STUDY GUIDE
ACADEMIC YEAR 2020-2021

UNIVERSITY OF WESTERN MACEDONIA
SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

http://www.mech.uowm.gr/

KOZANI 2020

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INTRODUCTION - WELCOME

I welcome you to the Department of Mechanical Engineering, University of Western Macedonia.

The Department of Mechanical Engineering, which was founded in 1999 and belonged to the Aristotle University of Thessaloniki, was originally called "Department of Engineering and Management of Energy Resources". In 2004, it became part of the newly established University of Western Macedonia, as the first Engineering degree course. Although it is one of the most recently established Engineering departments in Greece, it has already acquired high reputation in the Greek academia.

Engineering courses offer students a huge and diverse range of career and life opportunities and prospects, and help them handle typical everyday problems. They enable students acquire the fundamentals of scientific knowledge, and also a unique method to think, combine, analyze and solve problems.

Engineering is an all-embracing and wide-ranging discipline promoting new technological discoveries and advances, thus, triggering further investigation and challenges, which open up new doors and scope for exploration. Therefore, it seems rather wrong to explore its substantial function only in terms of what students are going to learn during studies. In any case, it is impossible to try to encapsulate the vast potential of Engineering in 10 academic semesters. Engineering expands beyond the narrow range of problems students will be taught to handle during courses; it involves a multiple number of problems and issues they are likely to encounter after graduation, although they may never have been taught how to.

Mechanical Engineering is a fundamental component of Engineering. Its major objective is to qualify students, by applying basic principles of mathematics, physics and chemistry, to be able to handle complicated problems and decision-making, and develop and manufacture a full range of products. Courses in Mechanical Engineering (an Integrated Master's Degree) motivate students to take a journey to the world of science, and have a different look at scientific knowledge. In this framework, the first course cycle offers them the opportunity to become familiar with the practical aspects of Mechanical Engineering via Statics, Thermodynamics, Statistics, Materials Technology, Heat Transfer and Fluid Mechanics. The second course cycle presents them with the challenge to travel to the fascinating world of combining the basic principles of science with abilities and skills to design and build integrated engineering systems. Finally, the third course cycle encourages focus on special Engineering issues and provides the framework and background for the Diploma Thesis, at the end of this exciting journey to learning and gaining experience.

For all our Mechanical Engineering students, graduation typically means the end of a short journey taken in the School of Engineering of the University of Western

Macedonia; however, it also implies the beginning of a longer one, a lifetime journey to Mechanical Engineering careers. Learning benefits -which I hope will accompany students throughout their lives- do not only derive from a 10-semester teaching process. Our legacy to students includes, beyond everything else, delivery and communication of a unique outstanding way to think, analyze and combine, which are fundamental assets for all engineers.

I invite all students to take this journey to science and learning with all of us together. I also advize them, both during studies and later in their professional career and personal life, to avoid following the easy path of pursuing superficial knowledge and high scores, and stay on the hard and highly rewarding path of focusing on thorough research and investigation across the range of their chosen area. This will definitely lead to graduation but, most significantly, to achieving a most successful and brilliant Mechanical Engineering career, and the competence to address relevant issues and solve problems.

I wish everyone to enjoy their journey in the Department of Mechanical Engineering, and gain education, skills and experience to accompany them forever.

I wish everyone a dream trip!

Head of the Department

George Nenes, Associate Professor

1. BRIEF HISTORICAL OVERVIEW

The Mechanical Engineering Department derives from the Department of Engineering & Management of Energy Resources, which was one of the three new departments that were founded at the Aristotle University of Thessaloniki (AUTH), in 1999, aiming at the enlargement of higher education in Greece. The city of Kozani was selected as the Seat of the Department, on account of its inextricable link to energy production, as in this region about 70% of Greece`s electric power is produced.

The foundation of the Department and its regulations are determined by the Presidential Decree published in the Government Gazette 179/6.1999 t.A.

For the academic year 1999-2000, the Department accepted its first 120 students, and since then it admits about 100 to 160 students annually. For the current academic year the number of students has been 159.

It should be noted that the Department which was originally founded at the Aristotle University of Thessaloniki was transferred by Joint Ministerial Decision 134 881 a/ B1/23.12.2003 (Government Gazette 1975/31.12.2003), since 01/01/2004 to the University of Western Macedonia, thus becoming the first Department of the University, which leads to Major in Engineering.

The Department was renamed from DEPARTMENT OF ENGINEERING & MANAGEMENT OF ENERGY RESOURCES to MECHANICAL ENGINEERING DEPARTMENT, according to the Presidential Decree 47 (Government Gazette 61 / 27-04-2009, vol. I).

2. ADMINISTRATION OF UOWM

2.1 GOVERNING BOARD

Rector	Theodoulidis Theodoros
Vice-rectors	Sariannidis Nikolaos Maropoulos Stergios Iordanidis Georgios Spirtou Anna
School Deans	Triantafillou Athanasios Dimitriadou Aikaterini Ziogas Ioannis Katarahia Androniki Kalogiratou Zaharoula Melfou Aikaterini Tsanaktsidis Konstantinos
Departments Presidents	Christoforidis Georgios Kapageridis Ioannis Kakoulis Konstantinos Nenes Georgios Frontistis Zaharias Thoidis Ioannis Ntinas Konstantinos Pnevmatikos Dimitrios Michail Domna Veletzas Ioannis Triantari Sotiria Dritsaki Chaido Monovasilis Theodoros Konteos Georgios Mpakouros Ioannis Anastasiadou Sofia Petrakis Andreas

	Dosis Michail Savvidis Serafim Tsiamitros Dimitrios
Representatives of Special Teaching Staff	**Sidiropoulou Christina**
Representatives of Special Technical and Laboratory Staff	**Tiggos Antonios**
Representatives of Administrative Staff	-
Representatives of Students	**Seliniotakis Charidimos** **Goudinidis Nikolaos**
Representatives of Postgraduate Students	-
Representatives of PhD Candidates	-

