students are specialized in one of the research areas of the program with the aim to create the best possible conditions for successful professional careers in the public or private sector, in industry or in research organizations."

Outcome 1. was changed from
"Gain a strong background in the fundamentals of the field, creativity, societal sensitivity and the independence of thought required for a successful career in Advance Materials and Nanotechnology." *to*

"Gain a strong background in the fundamentals of the field and the independence of thought required for a successful career in Advanced Materials and Nanotechnology."

Outcome 3. was changed from
"As successful Materials Scientists and Engineers, identify, describe, use and understand the basic science behind the properties of materials at the nanometre scale and the principles behind advanced experimental and computational techniques for studying advanced materials." *to*

"Identify, describe, use and understand the basic science behind the properties of materials at the nanometre scale and the principles behind advanced experimental and computational techniques for studying advanced materials."

Furthermore, the course purpose, objectives and learning outcomes of all courses, including new learning courses (see below) have been revised and can be found in the attachment "Attachment AMN MSc program response".

1.8 The following ensure the achievement of the program's purpose, objectives and the learning outcomes:

1.8.1 The number of courses 5

Five (5) new elective courses have already been added to the program (MME 532 - Biomaterials in Tissue Engineering and Regenerative Medicine, MME 558 - Fundamentals of Ceramics I, MME 559 - Fundamentals of Ceramics II, MME 564 - Nanomechanics and MME 565 - Physical Principles, Design and Fabrication of MEMS), and more elective courses should be available after the recruitment of new academic staff members. Furthermore, to strengthen their knowledge, students can also follow other courses outside the program on a voluntary basis, either within the Department of Mechanical and Manufacturing Engineering (for example, MME 452 - Introduction to Nanoscience and Nanotechnology; a new course developed for this purpose) or other departments involved in materials science and nanotechnology (for example, PHY 651 - Ultrashort Laser Pulse Phenomena, PHY 654 - Ultrafast Spectroscopy of Semiconductors and Semiconductor Nanostructures or PHY 656 - Modern Topics in Theoretical Condensed Matter Physics from the Department of Physics; CHE 650 - Computational Chemistry, CHE 681 - Biochemical Engineering or CHE 720 - Synthesis and Characterization Methods of Inorganic Compounds from the Department of Chemistry).

1.16 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. 5

The program of study has been revised, including the purpose and objectives, learning outcome and contents of all courses. Five previously constrained elective courses (MME 553 - Surface Engineering, MME 554 - Characterization Techniques of Bulk and Nano-Materials, MME 557 - Polymer Nanocomposites, MME 563 - Materials Physics and MME 566 - Advanced Semiconductor Materials and Devices) are now included as compulsory courses and five new elective course have been added to the program (MME 532 - Biomaterials in Tissue Engineering and Regenerative Medicine, MME 558 - Fundamentals of Ceramics I, MME 559 - Fundamentals of Ceramics II, MME 564 - Nanomechanics and MME 564 - Physical Principles, Design and Fabrication of MEMS); for more details, see attachment "Attachment AMN MSc program response". More elective courses should be available after the recruitment of new academic staff members. Furthermore, in an effort to help students from all science, technology and engineering backgrounds to strengthen their knowledge, they are allowed to follow other courses outside the program on a voluntary basis, either within the Department of Mechanical and Manufacturing Engineering (for example, MME 452 - Introduction to

Nanoscience and Nanotechnology; a new senior undergraduate course developed for this purpose) or other departments involved in materials science and nanotechnology (for example, from the Departments of Physics or Chemistry).

2. Teaching, learning and student assessment (*ESG 1.3*)

Response marked in blue/italic below.

Findings

The teaching methods and the teaching staff satisfy the above standards.

Thank you for the positive comments.

Strengths

1. The communication and interaction among the students, the academic and support staff are of a high quality.
2. Research and teaching are strongly interrelated.
3. The methodology followed is of a high quality.

Thank you for the positive comments.

Areas of improvement and recommendations

1. Despite the low number of students can be positive for constructive teaching, it is also a limitation in terms of course viability. A manageable number of students (ca 10) would benefit the viability as well as meet the international standards for this type of programs.

Various measurements have already been taken to increase the numbers of students. These include: (a) Program language changed to English; (b) announcements of the program on the University of Cyprus website, Facebook, LinkedIn, etc.; (c) organisation of research days for undergraduate students of other departments (for example, Chemistry, Physics, etc.); (d) promotion of research activities in Cyprus through the media (newspapers, etc.); (e) promotion of the ERASMUS program for graduate student exchange; and (f) sending out marketing emails to students, universities and industry. With these activities, it is expected that the number of incoming students will strongly increase in the coming years.

Quality indicators/criteria

Response below for quality indicators/criteria with scores of "5 or 6: Partially compliant".

2.2	The number of students in each class compares positively to the current international standards and/or practices.	5

As mentioned above in the response to "Areas of improvement and recommendations", various measurements are under way to increase the overall number of students. Through these actions, it is expected that the number of incoming students will strongly rise in the coming years.

3. Teaching Staff (*ESG 1.5*)

Response marked in blue/italic below.

Findings

Concerning the teaching staff, the standards above are fully compliant, including recruiting criteria, scientific background and research skills. The teaching staff is permanent, and it can support the program of study in the present form.

Thank you for the positive comments.

Strengths

The academic staff (teaching and research staff including coordinator of the program) are highly qualified and produce very high quality of research which is published in internationally recognised high impact factor journals.

Thank you for the positive comments.

Areas of improvement and recommendations

Considering that the number of academic staff and students is relatively small, it would be beneficial for the program to have these numbers increased and keep the ratio of student to staff at least 2:1.The ratio of student to staff number should be optimised so that the quality of the delivery of the program is not compromised.

The number of students is currently relatively low. However, various measurements are under way to increase the overall number of students (see comments above under 2. Teaching, learning and student assessment) and also the number of teaching staff.

Quality indicators/criteria

No quality indicators/criteria with scores below "7 or 8: Substantially compliant".

4. **Students** (*ESG 1.4, 1.6, 1.7*)

Response marked in blue/italic below.

Findings
The processes that concern students fulfil all the above standards.

Thank you for the positive comments.

Strengths
All processes and mechanisms are in place to help with the successful delivery of the program.

Thank you for the positive comments.

Areas of improvement and recommendations
The activity related to exchange of students requires some time in order to be fairly assessed. The program encourages students exchange via the Erasmus student exchange scheme and it is expected that with the introduction of English language, the scheme will be enhanced and will give further opportunities to students to experience different research environments.

Efforts are being made to encourage students to take part in the exchange schemes. For example, several ERASMUS agreements have been/are in progress to be signed with European collaborators, including the Department of Materials Science at the Montanuniversität Leoben (Austria).

Quality indicators/criteria

No quality indicators/criteria with scores below "7 or 8: Substantially compliant".

5. Resources (*ESG 1.6*)

Response marked in blue below.

Findings

The above standards are fulfilled by the program of study.

Thank you for the positive comments.

Strengths

1. The new lab facilities support effectively the delivery of a high-quality education
2. The state-of-the art library is a significant factor for the successful performance of the students in the program.

Thank you for the positive comments.

Areas of improvement and recommendations

Transport within and outside the campus is not adequate and improvements are recommended.

The current transport within the different university locations/campuses is indeed not adequate. Plans are under way to improve the transport until relocation to the new facilities of the Department of Mechanical and Manufacturing Engineering takes place within 2020.

Quality indicators/criteria

No quality indicators/criteria with scores below "7 or 8: Substantially compliant".

6. Additional for distance learning programmes *(ALL ESG)*

Not applicable (N/A).

7. Additional for doctoral programmes *(ALL ESG)*

Not applicable (N/A).

8. Additional for joint programmes *(ALL ESG)*

Not applicable (N/A).

B. Conclusions and final remarks

Response marked in blue/italic below.

Findings

- The master's program is typical of a program of study in other high-quality European Universities.
- The policy for quality assurance, the teaching methods and the teaching staff of the program, the processes that concern requirements and criteria for students fulfil all the required standards provided in this form.
- The learning outcomes are in place, but they require improvement.
- All the information including assessment processes and methodologies are available to the students and teaching staff.
- The teaching staff is permanent, and it can support the program of study in the present form.

Thank you for the positive comments.

Strengths

- There is a strong support by the administrative staff and the technical staff to achieve the objectives of the program study.
- The academic staff is highly qualified and established in the international research community and is within the vision of the University of Cyprus according to research, innovation and creativity.
- The available infrastructure (e.g., equipment) is sufficient and supports the achievements of the program.
- The communication and interaction among the students, the academic and support staff are of a high quality.
- Research and teaching are strongly interrelated.
- The methodology followed is of a high quality.
- The academic staff (teaching and research staff including the coordinator of the program) are highly qualified and produce very high quality of research which is published in internationally recognized high impact factor journals.
- All processes and mechanisms are in place to help with the successful delivery of the program.
- The new lab facilities support effectively the delivery of a high-quality research.
- The state-of-the art library is a significant factor for the successful performance of the students in the program.

Thank you for the positive comments.

Areas of improvement and recommendations

- The structure of the program is too specialised for a master's program study and an improvement should be expected through the introduction of the English language as well as the new recruitment of the academic staff.

  The program of study has been revised, including the purpose and objectives, learning outcome and contents of all courses. Further improvements are expected with the introduction to the English language and as well as the new recruitment of academic staff and therefore the introduction of more elective courses.

- The structure of the program does not follow a progressive development from the fundamentals to more advanced and complex concepts with the consequence to become very challenging for students especially those with a non-engineering background. The program should be accessible to all science, technology and engineering backgrounds, in order to attract a larger number of high-quality students from abroad.

  The program of study and all courses have been revised. Five previously constrained elective courses are now included as compulsory courses and four new elective course have been added to the program; more elective courses should be available after the recruitment of new academic staff members. Furthermore, in an effort to help students from all science, technology and engineering backgrounds to strengthen their knowledge, they are allowed to follow other courses outside the program on a voluntary basis, either within the Department of Mechanical and Manufacturing Engineering or other departments involved in materials science and nanotechnology (for example, from the Departments of Physics or Chemistry).

- The choice of courses is limited and is apparent that this is related to the number of available teaching staff. Recruitment of new academic staff should improve the situation.

  New elective courses have been added to the program, and more courses should be available after the recruitment of new academic staff members.

- The ratio of student to staff number should be optimized so that the quality of the delivery of the program is not compromised. A recommendation could be to achieve a ratio of 2:1 so that the design of the program (number of courses offered) is of a high quality.

  Measurements are under way to increase the overall number of students (through advertisements, etc.) and also the number of teaching staff and faculty members to achieve a ratio of 2:1 so that the number of courses offered stays of high quality. The introduction of the English language should also help to increase the number of students, since high quality students can be attracted to the program.

- Despite the low number of students can be positive for constructive teaching, it is also a limitation in terms of course viability. A manageable number of students (ca 10) would benefit the viability as well as meet the international standards for this type of programs.

  Various steps have been taken to increase the numbers of students, such as announcements of the program on websites, organisation of research days and promotion of research activities in Cyprus and abroad.

- The learning outcomes although known, they need to be clearly defined.

  The learning outcomes of all courses have been revised.

- The learning outcomes are not fully satisfied by the program design, specifically the learning outcomes 1 and 3 in section B of the program content, point 2. Consequently, improvement is necessary.

  The learning outcomes 1 and 3 have been rewritten. In addition, the new structure of the program (with compulsory courses) as well as the updated list of elective courses satisfy the learning outcomes.

- The activity related to exchange of students requires some time in order to be fairly assessed. The program encourages students exchange via the Erasmus student exchange scheme and it is expected that with the introduction of English language, the scheme will be enhanced and will give further opportunities to students to experience different research environments.

  Efforts are being made to encourage students to take part in exchange schemes. For example, ERASMUS agreements have been signed with different European collaborators.

- Although the labs are currently located in different areas within the University, it is expected that the relocation of the labs to the new building in the new University Campus will improve significantly the integration of the program in the context of the Department of Mechanical Engineering and its research activities.

  The in 2020 planned relocation of the labs is expected to have a catalytic effect on the program and its research activities and will help to create additional synergies with other at the main campus located departments (for example, Chemistry and Physics).

- Interaction with stakeholders should be improved perhaps by increasing the interaction with the industry and other institutions abroad, considering the limited industrial activities in Cyprus.

  The contacts and relations with industry and other institutions abroad are continuously being improved by signing ERASMUS agreements (for example, with the Department of Materials Science at the Montanuniversität Leoben/Austria) or collaboration agreements with industrial partners (for example, the Robert Bosch Group) for placements and/or the supervision of joint research theses.

- Transport within and outside the campus is not adequate and improvements are recommended.

  Plans are under way to improve the transport until relocation to the new facilities of the Department of Mechanical and Manufacturing Engineering takes place within 2020.

  More detailed answers to the above points can be found in the previous sections and in the "Attachment AMN MSc program response".

Overall assessment

Overall the master's in Advanced Materials and Nanotechnology is a highly promising postgraduate program. There is scope for improvement, however in its present form fulfils European standards and it is already comparable to similar programs in other European established universities. The academic staff (teaching and research) is of a very high quality and they have put in place an ambitious program that will contribute to the development of the local community and the society at large in Cyprus. The program will be also, a very good example and will serve as an ambassador of the research capabilities of Cyprus in Europe. This will have eventually as a result the growth of the program in the future and the establishment of significant research and teaching collaborations with important research institutions worldwide.

Thank you for the overall very positive assessment.