3. ADMINISTRATION OF MECHANICAL ENGINEERING DEPARTMENT

3.1 Head of the Department

Georgios Nenes, Associate Professor

3.2 Deputy Head of the Department

Nikolaos Taousanidis, Professor

3.3 Department General Assembly

1.	G. Nenes	*Associate Professor*	Head of the Department
2.	N. Taousanidis	*Professor*	Deputy Head of the Department
3.	A. Altini	*Assistant Professor*	Member
4.	E. Varitis	*Assistant Professor*	Member
5.	D. Giagopoulos	*Associate Professor*	Member
6.	S. Gerardis	*Assistant Professor*	Member
7.	S. Douvartzidis	*Assistant Professor*	Member
8.	T. Theodoulidis	*Professor*	Member
9.	L. Karagiannakis	*Lecturer*	Member
10.	A. Kontogianni	*Associate Professor*	Member
11.	A. Krestou	*Assistant Professor*	Member
12.	E. Konstantinidis	*Associate Professor*	Member
13.	G. Marnellos	*Professor*	Member
14.	S. Maropoulos	*Professor*	Member
15.	S. Panagiotidou	*Associate Professor*	Member
16.	G. Panaras	*Assistant Professor*	Member
17.	N. Sapidis	*Professor*	Member
18.	G. Sideridis	*Professor*	Member
19.	G. Skodras	*Professor*	Member

20.	R.E. Sotiropoulou	*Lecturer*	Member
21.	A. Tourlidakis	*Professor*	Member
22.	A. Tsamis	*Assistant Professor*	Member
23.	A. Tsouknidas	*Assistant Professor*	Member
24.	K. Filippidis	*Professor*	Member

Emeritus Professors

1.	Bartzis John
2.	Pilavachis Petros

The General Meeting of the Department is filled in by one (4) student representatives, one (1) member of Special Teaching Staff and one (1) member of Special Technical and Laboratory Staff.

3.4 Administration Office

Registrar & Secretary:	Anna V. Tzika
Administration Office telephone numbers	+30 24610 56600, +30 24610 56604, +30 24610 56605 FAX: +30 2461 056601 and +30 24610 56603.
Address	Bakola and Sialvera Str, 50 132, Kozani

3.5 Academic Consultants

Georgios Marnellos, Professor

4. DEPARTMENT AIMS AND ORGANIZATION

The Department of Mechanical Engineering aims at fostering and promoting education, scientific research and knowledge on the key items of mechanical engineering.

Mechanical engineering covers a wide range of areas such as energy, environment, materials science and technology, engine design and control systems engineering. The activities of mechanical engineering include, amongst others, research and development, design, testing and manufacturing of products and systems, organization of production processes and business administration. Our Department is preparing young engineers in order to contribute to the continuous technological development and distinguish themselves both nationally and internationally.

The **aims** of the Department regarding the education of students are:

- To provide students with a profound knowledge of the principles related to the subject of Mechanical Engineering, at the end of their studies.
- To educate students and to provide them with the necessary skills to implement their knowledge and knowhow.
- To provide them with high quality knowledge, reflecting both the requirements of industry and in general the needs of our country
- To develop teaching methods as well as student assessment methods in the Department`s fields of Study.
- To encourage students to perform as well as possible in their studies and to make sure that they make the best use of the possibilities and opportunities provided to them.
- To provide facilities and laboratories, that keep up with the progress and the needs of technology and
- To strengthen scientific cooperation amongst students and enable them to study independently and to deepen their knowledge.

Thus, upon completion of five years of studies the students should be able

- To apply their knowledge to contemporary problems of industry on their scientific field
- To be aware of the modern methods and techniques throughout the range of all the technologies they have been specialized in.

- To use modern tools to solve technical and scientific problems, such as the use of IT systems, computer use, use of software packages
- To communicate effectively both orally and in writing and to be able to collaborate in a group.
- To design, execute and manage a specific project.
- To track individually the development in their scientific field and to improve their knowledge continuously and
- To provide their services to industry as well as to society immediately.

The Department of Mechanical Engineering, except for its educational function, is involved in developing and operating high-tech research laboratories, which participate successfully in a number of national and international competitive research projects having publishing outcomes in international journals and presentations at international or national conferences. Also, the Department places special emphasis on linking academic research to industrial production, research and development. The knowledge and skills provided to the students of the Department, prepare them to staff the production and development departments of industries and businesses appropriately. In addition, the Department hopes that some of its graduates will become reputable researchers who will become faculty members in Universities and research centers.

Directions of Studies

1. Academic Direction of Energy

1st Cycle of Studies: Energy production & transfer

2nd Cycle of Studies: Environment and Energy Use

2. Academic Direction of Industrial Management

1st Cycle of Studies: Industrial Management

3. Academic Direction of Manufacturing

1st Cycle of Studies: Manufacturing & Materials

Directions and Laboratories

1. Direction of Energy

- Laboratory of Thermodynamics and Heat Engines
- Laboratory of Fluid Mechanics and Turbomachinery
- Energy & Pollution Control Systems Engineering Laboratory (EPSEL)
- Air and Waste Management Laboratory (AWMA)
- Center for Renewable & Alternative Energy Sources & Rational Use of Energy

2. Direction of Industrial Management

- Laboratory of Quantitative Methods of Operations Research and Statistics in Engineering (MORSELAB)

3. Direction of Manufacturing

- Laboratory of Mechanical Systems (LMS)
- Laboratory of Vibration and Machine Dynamics (LVMD)
- Laboratory of Machining Engineering and Quality Control
- Laboratory of Biomaterials and Computational Engineering
- Magnetic and Electric Analysis for Non-Destructive Evaluation Research (Research team Meander)

5. CALENDAR OF COURSES, EXAMS, NATIONAL & LOCAL HOLIDAYS, STUDENTS VACATIONS

5.1 Courses and Exams

Freshmen registration (The dates are determined by the Ministry of Education)

Courses statement submission of Winter semester courses	1st half of October
Winter semester courses	12/10/2020 - 23/12/2020
	and 07/01/2021 - 22/01/2021
Winter semester exams	01/02/2021 - 19/02/2021
Courses statement submission of Spring semester courses	2nd half of February
Spring semester courses	22/02/2021 - 23/04/2021
	and 10/05/2021 - 04/06/2021
Spring semester exams	07/06/2021 - 30/06/2021

5.2 National & Local Holidays and Student Vacations of Winter Semester

October, the 11th	Liberation of Kozani City
October, the 28th	National Day of "OXI" (NO)
November, the 17th	National Day of "Polytechneio" (Engineering School)
December, the 6th	Ag. Nikolaos-St. Nicholas Day- patron saint of Kozani
December, the 24th – January, the 6th	Christmas Holidays
January, the 30th	Three Hierarchs Holiday (Religion Holiday)

5.3 National & Local Holidays and Student Vacations of Spring Semester

March, the 15th	"Kathara Deftera"
March, the 25th	National Day of the 1821 Revolution
April the 24th – May the 9th	Easter Holidays
May, the 1st	1st May/Labor Day
June, the 21th	Holy Spirit Day (Religion Holiday)

6. INFORMATION ABOUT THE ORGANIZATION OF STUDIES

6.1 Duration of Studies

The **minimum possible duration** of studies is **10 semesters**

Every semester consists of at least 13 full teaching weeks

The working load for the successful completion of studies corresponds to 300 credit points (ECTS) including diploma thesis, which corresponds to 30 ECTS.