C. Higher Education Institution academic representatives

Name	Position	Signature
Claus Rebholz	Assoc Prof. Coordinator of AMN Program	
Theodora Kyratsi	Assoc Prof. Chair of the MME Department	

Date: 21/6/19

B. PROGRAM'S CONTENT

The content has been revised. *Changes are marked in blue/italic below.*

1. Program's purpose and objectives:

The program of study is structured to offer students a comprehensive education in Materials Science and Engineering and equip them for successful careers in the fields of Advanced Materials and Nanotechnology. The courses, taught by renowned faculty members with backgrounds in materials science, chemistry, physics and electrical, mechanical and manufacturing engineering, are designed to not only teach fundamentals but also to prepare students to apply modern day approaches to materials problems, in order to enable them to synthesise improved materials in response to challenges in the areas of energy, the environment and manufacturing. Collaborating with industry, the government and other departments and institutions, the research contributes to a broad range of fields and allows the exploration of relationships between processing, structure and properties in all classes of materials, including metals, ceramics, polymers, electronic and biomaterials.

The curriculum consists of a carefully selected set of compulsory courses, accompanied by elective courses, enabling the students to excel in a sub-discipline of their choice. Having access to state-of-the-art processing, characterisation, analytical and computational facilities, the students have all tools available to embark into high-impact research through discussions with their advisors and tackle some of the world's biggest problems, including energy and health.

The overall objective of this program is to train young scientists with up-to-date knowledge and techniques in the fast growing (and of particular importance for the society) fields of Advanced Materials and Nanotechnology. Students are specialized in one of the research areas of the program with the aim to create the best possible conditions for successful professional careers in the public or private sector, in industry or in research organizations.

2. Intended learning outcomes:

The program is designed to produce highly qualified graduates who

1. *Gain a strong background in the fundamentals of the field and the independence of thought required for a successful career in Advanced Materials and Nanotechnology.*
2. Obtain self-motivation and self-evaluation skills to acquire more knowledge in their area of specialization during their future professional careers.
3. *Identify, describe, use and understand the basic science behind the properties of materials at the nanometre scale and the principles behind advanced experimental and computational techniques for studying advanced materials.*
4. Systematically solve scientific problems related specifically to advanced and nanotechnological materials using conventional scientific and mathematical notation.
5. Integrate new knowledge in their background to design, propose and compose new products and services.
6. Apply their acquired knowledge and skills to a research project in the area of their specialization.
7. *Communicate clearly, precisely and effectively using conventional scientific language.*

E. TABLE 1: STRUCTURE OF THE PROGRAM OF STUDY

The program of study has been revised. *Changes are marked in blue/italic in the tables below*. Five previously constrained elective courses (MME 553, MME 554, MME 557, MME 563 and MME 566) are now included as compulsory courses and five new elective course have been added to the program (MME 532, MME 558, MME 559, MME 564 and MME 564); more elective courses should be available after the recruitment of new academic staff members. Furthermore, in an effort to help students from all science, technology and engineering backgrounds to strengthen their knowledge, they are allowed to follow other courses outside the program on a voluntary basis, either within the Department of Mechanical and Manufacturing Engineering (for example, MME 452 - Introduction to Nanoscience and Nanotechnology; a new course developed for this purpose) or other departments involved in materials science and nanotechnology (for example, from the Department of Physics or the Department of Chemistry).

PROGRAM REQUIREMENTS	ECTS
Compulsory courses	*44*
Elective courses (from MME or other departments)	*16*
Postgraduate Assignment	60
Practical training	0
Total ECTS	**120**

COMPULSARY COURSES
MME 507 – Technical Writing and Speaking
MME 553 – Surface Engineering
MME 554 – Characterization Techniques of Bulk and Nano-Materials
MME 557 – Polymer Nanocomposites
MME 563 – Materials Physics
MME 566 – Advanced Semiconductor Materials and Nanodevices

ELECTIVE COURSES
MME 532 – Biomaterials in Tissue Engineering and Regenerative Medicine
MME 539 – Nonlinear Mechanics & Modelling of Solids
MME 555 – Polymers in Medical Applications
MME 558 – Fundamentals of Ceramics I
MME 559 – Fundamentals of Ceramics II
MME 562 – Semiconductor Processing Technology
MME 564 – Nanomechanics
MME 565 – Physical Principles, Design and Fabrication of MEMS
MME 567 – Materials for Energy Production, Storage and Conversion

ANNEX 2 – COURSE DESCRIPTIONS

COMPULSARY COURSES
MME 507 – Technical Writing and Speaking
MME 553 – Surface Engineering
MME 554 – Characterization Techniques of Bulk and Nano-Materials
MME 557 – Polymer Nanocomposites
MME 563 – Materials Physics
MME 566 – Advanced Semiconductor Materials and Nanodevices

Course Title	**Technical Speaking and Writing**				
Course Code	**MME507**				
Course Type	**Compulsory**				
Level	Graduate				
Year / Semester	2nd Year / Fall Semester				
Teacher's Name	MME Faculty and Visitors				
ECTS	4	Lectures / week	2 hours	Laboratories / week	
Course Purpose and Objectives	The purpose of this course is to (a) ease students into confident and competent communication of their research to a live audience, and (b) achieve and improve their skills in writing of scientific publications and proposals.				
Learning Outcomes	• Acquire a foundation in public speaking and in professional and technical writing. • Create confidence in speaking ability through practice in class and rehearsals in individual tutorials. • Widen the language and skills needed for effective and clear communication of research projects. • Develop competence in preparing and presenting documents. • Achieve and improve skills in writing of scientific publications and proposals, therefore increasing the success rate.				

	• Develop the language and skills needed for effective and clear communication of technical, scientific and professional information in academia and industry.		
Prerequisites	NO	Required	NO
Course Content	This course covers the principles and processes of speaking and writing effectively through intense instructions in oral and written communication. In the first part of the course, the language and skills needed for effective and clear communication will be developed and instructions in the design and preparation of scientific talks and posters will be given. The second part focuses on the preparation of scientific publications and proposals, the art of scientific writing, the preparation of figures and tables, correct citations, the selection of suitable journals, the submission of manuscripts and proposals and the reviewing and publication process.		
Teaching Methodology	Class lectures; power point presentations; practical speaking/writing sessions 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	• Claus Ascheron, Angela Kickuth, *Make Your Mark in Science: Creativity, Presenting, Publishing, and Patents, a Guide for Young Scientists*, John Wiley, 2004. ISBN: 978-0-471-65733-0 • Mike Ashby, *How to Write a Paper*, University of Cambridge, Cambridge, 6th ed., 2005. http://www-mech.eng.cam.ac.uk/mmd/ashby-paper-V6.pdf • Raymond Boxman, Edith Boxman, *Communicating Science - A Practical Guide for Engineers and Physical Scientists*, World Scientific, 2017. ISBN: 9789813144224 • Lecture notes; selected articles		
Assessment	Presentations (50%), written assignments (50%)		
Language	English		

Course Title	**Surface Engineering**
Course Code	**MME553**

<table>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">Graduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">Fall Semester</td></tr>
<tr><td>Teacher's Name</td><td colspan="5">Claus Rebholz</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>2X1.5 hrs</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 (a) cover practical surface treatments and deposition of thin films and functional coatings for multiple applications, and (b) support students when faced with a multitude of options to select and specify a treatment to engineer the surface of a component.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">
Develop the fundamental knowledge of physical processes and interactions in materials and surfaces that affect the performance of engineering systems.
Understand the significance of engineered surfaces in materials technology.
Discuss and understand how coating technologies are embedded within all engineering disciplines.
Recognise various surface coating technologies and their applications.
Describe standard methods of testing of modified surfaces.
Understand the role that surfaces play in materials behaviour of thin film and coating systems.
Review concepts of surface engineering for multiple applications and how it may be used to optimise industrial component performance.
</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 surface treatments and deposition of thin films and functional coatings for multiple applications such as mechanical, biomedical, catalytic, etc. using a large variety of methods. The processes involved range from traditional, well established techniques (e.g. painting, electroplating and galvanising), to more technologically demanding coating technologies and surface treatments (e.g. physical and chemical vapour deposition, ion implantation and laser treatment) which have benefited from recent innovations. Integrating both theory with lab practice in this course ensures a greater understanding and appreciation of the concepts for application.</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">Class and laboratory lectures; power point presentations
Communicative, Collaborative</td></tr>
</table>

	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	• P.A Dearnley, *Introduction to Surface Engineering*, 2017. ISBN-13: 978-0521401685 • Michel Cartier, *Handbook of Surface Treatments and Coatings*, 2003. ISBN: 0791801950 • *Surface Engineering* (ASM Handbook, Vol 5), 1994. ISBN: 087170384X • Milton Ohring. *Materials Science of Thin Films*, 1991. ISBN: 0125249756 • Lecture notes; selected articles
Assessment	Midterm exam (35%), final exam (35%), homework, lab reports/presentation (30%)
Language	English

Course Title	**Characterization Techniques of Bulk and Nano-Materials**				
Course Code	**MME554**				
Course Type	**Compulsory**				
Level	Graduate				
Year / Semester	Spring Semester				
Teacher's Name	Theodora Kyratsi				
ECTS	8	Lectures / week	2x1.5 hrs	Laboratories / week	1
Course Purpose and Objectives	To understand the principles, methodology, limitations and possible applications of a wide range of characterization.				
Learning Outcomes	The students will be able to: 1. Describe methodology-capabilities-limitations of typical measurements techniques for structural characterization (Powder X-Ray Diffraction, Elemental Analysis) and their application at single/multiphase materials and macro- and nano-scale.				

	2. Analyze Powder X-ray Diffraction patterns based on available databases; identification; multiphase materials; qualitative and quantitative analysis; size strain. 3. Describe methodology-capabilities-limitations of microscopy techniques (Optical Microscopy, Scanning Electron Microscopy, and Scanning Probe Microscopy) and their application at single/multiphase materials and macro- and nano-scale. 4. Run typical experiments on Powder X Ray Diffraction, Scanning Electron Microscope, Elemental Analysis via Energy Dispersive Spectroscopy and Thermal Analysis. 5. Describe methodology-capabilities-limitations of spectroscopic characterization techniques (Vibrational, Visible and Ultraviolet, Nuclear Magnetic Resonance, Electron Spin Resonance, X-ray, Electron spectroscopies etc) and their application at single/multiphase materials and macro- and nano-scale. 6. Decide/Select/Combine various complementary techniques depending on case studies.		
Prerequisites	NO	Required	NO
Course Content	The course is designed to develop an understanding of materials characterization techniques used in materials science and engineering. Diffraction techniques: X-ray, electron and neutron diffraction. Microscopic techniques: Electron, Atomic Force Microscopy. Spectroscopic techniques: Vibrational, Visible and Ultraviolet, Nuclear Magnetic Resonance, Electron Spin Resonance, X-ray, Electron spectroscopies. Other techniques: thermal, electrical, mechanical, magnetic characterization. The course includes demonstrations and/or lab experiments: • Powder X-Ray Diffraction • Scanning Electron Microscopy • Elemental Analysis via Energy Dispersive Spectroscopy • Thermal Analysis		
Teaching Methodology	Lectures, ppt presentations, labs 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	• Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Prof. Yang Leng, Wiley, 2013, Online ISBN: 9783527670772 • Materials Characterization Techniques, Sam Zhang, Lin Li, Ashok Kumar, CRC Press, 2008, ISBN: 9781420042948		

	• ASM handbook / prepared under the direction of the ASM International Handbook Committee, Vol 10 Materials Characterization, 1991, ISBN: 978-0-87170-016-2 • Elements of X-ray diffraction / B.D. Cullity, S.R. Stock, 2001, ISBN: 978-0201610918 • Selected articles
Assessment	Midterm exam (25%), final exam (40%), presentation (25%), lab (10%)
Language	English

Course Title	**Polymer Nanocomposites**		
Course Code	**MME557**		
Course Type	**Compulsory**		
Level	Graduate		
Year / Semester	Fall semester (offered every 2nd year)		
Teacher's Name	Theodora Krasia		
ECTS	8	Lectures / week	1x3 hrs (including 6 hrs laboratory experiments/demonstrations per semester)
Course Purpose and Objectives	The Polymer Nanocomposites postgraduate course, aims in enriching the knowledge and expertise of postgraduate students on the synthesis, characterization and applications of polymer-based nanocomposites.		
Learning Outcomes	• Discuss on the basics on polymers. • Recognise the advantages and disadvantages of nanoparticle inclusion into polymers and discuss on the use of different nanoparticulates as additives in polymer nanocomposites. • Acquire knowledge on various synthetic approaches employed in the preparation of polymer-based nanocomposites; Gain hands-on experience in related synthetic processes. • Describe and discuss on the basic principles of various methods used in the characterization of polymer nanocomposites. Use UV-Vis and FTIR for characterizing polymer nanocomposites and get familiar with the mechanical testing system and the SEM *via* lab demos. • Recognise the broadness in the use of polymer nanocomposites in various fields. **General learning outcomes:**		