6.2. Maximum duration of studies - Part-time Studies

n = number of standard studies duration, in semesters (in our Department ten (10) semesters).

a) Students **should register (submit a course statement) at the beginning of every semester**. **Otherwise, they will not be allowed to participate in the final exams.**

b) Students have the right to interrupt, upon written request to the Administration Office of the Department and approval by the General Meeting of the Department, their studies for as many semesters, consecutive or not, as they desire, and certainly no more than the minimum number of semesters required to receive a diploma according to the indicative curriculum. **These semesters are not calculated in the maximum studies duration as indicated above**. Students who interrupt as aforesaid their studies, do not maintain their student membership throughout the whole period of their studies interruption. After the end of the studies interruption, students return automatically to the Department. **The application for interruption of studies, is submitted twice a year and exclusively during the submission time of courses statement. (winter and spring semester)**

6.3 Cycles and Directions of Studies- Specialization of Studies

The studies in Mechanical Engineering at the University of Western Macedonia consist of three Cycles.

- The **First Cycle of Studies** lasts six semesters (1^{st} to 6^{th}) and includes **35** mandatory courses (including the Engineering Design Project), which are common to all directions of studies.

- **The Second Cycle of Studies** lasts two semesters (7th and 8th) and includes twelve (12) courses, six (6) Mandatory Direction (MD) courses, two (2) Elective Direction (ED) courses and four (4) Elective (E) courses for each Academic Direction. In the second cycle students are given the opportunity, based on their interests, to choose one of the following Directions of Study.
  1. Academic Direction of Energy
  2. Academic Direction of Industrial Management
  3. Academic Direction of Manufacturing

The academic direction opted by each student, is determined with a corresponding **statement for inclusion in Direction of Studies**, which is made by the student himself and addressed to the Departments Administration Office at the beginning of the **Second Cycle of Studies** (7th semester).

- **The Third Cycle of Studies** lasts two semesters (9th and 10th semester) and includes the Diploma Thesis and six (6) courses: two (2) Mandatory Direction courses, two (2) Elective Direction courses and two (2) Elective for each Academic Cycle of Studies.

Specialization of Studies per Academic Direction are the following:

1. **Academic Direction of Energy**

1st Cycle of Studies: Production and Transport of Energy

2nd Cycle of Studies: Environment and Energy Use

2. **Academic Direction of Industrial Management**

1st Cycle of Studies: Industrial Management

3. **Academic Direction of Manufacturing**

1st Cycle of Studies: Manufacturing & Materials

The Specialization of Studies opted for attendance by each student is determined with a corresponding **statement for inclusion in Specialization of Studies** (included in the academic direction chosen at the second cycle of studies), which is made by the student himself and addressed to the Departments Administration Office at the beginning of the **Third Cycle of Studies** (9th semester).

For the students convenience, a summary table follows with the number of courses that must be completed in order to obtain the Diploma

STUDENTS OBLIGATIONS FOR OBTAINING THE DIPLOMA

CAUTION: In completing the statement make sure to cover the following number of courses per category i.e. (M), (DM), (DE), (E).

Admission year	Number of Courses in 1st Cycle of Studies (1st-2nd -3rd year)	Number of Courses in 2nd Cycle of Studies (4th year)	Number of Courses in 3rd Cycle of Studies (5th year)	Total Number of Courses, inc. Design Paper	Overview
1999-2001	31 MANDATORY (M)	6 DIRECTION MANDATORY (DM) 4 ELECTIVE (E) + Engineering Design Project	8 CYCLE MANDATORY(CM) + DIPLOMA THESIS	50+ DIPLOMA THESIS	**31 M, 14 DM** **4 E** **EDP**
2002-2004	32 MANDATORY (M) + Engineering Design Project	6 DIRECTION MANDATORY (DM) 4 ELECTIVE (E)	8 CYCLE MANDATORY(CM) + DIPLOMA THESIS	51 + DIPLOMA THESIS	**32 M, 14 DM** **4 E** **EDP**
2005-2009	37 MANDATORY (M) + Engineering Design Project	6 DIRECTION MANDATORY (DM) 4 DIRECTION ELECTIVE (DE) 2 ELECTIVE (E)	8 CYCLE MANDATORY (CM) + DIPLOMA THESIS	58 + DIPLOMA THESIS	**37 M, 14 DM** **4 DE, 2 E** **EDP**
2010-2012	37 MANDATORY (M) + Engineering Design Project	6 DIRECTION MANDATORY (DM) 2 DIRECTION ELECTIVE (DE) 4 ELECTIVE (E)	3 CYCLE MANDATORY(CM) 5 CYCLE ELECTIVE (CE) + DIPLOMA THESIS	58 + DIPLOMA THESIS	**37 M, 9 DM** **7 DE, 4 E** **EDP**
2012-2019	34 MANDATORY (M) + Engineering Design Project	6 DIRECTION MANDATORY (DM) 2 DIRECTION ELECTIVE (DE) 4 ELECTIVE (E)	3 CYCLE MANDATORY(CM) 5 CYCLE ELECTIVE (CE) + DIPLOMA THESIS	55+ DIPLOMA THESIS	**34 M, 9 DM** **7 DE, 4 E** **EDP**
2020-2021	33 MANDATORY (M)	6 DIRECTION MANDATORY (DM) 2 DIRECTION ELECTIVE (DE) 4 ELECTIVE (E)	2 CYCLE MANDATORY(CM) 2 CYCLE ELECTIVE (CE) 2 ELECTIVE (E) + DIPLOMA THESIS	51+ DIPLOMA THESIS	**33 M, 8 DM** **4 DE, 6 E**

Note: EDP = Engineering Design Project

6.4 Freshmen admission documents

Based on the results of the "Panhelladikes" University Entrance exams, the registration deadline of the successful candidates is determined by the Ministry of Education.

The successful candidate or a legally authorized person should submit for his/her registration to the Administration Office of the Department the following documents:

1. **Application** for registration (the form is issued by the Administration Office of the Department).

2. **Graduation certificate**, diploma or degree or other certificate of the school he/she has graduated or legally certified translated copy of such documents.

3. **Solemn statement** in which the new entrant affirms that he/she is not registered in another School or Department of Higher Education in Greece (the form is issued by the Administration Office of the Department).

4. Four (4) ID type **photos**.

5. A plain copy of **ID card** or another official document which certifies his/her personal details.

6. **A copy of the access certificate** (issued by the Greek Senior High School).