	• Develop presentation skills through oral presentations in class. • Retrieve and analyse scientific manuscripts on the topic. • Learn to work in small groups in the lab and prepare lab reports.		
Prerequisites	NO	Required	NO
Course Content	**Lectures (in the form of ppt. presentations)** • Introduction to polymers • Introduction in polymer nanostructured materials - Overview of different types of nanoparticles introduced within polymer matrices • Synthetic methods towards the fabrication of polymer-based nanocomposites • Polymer nanocomposites characterization techniques • Applications of polymer-based nanocomposites **Laboratory experiments/demonstrations** • Synthesis of polymer-coated metallic nanoparticles • Fabrication of magnetic electrospun polymer nanocomposite fibers • Fabrication of polymer/carbon fiber composites by 3D printing • Materials characterization: Mechanical testing, microscopy, UV-vis, FTIR.		
Teaching Methodology	- Lectures (in the form of ppt. presentations) - Use of audio and video tools - Laboratory experiments/demonstrations - Presentations by students 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	• Polymer Nanocomposites: Processing, Characterization, and Applications, Joseph H. Koo, **ISBN:** 9780071458214 (2006) • Scientific manuscripts and review papers • Course handouts		
Assessment	• Quiz: 15% (introductory lecture) • Final examination: 50% • Group presentations/round table discussions: 15% • Laboratory group reports: 20%		
Language	English		

Course Title	**Materials Physics**				
Course Code	**MME563**				
Course Type	**Compulsory**				
Level	Graduate				
Year / Semester	Fall Semester				
Teacher's Name	Ioannis Giapintzakis				
ECTS	8	Lectures / week	2 x 1.5 h	Laboratories / week	--
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. The course places emphasis on the understanding of phenomena and calculation of physical quantities related to electrical, thermal, magnetic and dielectric properties of solids.				
Learning Outcomes	• Describe the different types of atomic structure and chemical bonding and correlate them with the physical properties of solids • Calculate cohesive energy, equilibrium lattice constants, reciprocal lattice space and structure factor for different atomic structures of solids • Describe the physical mechanisms and calculate heat capacity, thermal expansion and thermal conductivity in insulators • Explain the differences between the Jellium model and the nearly free electron approximation and use the two models to describe/calculate physical properties such as specific heat, electrical and thermal conductivity in metals • Discuss and sketch the electronic band structure of crystalline solids • Explain the physical mechanisms of paramagnetism, diamagnetism, ferromagnetism and antiferromagnetism • Describe the fundamental phenomena and basic theory of superconductivity • Describe the absorption of electromagnetic radiation in solids				
Prerequisites	NO	Required	NO		
Course Content	Crystal lattice and symmetry; Bonds and structure; Defects; Phonons; Heat capacity in insulators; Thermal expansion; Phonon thermal conductivity; Jellium model; Fermi statistics; Specific heat in metals; Nearly free electron approximation; Density of electronic states; Electronic band structure; Effective mass; Electrical conductivity in metals; Wiedemann-Franz law; Thermoelectric phenomena;				

	Superconductivity (Fundamental phenomena); BCS theory; Dielectric properties; Paramagnetism; Diamagnetism; Ferromagnetism; Antiferromagnetism.
Teaching Methodology	Lectures; Homework exercises; Reports and Presentations by students on selected current topics of materials physics 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	Charles Kittel, *Introduction to Solid State Physics*, 8th Edition; H. Ibach & H. Lüth, *Solid-State Physics*, 3rd Edition, Springer-Verlag, Berlin (2003)
Assessment	Homework exercises (15%); report/presentation (15%); Midterm Exam (35%); Final Exam (35%)
Language	English

Course Title	**Advanced Semiconductor Materials and Devices**				
Course Code	**MME566**				
Course Type	**Compulsory**				
Level	Graduate				
Year / Semester	Fall Semester				
Teacher's Name	Matthew Zervos				
ECTS	8	Lectures / week	2x1.5 hrs	Laboratories / week	--
Course Purpose and Objectives	The objectives of this course is to provide an in-depth overview of semiconductor physics and devices in order to bring all students to the same level and then introduce them to state of the art low dimensional semiconductors with emphasis on materials used in solar cells. The purpose of this course is to provide to MSc students on Advanced Materials and Nanotechnology a solid scientific background on semiconductor materials and devices related primarily to energy conversion e.g. solar, thermoelectric.				

Learning Outcomes	Upon successful completion of the course, students will 1. Have fundamental knowledge on semiconductors 2. Acquire in-depth knowledge of the p-n junction in equilibrium 3. Understand the workings of a p-n junction under an applied electric field. 4. Understand p-n junction solar cells. 5. Know how to derive the 3D, 2D and 1D Density of States 6. Understand how dimensionality affects the properties of semiconductors 7. Understand how low dimensional semiconductors and devices are grown and fabricated. 8. Know the state of the art semiconductors used in solar cells, their properties advantages and disadvantages.		
Prerequisites	NO	Required	NO
Course Content	Si, Ge III-V semiconductors; intrinsic, n-type and p-type; Carrier transport, Hall effect, resistivity, conductivity, mobility, photoconductivity, The infinite quantum well; derivation of 3D DOS, Fermi Dirac statistics, carrier concentration, law of mass action. Temperature dependence of carrier density and mobility, scattering mechanisms. Energy band diagrams and Fermi level, temperature dependence of Fermi level. The p-n junction in equilibrium , under forward and reverse bias in the dark; The p-n junction as photovoltaic device, open circuit voltage, short circuit current, efficiency, fill factor. Derivation of 2D, 1D, 0D DOS, quantum wells, wires and dots. Bottom-up versus top down growth. Nanowires, Quantum dots, bandgap tuning and absorption application to solar cells.		
Teaching Methodology	Lectures 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	S.M. Sze, Semiconductor Devices: Physics and Technology, 2002 B.G. Streetman and S.K. Banerjee, Solid State Electronic Devices 6th edition PDF download; https://ebooks.cybernog.com/2017/11/solid-state-electronic-devices-streetman-banerjee-pdf.html		
Assessment	Midterm Exam (50%), Final Exam (50%)		
Language	English		

ELECTIVE COURSES
MME 532 – Biomaterials in Tissue Engineering and Regenerative Medicine
MME 539 – Nonlinear Mechanics & Modelling of Solids
MME 555 – Polymers in Medical Applications
MME 558 – Fundamentals of Ceramics I
MME 559 – Fundamentals of Ceramics II
MME 562 – Semiconductor Processing Technology
MME 564 – Nanomechanics
MME 565 – Physical Principles, Design and Fabrication of MEMS
MME 567 – Materials for Energy Production, Storage and Conversion

Course Title	**Biomaterials in Tissue Engineering and Regenerative Medicine**				
Course Code	**MME532**				
Course Type	**Elective**				
Level	Graduate				
Year / Semester	Fall Semester				
Teacher's Name	Dimitrios Tzeranis				
ECTS	8	Lectures / week	3	Laboratories / week	
Course Purpose and Objectives	Provide the required biological background so that students can understand in depth the design & applications of tissue constructs. Describe the major components of tissue constructs (cells, biomaterials, diffusible molecules). Present established and emerging techniques for the fabrication of tissue constructs and key *in vitro* applications. Present established and state-of-the-art applications of grafts in regenerative medicine.				
Learning Outcomes	After this course students 1. Will have good understanding of cell biology, tissue physiology & wound healing principles relevant to tissue engineering & regenerative medicine. 2. Will possess strong background on established and emerging fabrication methods for biomaterials and tissue constructs 3. Will possess strong background on interactions of cells with materials. 4. Will be exposed to the state of the art of tissue constructs for *in vitro* applications (3D culture, organoids, organ-on-chip systems).				

	5. Will be exposed to the state of the art of biomaterial-based grafts in regenerative medicine. 6. Be able to evaluate tissue construct designs from the viewpoint of a biologist, an engineer and a physician.		
Prerequisites	NO	Required	NO
Course Content	Cell biology: regulation of gene expression, receptors and signal transduction, cell-cell interactions, extracellular matrix structure, cell-matrix interactions, diffusible molecules (cytokines, growth factors, hormones, small molecules). Cell culture: cell isolation, growth and quantification techniques. Stem cells: kinds, differentiation, induced pluripotent stem cells. Biomaterials: types, fabrication methods, characterization techniques. Instrumentation and experimentation: fluorescence microscopy and spectroscopy, fluorescence proteins. Tissue constructs: cell seeding techniques, bioreactors, microfluidic devices, 3D cell culture, organoids, tissue-on-a-chip systems. *In vitro* applications of tissue constructs: biological research, systems biology, preclinical drug discovery. Wound healing: the irreversible nature of injury, inflammation, foreign body response, wound contraction, induced regeneration. Tissue constructs in regenerative medicine: animal models, grafts, case studies (skin, peripheral nerves, central nervous system, cartilage). Clinical translation.		
Teaching Methodology	• Book readings. • Lectures with powerpoint presentations. • Research journal paper readings. • Design case studies.		
Bibliography	• Alberts B., Bray D., Hopkin K., Johnson A., Lewis J., Raff M., Roberts K., Walter P. Βασικές Αρχές Κυτταρικής Βιολογίας Alberts, 4η Έκδοση. Εκδοσεις Πασχαλιδης, 2018. • Slack M. W. Jonathan. Βασικες αρχες βιολογιας αναπτυξης. Ακαδημαικες εκδοσεις, 2014 • Temenoff J.S., Mikos A.G., Βιοϋλικά Η Διεπαφή μεταξύ της Επιστήμης των Υλικών και της Βιολογίας. Utopia publishing, 2017. • Truskey G.A., Yuan F., Katz D.F Transport Phenomena in Biological Systems. 2nd Edition. Pearson, 2009.		
Assessment	Weekly presentations of journal papers (30%), a class presentation of a semester project (35%) and a final exam (35%).		
Language	English		

Course Title	**Nonlinear Mechanics & Modelling of Solids**

<table>
<tr><td>Course Code</td><td colspan="5">MME539</td></tr>
<tr><td>Course Type</td><td colspan="5">Elective</td></tr>
<tr><td>Level</td><td colspan="5">Graduate</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>2 × 1 ½ hours</td><td>Laboratories / week</td><td>0 hours</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The purpose of this course is to cover particular topics in continuum mechanics in applied mechanics, biomechanics and materials science: nonlinear mechanics of solid matter. As such, this course provides the students with the opportunity to familiarise themselves with concepts pertinent to nonlinearity and nonlinear behaviour of materials and structures. In particular, fundamental principles of analytical methods used in nonlinear solid mechanics are examined, while simple nonlinear engineering problems are modelled and analysed using the Finite Element (FE) method.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">This course has in its core a two-fold learning outcome: the students
(1) will obtain the fundamental theoretical knowledge in the mechanics of nonlinear solids (from metals to ceramics, from polymers and plastics to biological tissues),
(2) will obtain the theoretical knowledge in computer modelling of nonlinear solid mechanics problems, and thus
(3) will gain experience utilizing a commercial FE software (ABAQUS).
(4) will be capable to employ analytical methods to evaluate stresses, strains, deformations, etc. in simple nonlinear elastostatic problems,
(5) will be able to design and construct 2D and 3D FE models in nonlinear solid mechanics problems, and
(6) will be able to develop their critical thinking towards assessing, improving and correcting their calculations and model predictions.</td></tr>
<tr><td>Prerequisites</td><td colspan="2">NO</td><td colspan="2">Required</td><td>NO</td></tr>
<tr><td>Course Content</td><td colspan="5">The course opens in the first part presenting the fundamental theory in continuum solid mechanics – applicable to nonlinear solids – that spans from the various stress and strain measures to a short outline of constitutive laws of solid materials. In the second part of the course, the derivation of the equations of motion and equilibrium for deformable solids is presented, while also briefly covering the</td></tr>
</table>

	fundamentals of variational principles. In the third and major part of the course, the constitutive equations that describe the mechanical behaviour of elastic solids is presented; the course material will span from linear elastic (including isotropic and anisotropic) solids, to hypo- and hyperelastic materials, as well as viscoelastic, poroelastic and elastoplastic solids.
Teaching Methodology	Communicative, Collaborative • Class lectures (PowerPoint, Socrative, Screencast-o-matic); • Laboratory lectures – hands-on practice at the School computing center. 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	• 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 • 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	One final written exam (30%), bi-weekly homework assignments (40%), and a project assignment (30%).
Language	English

Course Title	**Polymers in Medical Applications**
Course Code	**MME555**
Course Type	**Elective**
Level	Graduate

<table>
<tr><td>Year / Semester</td><td colspan="5">Fall semester (offered every 2nd year)</td></tr>
<tr><td>Teacher's Name</td><td colspan="5">Theodora Krasia</td></tr>
<tr><td>ECTS</td><td>8</td><td>Lectures / week</td><td>1x3 hrs</td><td>Laboratories / week</td><td>--</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">During the last decades, polymers have been the key-players in the development of new materials destined for use in medical and biomedical applications. The latter include therapy, diagnostics, bioseparation, biosensing, biocatalysis, etc. This course aims in providing an overview on the use of polymeric materials and polymer-based nanocomposites in the biomedical field.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">
Acquire general knowledge and understanding on polymers, their thermomechanical properties and structure-to-property relation.
Discuss on the properties of polysiloxanes and their use in biomedical applications.
Discuss on the use of polymers and polymer composites in dental applications.
Acquire knowledge on hydrogels in terms of synthesis, properties, and biomedical applications.
Recognize the use of polymers in drug and gene delivery and discuss on various parameters influencing the drug delivery process.
Discuss on the use of polymer-based nanofibers in biomedicine and biotechnology.
Discuss on the applications of SPIONs and biofunctionalized carbon nanotubes.in biomedicine.
Acquire knowledge and discuss on blood contacting polymeric materials.