The abovementioned documents are uploaded in the website of the Department (**mech.uowm.gr**) at the beginning of every academic year and are subject to changes according to the Ministry of Education guidelines.

6.5. Statement of attendance of semester courses

At the beginning of each semester and on specified dates, each student **must** electronically submit to the Administration Office of the Department (through the department website) a statement including those courses he decides to attend in the specific semester. **The course statement is essentially equivalent to the student`s enrollment per semester in the Department.**

After the deadline no statement will be accepted as any course change will not be allowed.

By this statement every student gains access to:

1. **receive academic material** through **EYDOXOS** program (books, textbooks etc.) available for these courses at the beginning of this semester.
2. **participate in examinations of the courses stated** at the end of that semester and at the following additional examination period of September.

The statement above can be submitted **in person** by the student concerned or by anyone who has **legal authorization** for this purpose, or by registered mail.

If a student does not submit a statement at the beginning of the semester, then he is considered not to attend any courses, he is not entitled to acquire any academic material, nor to participate in the exams of this semester.

Students who were admitted in the academic year 2017-2018 and onwards, have the right to state: (a) up to N+3 courses per semester, where N is the nominal number of semester courses according to the indicative curriculum, for the first 8 semesters, (b) up to eight (8) courses per semester during the 9th and 10th semester and (c) up to twelve (12) courses per semester from the 11th semester and onwards.

Students who were admitted in the academic year 2016-2017 and backwards, have no restrictions on the number of courses they can include in their course statement.

In all cases, students may include in their statement of courses any courses of the current or previous semesters but they cannot include courses from the forthcoming semesters.

Students who attend the winter semester may only state those courses, that are offered during winter semesters (1st, 3rd, 5th, 7th and 9th) according to the indicative curriculum. For a summer semester only summer semester courses may be stated (2nd, 4th, 6th, 8th and 10th) according to the indicative curriculum. **The winter semester courses are not taught during the summer semester and vice versa**.

6.6. Students evaluation. Exams

The Students` performance evaluation in each course takes place during the whole academic year. The final grade in each course consists of two parts. The first part, which forms 30% of the final grade assesses the student's performance during the semester and the grade results from grading exercises, questions, or at least one mid-semester written test, lying to the discretion of the tutor. The second part, which forms 70% of the final grade evaluates the student's performance in the final exams of the course.

There are **two (2) examination periods** for the courses taught in each semester. The first period is set immediately after the end of that semester, winter or summer. The second is set in September, before the beginning of the next winter semester.

Each student is entitled **to participate in the exams, only of those semester courses, that he/she alone has determined through the courses statement, which he/she submitted at the beginning of this semester**.

The January-February exam period lasts three weeks, the June period lasts three weeks and the September period lasts four weeks, but they can be lengthened if necessary.

If a student does not participate in the course exams or he participates but still has not got a definite grade that is greater or equal to five even after the second final exam of the course in September, then:

1. If the course is **Mandatory, Direction Mandatory or Direction Elective**, the student **is obliged to restate this course again a following semester**. Through this statement he has the opportunity to repeat the educational process in this course and to acquire the right to participate in the corresponding exams.

2. If the course is **Elective**, the student **has the opportunity to restate this course again in a following semester** in order to repeat the educational process in this course and to acquire the right to participate in the corresponding exams. But he has also the possibility not to restate this course anymore, but **to choose and state another Elective course** available in his academic direction **in a following semester** instead.

6.7 Educational material

The educational procedure is complemented with the use of textbooks and other educational aids which are provided to students for free, as well as by ensuring their information and access to the relevant Greek and foreign bibliography (Art. 23 § 2 Law 1268/82).

6.8 Changeability of Studies Direction

If a student, after having stated that he is going to follow a certain Studies Direction, considers that for some reason he wants to change that Direction, he may do so within the submitting statement deadline for inclusion in Studies Direction **at the beginning of the following next semester,** thus stating the Direction of his new preference.

The Studies Direction change takes place through the submission of courses statement in the summer semester of the 4th year and provided that the student has successfully completed the exams in the courses (common mandatory and elective) corresponding to the new Studies Direction that he will choose, no matter how many successful exams he/she has already taken until the time of change.

6.9 Engineering Design Project - Diploma Thesis

The studies in Mechanical Engineering, in addition to the courses offered, include two papers.

a) Engineering Design Project

The Engineering Design Project is a subject of detailed analysis and study for the design or construction of any device or process, based on acquired knowledge and it aims to demonstrate the synthesis potential of the acquired knowledge but also to show that the student is able to face the problems that he/she will be confronted with in the real world. Depending on the manner of conducting it, the project helps the students to develop a spirit of collaboration with other specialists that is essential in today's society.

This paper takes place during the Second Cycle of Studies, can be performed in collaboration with other students under the guidance of their supervisor, is graded successfully or unsuccessfully (pass / fail) as a semester elective course and corresponds to 5 ECTS.

The Engineering Design Project is conducted during the fourth year of studies and it should be successfully completed prior to the initiation of the Diploma Thesis.

b) Diploma Thesis

The studies in Mechanical Engineering are completed with the Diploma Thesis. This thesis is an extended study in a scientific area of the Department and corresponds to 30 ECTS. The Diploma Thesis, aims to demonstrate the student`s ability to work and deepen scientifically in a narrow academic field.

Every student may choose the scientific area in which he/she wants to work out his/her Diploma Thesis. The only limitation to this option is that **the Diploma Thesis should correspond to the knowledge faculty of one (at least) of the courses of the Studies Direction, he has attended.**

6.10 Diploma

All graduates of the Department of Mechanical Engineering of UoWM without any exception get the title of Licentiate Mechanical Engineer. The five-year Diploma of Mechanical Engineering of the Department corresponds to an Integrated Master of EQF level 7.

In the **grades transcript certificate**, that any graduate can receive, all the courses, that the student has attended, appear in detail. In this certificate, that shows the personal curriculum of every graduate, the Direction and Specialization of Studies appear.

6.11. Calculating the Diploma Grade

Details on calculating the diploma score are provided in Chapter 8.5 (Diploma acquisition prerequisites).

7. RESPONSIBILITIES AND DUTIES OF THE ADMINISTRATION OFFICE

The Administration Office of the Department is responsible for student and administrative issues. More specifically student affairs include:

1. The registration of students.
2. The keeping of the student archive, which includes the grades, information concerning scholarships and granting degrees.
3. The drafting of student catalogues in accordance with their selection statement of courses they wish to attend.
4. The issuing of certificates.

The students service takes place on all working days from **11:00** to **13:00** in the Administration Office.

For **registration of freshmen** the following apply more specifically:

After the lists of the successful candidates are sent by the Ministry of Education, the Executive Committee of UoWM states the deadline within which the registration should be completed. This deadline is crucial, meaning that whoever is overdue, loses the right to register. The registration deadline is communicated on the Department's notice board immediately after it is determined.

Finally, the Administration Office informs students about the European student exchange programs, as well as the **written exams regulation**.

8. SEMESTER PROGRAMME

ECTS Credits*: Course Credits according to European Credit Transfer System (E.C.T.S.)*

1st Study Cycle

The First Study Cycle includes 6 Semesters (1st to 6th). All courses are mandatory.

1st Semester

s/n	Code	Course	Instructor	Assisting	Course Designation	Hours	ECTS Credits
1	101	Mathematics I	*A. Petrakis*		Mandatory	4	5
2	103	Physics	*K. Filippidis*		Mandatory	4	5
3	104	Chemistry	*G. Marnellos E.Tolis*		Mandatory	4	5
4	105	Introduction to Computing	*C. Grompanopoulos*		Mandatory	5	5
5	113	Mechanical Drawing I	*N. Sapidis*	*N. Ntinas*	Mandatory	4	5
6	144	Linear Algebra	*K. Mpalassas*		Mandatory	3	5
7	141	English	*A. Altini*		Mandatory	2	2

2nd Semester

s/n	Code	Course	Instructor	Assisting	Course Designation	Hours	ECTS Credits
1	102	Mathematics II	*A. Petrakis*		Mandatory	4	5
2	109	Materials Science and Technology I	*A. Tsouknidas*	*D. Fasnakis*	Mandatory	5	6
3	111	Engineering Statics	*A.Tsamis*		Mandatory	5	6
4	146	Mechanical Drawing II	*N. Sapidis*	*N. Ntinas*	Mandatory	4	6
5	114	Fundamentals of Machining	*S. Gerardis*		Mandatory	5	5
6	142	English (ESP/EAP)	*A. Altini*		Mandatory	2	3

3rd Semester

s/n	Code	Course	Instructor	Assisting	Course Designation	Hours	ECTS Credits
1	110	Strength of Materials	*A.Arailopoulos*		Mandatory	5	6
2	107	Statistics	*S. Panagiotidou*	*G.Krommidas*	Mandatory	5	6
3	119	Thermodynamics I	*G. Skodras* *E. Tolis*		Mandatory	5	6
4	132	Mathematics III	*K. Mpalassas*		Mandatory	4	6
5	135	Materials Science and Technology II	*S. Maropoulos* *A. Tsouknidas*	*L. Papadakis*	Mandatory	5	6

4th Semester

s/n	Code	Course	Instructor	Assisting	Course Designation	Hours	ECTS Credits
1	112	Dynamics	*D. Giagopoulos*		Mandatory	5	6
2	108	Machine Elements I	*E. Varitis*		Mandatory	5	6
3	120	Fluid Mechanics I	*G. Panaras*		Mandatory	5	6
4	137	Mathematics IV	*K. Mpalassas*		Mandatory	4	6
5	133	Thermodynamics II	*S. Douvartzidis*		Mandatory	5	6

5th Semester

s/n	Code	Course	Instructor	Assisting	Course Designation	Hours	ECTS Credits
1	118	Heat Transfer	*E. Konstantinidis*		Mandatory	5	6
2	140	Mechanical Vibration and Machine Dynamics	*D. Giagopoulos*		Mandatory	5	6
3	147	Operations Research I	*G. Nenes*	*G. Krommidas*	Mandatory	5	6
4	116	Electrotechnics	*Th. Theodoulidis*	*A. Kiriazoglou*	Mandatory	4	6
5	138	Machine Elements II	*E. Varitis*		Mandatory	5	6

6th Semester

s/n	Code	Course	Instructor	Assisting	Course Designation	Hours	ECTS Credits
1	117	Electrical Machines	*K. Rallis*		Mandatory	4	6
2	123	Industrial Management	*K. Tasias*		Mandatory	5	6
3	106	Numerical Analysis	*R. Sotiropoulou* *C. Grompanopoulos*		Mandatory	5	6
4	219	Automatic Control Systems	*K. Rallis*		Mandatory	5	6
5	206	Internal Combustion Engines	*S. Douvartzidis*		Mandatory	5	6

2nd Study Cycle

The 2nd Study Cycle includes two semesters (7o and 8o).

Choose 3 Concentration Mandatory (CM) courses and 3 Elective (E) courses per semester, at least 1 of which should be Concentration Elective (CE).

En: Energy

I.M.: Industrial Management

Man: Manufacturing

7th Semester

s/n	Code	Course	Instructor	Assisting	Course Designation			Hours	ECTS Credits
					En.	I.M.	Man.		
1	204	Steam Generators	*S. Douvartzidis*		CM	E	E	5	5
2		Heating	*G. Panaras*	*L. Karagiannakis*	CM	E	E	5	5
3		Ventilation - Air-Conditioning	*N. Taousanidis*		CM	E	E	5	5
4	250	Experimental Methods and Measurement Technology	*E. Konstantinidis*		CE	CE	E	4	5
5	228	Computational Mechanics	*R. Sotiropoulou*		CE	CE	E	4	5
6	230	Quality Control	*S. Panagiotidou*		E	CM	CE	4	5
7	372	Numerical methods in design of mechanical structures	*D. Giagopoulos*		E	E	CM	5	5
8	380	Computer Aided Design	*N. Sapidis*	*N. Ntinas*	E	E	CM	4	5
9	261	Advanced Structural Mechanics	*A.Arailopoulos*		E	E	CM	4	5
10	262	Advances Materials - Nanomaterials	*A. Krestou*		E	-	CE	4	5
11	377	Operations Research II	*G. Nenes*		E	CM	E	4	5
12	260	Decision Analysis	*K. Tasias*		E	CM	E	4	5
13	131	Environmental Technology	*G. Marnellos*	*E. Mantella*	E	E	E	4	5
14	199	Mechanical Engineering Capstone Project	-		E	E	E	-	5