General learning outcomes:

Develop presentation skills through oral presentations in class
Retrieve and analyse scientific manuscripts on the topic.
</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">Polymers – introduction. Polysiloxanes in biomedical applications. Biodegradable polymers. Polymers in dental and maxillofacial applications. Medical applications of hydrogels. Polymers in therapeutic applications. Polymeric nanofibers in biomedical and biotechnological applications. Polymer-stabilized superparamagnetic iron oxide nanoparticles. Blood contacting polymers. Polymer-carbon nanotube composites in medical applications.</td></tr>
</table>

Teaching Methodology	- Lectures (in the form of ppt. presentations) - Use of audio and video tools - Lab demonstrations - Presentations by students 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	• *Polymeric Biomaterials*, 2nd Ed. Revised and Expanded, Ed. S. Dumitriu, Marcel Dekker Inc. NY, 2002. **ISBN**: 0-8247-0569-6 • *Magnetic Nanoparticles: Synthesis, Physicochemical Properties and Role in Biomedicine,* (Editor: Nora P. Sabbas), Nova Science Publishers, Inc. USA, 163-199, **2014 , ISBN:** 978-1-63117-434-6 • *Nanoscale Drug delivery/Drug Design in Nanomedicine – Basic and clinical Applications in Diagnostics and Therapy* (Editor: Alexiou C), Else Kröner-Fresenius Symp. Basel, Karger, vol. 2, 35-52, **2011**. **ISBN:** 978-3-8055-9818-7 • Scientific manuscripts and review articles • 3. Course handouts (http://www.eng.ucy.ac.cy/krasia/)
Assessment	Midterm Examination: 35 % Oral Presentations: 15 % Final Examination: 50%
Language	English

Course Title	**Fundamentals of Ceramics I**				
Course Code	**MME558**				
Course Type	**Elective**				
Level	Graduate				
Year / Semester	Fall semester				
Teacher's Name	Ioannis Giapintzakis				
ECTS	8	Lectures / week	2 X 1,5 hours	Laboratories / week	NO
Course Purpose and Objectives	This is the first of the two-course series dedicated to ceramic materials. The main objective of the course is the in-depth familiarization of graduate engineering students with bonding,				

	structure, and the physical and chemical properties that are influenced mostly by the type of bonding rather than the microstructure, such as defect structure and the atomic and electronic transport in ceramics.		
Learning Outcomes	• Discuss the main types of bonding found in ceramics • Identify, discuss and compare the arrangement of ions and atoms in crystalline ceramics • Discuss thermodynamic and kinetic issues related to ceramics • Discuss different types of defects, and especially point defects, found in ceramics • Discuss the phenomena of diffusion and electrical conductivity and their relation to defects and type of bonding found in ceramics • Explain why glasses form and discuss their structure and properties that make them unique		
Prerequisites	NO	Required	NO
Course Content	This course deals with bonding, structure, and the physical and chemical properties that are influenced mostly by the type of bonding rather than the microstructure, such as defect structure and the atomic and electronic transport in ceramics. Bonding in ceramics – Structure of ceramics – Effect of chemical forces and structure on physical properties – Thermodynamics and kinetics - Defects in ceramics – Diffusion and electrical conductivity – Phase equilibria – Formation, Structure, and Properties of Glasses		
Teaching Methodology	Lectures; Projects on topics of materials and technologies related to the course; Written report; Presentations by students 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	M. W. Barsoum, Fundamentals of Ceramics, McGraw Hill, New York (2003); Y. M. Chiang, W.D. Kingery, D. Birnie, Physical Ceramics: Principle of Ceramic Science and Engineering, John Wiley and Sons (1996)		
Assessment	Written report (25%), Project presentation (25%), Midterm Exam (20%), Final Exam (30%)		
Language	English		

Course Title	**Fundamentals of Ceramics II**				
Course Code	**MME559**				
Course Type	**Elective**				
Level	Graduate				
Year / Semester	Spring semester				
Teacher's Name	Ioannis Giapintzakis				
ECTS	8	Lectures / week	2 X 1,5 hours	Laboratories / week	NO
Course Purpose and Objectives	This is the second of the two-course series dedicated to ceramic materials. The main objective of the course is the in-depth familiarization of graduate engineering students with the science of sintering and microstructural development and with properties that are more microstructure dependent, such as fracture toughness, optical, magnetic, and dielectric properties.				
Learning Outcomes	• Discuss the science behind the sintering process. • Discuss the various aspects of brittle failure from several viewpoints. • Discuss the atomic processes and micromechanisms that are occurring during Creep, Subcritical Crack Growth, and Fatigue • Explain why thermal residual stresses develop and how to quantify them. • Discuss linear dielectrics from a microscopic point of view as well as the effects of temperature and frequency on the dielectric response • Discuss the basic principles and relationships between various parameters concerning magnetic and non-linear dielectric responses of ceramics • Discuss the basic interactions between electromagnetic radiation and ceramics with emphasis around the visible region				
Prerequisites	NO	Required	NO		
Course Content	This course deals with the science of sintering and microstructural development and with properties that are more microstructure dependent, such as fracture toughness, optical, magnetic, and dielectric properties. Sintering and grain growth – Mechanical Properties: Fast Fracture – Creep, Subcritical Crack Growth, and Fatigue – Thermal Properties – Dielectric Properties – Magnetic and Nonlinear Dielectric Properties – Optical Properties				

Teaching Methodology	Lectures; Projects on topics of materials and technologies related to the course; Written report; Presentations by students 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	M. W. Barsoum, Fundamentals of Ceramics, McGraw Hill, New York (2003); Y. M. Chiang, W.D. Kingery, D. Birnie, Physical Ceramics: Principle of Ceramic Science and Engineering, John Wiley and Sons (1996)
Assessment	Project presentation (25%), Written report (25%), Midterm Exam (20%), Final Exam (30%)
Language	English

Course Title	**Semiconductor Processing Technology**				
Course Code	**MME562**				
Course Type	**Elective**				
Level	Graduate				
Year / Semester	Spring Semester				
Teacher's Name	Special Scientist				
ECTS	8	Lectures / week	2x1.5 hrs	Laboratories / week	--
Course Purpose and Objectives	The purpose of the course is to familiarize the student with the various modern semiconductor-processing techniques, from crystal growth to device packaging. By the end of the course, students will be able to explain the basic fabrication steps one needs to follow in fabricating an integrated circuit-based device and to differentiate between the various available techniques for those fabrication steps.				
Learning Outcomes	• Describe techniques used for growth of monocrystalline silicon ingots and wafer preparation • Describe processes used to control contamination in silicon wafers • Describe processes employed for silicon surface oxidation and uses of the formed silicon dioxide layer • Describe commonly used metallization techniques in the fabrication of devices				