8th Semester

s/n	Code	Course	Instructor	Assisting	Course Designation			Hours	ECTS Credits
					En.	I.M.	Man.		
1	205	Turbomachinery	*A. Tourlidakis*		CM	E	E	5	5
2	251	Energy design of buildings I	*G. Panaras*	*L. Karagiannakis*	CM	E	E	4	5
3	249	Fluid Mechanics II	*E. Konstantinidis*		CM	E	E	4	5
4	263	Computational Fluid Dynamics	*K. Vafiadis*		CE	E	E	4	5
5	210	Unit Operations	*A. Krestou*	*A. Lampropoulos*	CE	E	E	4	5
6	241	Technological Systems Reliability and Maintenance	*S. Panagiotidou*	*D. Kampitsis*	E	CM	E	4	5
7	255	Inventory Management	*G. Nenes*	*G. Krommidas*	CE	CM	E	4	5
8	224	Strategic Management	*A. Kontogianni*		E	CE	E	4	5
9	252	Computer Aided Manufacturing for Industrial Production	*S. Gerardis* *E. Varitis*		E	E	CE	4	5
10	256	Nondestructive Testing	*Th. Theodoulidis*	A. Kiriazoglou	E	CE	CM	4	5
11	257	Design and Analysis of Experiments	*S. Panagiotidou*	*G. Krommidas*	E	CM	E	4	5
12	258	Biomedical Engineering	*A. Tsamis*		E	CE	CM	4	5
13	259	Advanced Information Technologies and Programming for Mechanical Engineers	*C. Grompanopoulos*		E	CE	CE	4	5
14	382	Structural Dynamics	*D. Giagopoulos*		E	E	CM	4	5
15	264	Structural Optimization	*A.Arailopoulos*		E	E	CE	4	5
16	127	Alternative Energy Systems	*G. Skodras*		E	E	E	4	5

3rd Study Cycle

The 3rd Study Cycle includes two semesters (9o and 10o).

Choose 2 Concentration Mandatory courses and 4 Elective Courses, at least 2 of which should be Concentration Elective (CE)..

PTDE: Production, Transport and Distribution of Energy

EEEU: Environmental Engineering and Energy Use

I.M.: Industrial Management

Man: Manufacturing & Materials

9th Semester

s/n	Code	Course	Instructor	Assisting	Course Designation				Hours	ECTS Credits
					PTDE	EEEU	I.M.	Man		
1	327	Energy design of buildings II	*G. Panaras*	*L. Karagiannakis*	CM	CE	E	E	4	5
2	318	Wind and water turbines, hydroelectric plants	*A. Tourlidakis*		CM	E	E	E	4	5
3	316	Solar Technique/ Photovoltaic systems	*N. Taousanidis E. Souliotis*		CE	CE	E	E	4	5
4	391	Atmospheric Pollution	*R. Sotiropoulou*		E	CM	-	E	4	5
5	349	Special topics on energy conversion technologies	*G. Marnellos*		CE	CM	E	E	4	5
6	397	Applied Aerodynamics	*K. Vafiadis*		CE	E	E	E	4	5
7	398	Design of Welded Structures	*S. Gerardis*		E	E	E	CM	4	5
8	371	Vehicle Design Methods	*I. Ziganitidis*		E	E	E	CE	4	5
9	356	Technology, Research, Innovation Policies and Entrepreneurship	*E. Samara*		-	-	CE	E	5	5
10	389	Risk Management and Safety of Large Industrial Systems	*I. Bakouros*		-	-	CE	E	3	5
11	376	Technical and Energy Legislature	*K. Rallis*		E	E	E	E	3	5
12	393	Supply Chain Management	*K. Tasias*		E	E	CM	E	4	5

s/n	Code	Course	Instructor	Assisting	Course Designation				Hours	ECTS Credits
					PTDE	EEEU	I.M.	Man		
13	394	Advanced Robotics Technology in Mechanical Manufacturing	*Not Available*		E	E	E	CE	4	5
14	387	Environmental Management	*A. Kontogianni*		E	CE	E	E	4	5
15	396	Design and Development of Mechanical Products	*I. Chatziparasidis*		E	E	E	CM	4	5
16	399	Production of Environmentally Friendly Fuels	*E. Papista*		E	E	E	E	4	5

10th Semester

s/n	Code	Course	Instructor	Assisting	Course Designation				Hours	ECTS Credits
					PTDE	EEEU	I.M.	Man		
1	385	Gas Turbine Technology	*A. Tourlidakis*		CE	E	E	E	4	5
2	404	Unsteady Flows	*E. Konstantinidis*		E	E	-	E	4	5
3	348	Combustion Phenomena	*S. Douvartzidis*		E	E	E	E	4	5
4	390	Renewable Energy Sources Laboratory	*N. Taousanidis G. Panaras E. Souliotis*		E	E	E	E	3	5
5	350	Special topics on pollution control technologies	*R. Sotiropoulou*		E	CE	E	E	4	5
6	379	Materials for Environmental and Energy Applications	*A. Krestou*		E	CE	E	E	4	5
7	367	Simulation and System Dynamics	*G. Nenes*		E	E	CM	E	4	5
8	400	Expert Systems for Engineers and Design Automation for Mechanical Products	*I. Chatziparasidis*		-	-	E	CE	4	5
9	388	Economic Valuation of Energy and Industrial Externalities	*A. Kontogianni*		E	CE	CE	E	4	5
10	401	Thermal Process Equipment	*E. Papista*		CE	E	E	E	3	5
11	392	Project Management	*G. Konstantas*		E	E	CE	E	4	5

s/n	Code	Course	Instructor	Assisting	Course Designation				Hours	ECTS Credits
					PTDE	EEEU	I.M.	Man		
12	395	Total Quality Management	*M. Gianni*		-	-	CE	E	4	5
13	352	Techno-economic Assessment	*A. Asimakopoulou*		E	E	CE	E	4	5
14	403	Aerodynamic Design and Control of Aircrafts	*K. Vafiadis*		E	E	E	E	4	5
15	402	Conventional and Advanced Energy Storage Systems	*E. Papista*		E	E	E	E	4	5

8.4 Degree Grade Calculation

The degree is calculated using the following algorithm:

α) all 32 first cycle courses (excluding English), the 12 second cycle courses (Concentration Mandatory, Concentration Elective and Elective) along with the six third cycles courses (Cycle Mandatory) as per the indicative Curriculum Guide are required for obtaining a Degree and carry a weight of W_i=1.

β) Diploma thesis weight is W_δ=6.

Degree grade is then (D.G.) given by:

$$\mathrm{D.G.} = \frac{W_\delta B_\delta + \sum_{i=1}^{M} W_i B_i}{W_\delta + \sum_{i=1}^{M} W_i}$$

where M is the number of courses passed successfully in exams, B_i is the successful examination grade of course i and B_δ is the Diploma Thesis grade.

COURSE CONTENTS

9. COURSE CONTENTS

*Detailed Course description of **available** courses*

Abbreviations:

Sm.: Course Semester

C.H.: Weekly Course Lecture hours

ECTS: Course Credits according to European Credit Transfer System (E.C.T.S.)

Semester duration is 13 full weeks

Lecture language is Greek

MATHEMATICS I	
Course code	101
URL	-
Recommended Prerequisites	-
Course content	Sets, Real numbers, Sequences of real numbers, Series of real numbers, Real functions of a single variables, Limits and continuity, Derivatives, Application of derivatives, Indefinite and definite integrals, improper integrals, Applications of integration, Power series.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • examine the convergence of real sequences, series, as well as power series, • calculate infinite sums, • study real functions of one variable, • differentiate parametrically-defined and implicit functions, • determine lines tangent to plane curves that are described in different ways, • calculate indefinite, definite, and improper integrals,

	• use polar coordinates, • calculate the area between curves, and the length of plane curves, • approximate functions with polynomials.
Teaching methods	Lectures, exercises

PHYSICS	
Course code	103
URL	http://eclass.uowm.gr/courses/MECH201/
Recommended Prerequisites	-
Course content	Basic Theory of Mechanics. Newton's Laws. Forces. Principles of Energy Conservation of Momentum and Angular Momentum. Kinematics and Dynamics of Material Point. Rigid Body Kinematics. Relative Motion. Rigid Body Dynamics in the Plane and in Space. Oscillations, Electric charge and Electric Field, Electric Potential, Electric Currents, DC Circuits, Magnetism, Electromagnetic Induction and Faraday’s Law, Electromagnetic Waves.
Expected learning outcomes and competences to be acquired:	The course presents systematically basic knowledge of Mechanics and Electromagnetics. After the completion of the course the students should be able to: • Extract the equations that define the variation of the space, speed and acceleration in one, two and three dimensions • Extract the equations of the motion of material point • Apply the law of Conservation of Energy • Calculate the Rolling, Torque, and Angular Momentum • Apply the Coulomb’s Law • Calculate the Intensity of Electric Fields • Calculate the electric potential • Apply the Gauss law • Calculate the capacitance

	• Calculate the resistance • Calculate the intensity of magnetic fields • Apply the Kirckoff laws for the electrical circuits
Teaching methods	Hours of Instruction 52

CHEMISTRY	
Course code	104
URL	http://eclass.uowm.gr/courses/MECH118/
Recommended Prerequisites	-
Course content	Introduction to the basic principles of the structure of atoms, Quantum mechanical approach of atoms, Electronic configuration of atoms, Periodic system of elements, Ionic and co-valent bonds, Molecular geometry, Hybridization, Molecular orbital theory, Metallic bonds, Intermolecular forces, Chemical kinetics, Chemical equilibrium, Chemical solutions, Acids – Bases - Salts, Redox processes & electrochemistry, Spectroscopic techniques.
Expected learning outcomes and competences to be acquired:	The course introduces the student to the basic principles of chemistry with particular emphasis on inorganic chemistry and physical chemistry. Through theoretical lectures and by solving related exercises, the students following the chemistry course are introduced to the basic principles and applications of chemistry related to the mechanical engineering field (i.e., Materials, Kinetics, Thermodynamics, Electrochemistry, etc.). Upon successful completion of the chemistry course the student will be able to: • Understand the basic principles of Chemistry and Physical Chemistry. • Understand the structure of the atoms and their properties according to their position on the periodic table. • Understand their electronic configuration and how their orbits are completed. • Understand the types of bonds to which the elements are

linked to form the compounds (gases, liquids, solids).

- Understand their geometrical configuration.
- Understand the concepts of Chemical kinetics and the rate of reactions (activation energy, reaction order).
- Explore reaction mechanism and kinetics by the experimental data
- Understand how temperature, pressure and concentration affect the collisions of the elements for the evolution of the reaction.
- Understand the mechanism of catalysis and its applications.
- Understand the concept of chemical equilibrium and its role in selecting the reaction conditions for industrially important reactions.
- Be aware that the reaction conditions affect the position of equilibrium.
- Understand the chemical solutions, the concept of solubility, the effect of the conditions (temperature, pressure) on the solubility of the compounds in various solutions.
- Be able to define concentrations in solutions in various ways.
- Identify which compounds are considered as acids, bases and salts.
- Be able to determine which acids or bases are strong or weak.
- Define the pH value of the solutions.
- Be aware of the phenomenon of acid rain.
- Be aware of the importance of solutions in everyday life.
- Define which reactions are oxidation or reduction processes.
- Understand the redox mechanism.
- Equilibrate redox reactions.
- Be able to estimate the open circuit potential in electrochemical cells.
- Understand the principles of operation of electrolyzers,

	fuel cells and batteries.
Teaching methods	Hours of Instruction 52

INTRODUCTION TO COMPUTING	
Course code	105
URL	http://eclass.uowm.gr/courses/MECH154/
Recommended Prerequisites	-
Course content	General computing literacy, hardware design and operation, basic problem solving techniques. Basic principles of programming using the MATLAB environment and language: the command prompt, scripts, tables, graphics and data visualization, flowcharts, selection and repetition structures, data input-output.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to: • recognize the main parts of a Computer System (processor, memory, peripherals) and understand their operation during the execution of an application, • have adequate knowledge of the basic programming principles (variables, selection, repetition, functions) through a high level programming language (Matlab/Octave), • formulate ways of solving simple algorithmic problems and demonstrate their solution with the creation of the appropriate scripts, • apply mathematical knowledge (arrays, functions) with the use of Matlab/Octave, • collect/store (from/into files) and represent graphically data with the use of Matlab/Octave, • utilize files to collect/store data and create plots with the use of Matlab/Octave, • utilize computing systems and their applications for the solution of problems in the field of Mechanical Engineering, • engage in collaborative problem-solving of complex

	problems during group projects.
Teaching methods	Lectures (13 weeks x 2 hours theory and 2 hours practice problems in the lab)

MECHANICAL DRAWING I

Course code	113
URL	http://eclass.uowm.gr/courses/MECH115
Recommended Prerequisites	-
Course content	Fundamental ISO rules for drawing (types of technical drawings, drawing tools and sheets, title block, parts list, drawing scales, types of lines and line widths, lettering), introduction to Computer-Aided Design/Drafting (CAD), views and representation of mechanical components (types of views, technical sketch, construction drawing, assembly drawing, rules and basic conventions for views), dimensions (ISO rules and principles for dimensioning, special symbols for dimensioning, basic methods and paradigms for dimensioning), Sections (general principles and rules for drawing sections, special types of sections, sections in multiple cutting planes).
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to • fully comprehend fundamental concepts related to the various kinds of Technical Drawings, • comprehend and apply ISO rules dealing with Technical/Mechanical Drawings, • construct a correct, according to the related ISO rules, Technical Drawing for an object of low or medium complexity, • evaluate correctness of a given Technical Drawing regarding both accuracy of representation (of the corresponding object) as well as agreement with applicable ISO rules,