	• Describe commonly used photolithography techniques in the fabrication of devices • Describe commonly used etching techniques in the fabrication of devices • Describe commonly used doping techniques in the fabrication of devices • Describe commonly used packaging techniques in the fabrication of devices		
Prerequisites	NO	Required	NO
Course Content	Elemental and compound semiconductors – Growth of semiconducting crystals – Wafer preparation –Thermal oxidation and nitridation – Silicon dioxide and interface SiO2-Si – Growth of thin films – Physicochemical processes of growth - Chemical vapor deposition –Physical vapor deposition – Lithography – Optical lithography – Techniques for improving resolution – Electron beam lithography – X-ray lithography – Ion beam lithography – Control of purity and etching – Purity processes – Etching – Ion implantation – Destruction of crystal and activity of dopants – Diffusion sources - Non constant diffusion coefficient – Diffusion in polycrystalline Si – Diffusion in insulators — Gettering in Si – Contact and interconnect technology – Contact metallization – Multimetal dielectrics – Metallic interconnects – Interlevel dielectrics – Multilevel metals – Reliability		
Teaching Methodology	Lectures, power point presentations 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	Peter Van Zant (2000) *Microchip Fabrication – A practical guide to semiconductor processing (4th Edition)*, McGraw-Hill; Gary S. May and Simon M. Sze (2004) *Fundamentals of Semiconductor Fabrication*, Wiley. Lecture Notes		
Assessment	Home Exercises: 20%, Midterm Exam: 30%, Final Exam: 50%		
Language	English		

Course Title	**Nanomechanics**
Course Code	**MME564**

<table>
<tr><td>Course Type</td><td colspan="5">Elective</td></tr>
<tr><td>Level</td><td colspan="5">Graduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">Spring 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 hours</td><td>Laboratories / week</td><td>NO</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">The course aims to introduce to students those notions of mechanics, both classical and quantum that are important in understanding the operation of micro and nano-devices.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">Students should be able to
1) understand when solids can be described as continuum and when as quantum mechanical objects
2) recognize the key dynamics in play as the size scale of a system is reduced
3) apply this knowledge in analyzing existing micro-nano-devices
4) apply this knowledge in designing new micro-nano-devices
5) understand the principle of operation of different equipment used to probe events at nano-scale
6) carry out literature survey on a topic of interest in Nanomechanics</td></tr>
<tr><td>Prerequisites</td><td colspan="2">NO</td><td colspan="2">Required</td><td>NO</td></tr>
<tr><td>Course Content</td><td colspan="5">The operating environment of nanostructures is completely different of that of their macroscale counterparts. For example, responses to thermal fluctuations, and for certain scales to quantum potentials, contribute to their positional uncertainty. The basic classical, statistical and quantum mechanics and thermodynamics required to characterize nano-mechanical devices will be introduced. In addition the principle of operation of various devices used to probe the properties of a nano-system will be explained. An overview of continuum mechanics notions such as stress and strains, elastic contacts and waves in solids will be given.</td></tr>
<tr><td>Teaching Methodology</td><td colspan="5">Lectures; Written report and Presentations by students of individual projects on topics of materials and technologies related to the course
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</td></tr>
</table>

Bibliography	• Andrew Cleland, *Foundations of Nano-mechanics*, 2003, ISBN: 3-540-43661-8 • Flexible reading tailored to each student's background.
Assessment	Homework 5% Midterm exam 25% Literature survey on a Special Topic (Analysis of at least six relevant research articles): 30% Final Exam: 40%
Language	English

Course Title	**Physical Principles, Design and Fabrication of MEMS**				
Course Code	**MME565**				
Course Type	**Constrained Elective**				
Level	Graduate				
Year / Semester	Spring semester				
Teacher's Name	Matthew Zervos				
ECTS	8	Lectures / week	2 X 1,5 hours	Laboratories / week	NO
Course Purpose and Objectives	The purpose of this course is to provide an introduction to the physical principles, design and fabrication of micro electro mechanical systems (MEMs) thereby integrating knowledge of materials science with device processing and design. The objectives of MME565 is to expand and broaden the knowledge that postgraduate students have on Materials Science I and II and Chemistry for Engineers etc in the direction of MEMs with emphasis on sensors.				
Learning Outcomes	Upon successful completion of the course, students will 1. Understand length scales and dimensionality 2. Know the growth methods main materials used for the fabrication of MEMs and their structural ,electrical, optical , mechanical and thermal properties 3. Grasp the methods used for top-down and bottom-up device processing. 4. Know what is surface and bulk micromachining.				

	5. Understand all aspects of the ubiquitous microelectromechanical cantilever 6. Know how MEMs sensors are fabricated and the physical principles of operation 7. Know how microfluidic circuits are fabricated, work and their applications 8. Understand nanoelectromechanical systems with emphasis on energy harvesting
Prerequisites	NO | **Required** | NO
Course Content	A historical overview; relevant length scales, market analysis and motivation; simple MEMs e.g. cantilever, switches, comb drives, pressure sensors, transduction principles i.e., mechanical, electrostatic, thermal, piezoelectric. Fabrication of MEMs using standard integrated circuit processing technology, types of lithography, i.e., photolithography, electron beam lithography, soft lithography, thin film deposition, wet and dry etching methods. Surface and bulk micromachining, hot embossing, micro-molding. Assembly, packaging and reliability. Advanced radio frequency MEMs, Piezo MEMs, Magnetic MEMs, Biological MEMs.
Teaching Methodology	Lectures; Written report and Presentations by students of individual projects on topics of materials and technologies related to the course 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	N. Maluf, K. Williams, An Introduction to Microelectromechanical Systems Engineering, 2004
Assessment	Assignments and Presentation (20%), Mid-Term Exam (30%), Final Exam (50%)
Language	English

Course Title	**Materials for Energy Production, Storage and Conversion**
Course Code	**MME567**
Course Type	**Elective**

Level	Graduate				
Year / Semester	Spring semester				
Teacher's Name	Ioannis Giapintzakis				
ECTS	8	**Lectures / week**	2 X 1,5 hours	**Laboratories / week**	NO
Course Purpose and Objectives	The main objective of the course is the in-depth familiarization of graduate engineering students with materials issues and challenges concerning the state-of-the-art technologies used or proposed for production, conversion, storage, transport and use of energy, as well as capturing and storing pollutants such as CO_2.				
Learning Outcomes	• Identify, discuss and compare materials and technologies for energy production • Identify, discuss and compare materials and technologies for energy storage • Identify, discuss and compare materials and technologies for energy transport • Identify, discuss and compare materials and technologies for energy conversion • Identify, discuss and compare materials and technologies for energy use • Identify, discuss and compare materials and technologies for CO_2 capture and storage				
Prerequisites	NO	**Required**	NO		
Course Content	This course deals with materials issues that need to be resolved in order for technologies used or proposed for energy production, conversion, storage, transport and use of energy, as well as for CO_2 capture and storage to become more efficient.				
Teaching Methodology	Lectures; Written report and Presentations by students of individual projects on topics of materials and technologies related to the course 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	«Fundamentals of Materials for Energy and Environmental Sustainability», edited by David Ginley και David Cahen, Materials Research Society & Cambridge University Press, 2012				

Assessment	Written report (25%), Project presentation (25%), Midterm Exam (20%), Final Exam (30%)
Language	English