	• demonstrate basic knowledge of industrial application of Technical/Mechanical Drawings, • construct a correct Technical Drawing (for an object of low complexity) using appropriate Computer-Aided Design software, • demonstrate basic knowledge of difficulties (and research issues) related to applying ISO rules in Mechanical Drawing and in engineering work in general.
Teaching methods	Lectures (13 weeks x 2 hours of Theory and 2 hours of Drawing Exercises)

LINEAR ALGEBRA

Course code	144
URL	eclass.uowm.gr/courses/ICTE211/
Recommended Prerequisites	-
Course content	Vector Calculus. Straight Lines, Surfaces and Curves in Space. Vector Spaces and Vector Subspaces. Linear independence, Bases and dimension of vector Spaces. Matrices and Determinants. Finite-dimensional linear mappings. Matrices of linear maps. Systems of Linear Equations and Matrices. Solution of Systems of Linear Equations. Eigenvalues-Eigenvectors. Matrix Diagonalization, Quadratic Forms.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • know and manage the general form of curves and surfaces, • understand and use concepts of vector spaces, • use matrices as tools in theoretical and numerical computations, • compute eigenvalues and eigenvectors, • compute determinants, • solve systems of linear equations,

	• manage and use matrix diagonalization.
Teaching methods	Lectures, exercises

ENGLISH	
Course code	141
URL	eclass.uowm.gr/courses/ICTE141/
Recommended Prerequisites	-
Course content	What is Engineering, Traits of an Engineer, An Engineer's Education, Tables & Graphs, Dimensions & Drawings, Working with Numbers, Newton's Laws, Rate Processes, SI System of Units
Expected learning outcomes and competences to be acquired:	The course is an introduction to ESP/EAP courses and includes short discipline-based texts with a view to enabling students to: • enhance already English language acquired skills and be able to attend ENGLISH (ESP/EAP) courses • take part in various European programmes (Erasmus + etc.) The course is focused on understanding and learning special Engineering vocabulary, and developing skills for reading and understanding authentic scientific texts. In particular, emphasis is placed on: • recognising and becoming familiar with ESP linguistic structure and function (grammar, lexis, discourse) used to connect and organise meanings in written and oral speech • identifying and composing information and applying basic skills to produce simple academic discourse (short sentences, paragraphs descriptions, comparisons, references, etc.) • interpret and produce information from diagrams, tables, Mathematics & Physics formulae, etc. • compare academic discourse between L1 (Greek) and

	L2 (English) • develop intercultural competence as a requirement of contemporary social awareness
Teaching methods	2 Hours per week (lectures)

MATHEMATICS II

Course code	102
URL	-
Recommended Prerequisites	-
Course content	The ℝn space, Quadratic surfaces, Real functions of several variables, Partial derivatives, Chain differentiation, Directional derivative, Extreme values, Taylor series, Double integrals, Triple integrals, Vector functions, Curves, Line integrals, Differentiation of scalar and vector fields, Conservative fields, Green's theorem, Surface integrals, Gauss και Stokes theorems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • differentiate variables of several functions, • use cylindrical and spherical coordinates, • find extreme values (free/constraint) and saddle points, • linearize functions and find tangent planes, • perform double and triple integration, • manipulate vectors, • differentiate vector functions, • detect irrotational and solenoidal fields, • determine potentials for conservative fields, • parametrically describe curves and surfaces, • calculate line integrals and fluxes through surfaces of vector fields, • use Green's, Gauss, και Stokes theorems.
Teaching methods	Lectures, exercises

MATERIALS SCIENCE AND TECHNOLOGY I

Course code	109
URL	https://eclass.uowm.gr/courses/MECH200/
Recommended Prerequisites	• Physics • Chemistry
Course content	Atomic structure, chemical bonds, Crystallography and Crystal Stucture (crystalline systems, Bravais lattices, elementary cells, directions, levels, measuring density, single- and poly-crystalline materials), structure verification diffraction X-ray crystal structure imperfections (point, linear, flat, three-dimensional). Granules, grain microstructure limits, microscopy, particle size. Mobility of atoms and Diffusion in solid state (mechanisms, laws of Fick). equilibrium phase diagram (solid solutions, thermodynamic interpretation of Gibbs law, binary diagrams). Physical Properties (Electrical, Thermal, Magnetic, Optical). Oxidation, Corrosion and Protection.
Expected learning outcomes and competences to be acquired:	Introduction to basic concepts of crystal structure, materials properties as a function of the microstructure and processing. Standard materials are metallic materials, but also considered are non-metallic (ceramic, polymer for which are developed the relationships governing the physical properties.
Teaching methods	Lectures and tutorials, Materials and XRD lab

ENGINEERING STATICS

Course code	111
URL	http://eclass.uowm.gr/courses/MECH151/
Recommended Prerequisites	• Mathematics I • Physics • Linear Algebra

Course content	Force and moment. Addition and resolution of forces. Free body diagram. Equilibrium conditions. Elementary structures: rods, beams, cables. Advanced structures: frames, trusses. N-Q-M diagrams. Friction: brakes, clutches, couplings, belts. Center of mass. Moments of Inertia.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to • have/demonstrate a full understanding of the basic types of structures involved in standard engineering applications, • know about and handle the various types of external loads for all kinds of structures considered in this course, • comprehend issues related to supporting a structure either on the "ground" or on some other structure, • analyze beams and frames of various geometric configurations, • thoroughly analyze a truss of medium complexity regarding both geometric rigidity as well as member forces, • calculate the centroid of a complex planar area, • analyze a flexible chain or cable subjected to loads appearing in standard applications.
Teaching methods	Lectures (13 weeks x 2,5 hours of Theory and 2,5 hours of Exercises)

MECHANICAL DRAWING II

Course code	146
URL	http://eclass.uowm.gr/courses/MECH140
Recommended Prerequisites	• Mechanical Drawing I • Mathematics I • Physics • English I
Course content	Computer-aided mechanical drawing (CAD), Drawing of connection elements (geometric features and categories of threads, standard threads, drawing of thread holes,

	dimensions and types of screws, standardization of bolts, nuts and tools, bolted joints and related components, rivets, welding methods and drawing of welds), Manufacturing processes (surface quality, surface roughness, selection criteria for manufacturing processes, symbols and regulations, notations for heat treatments and hardness processes), Tolerances (dimensional tolerances, fits and fittings, standardization according to ISO, tolerances of form/orientation/location), Power transmission elements (shafts, bearings, wedges, splines, gear geometry and notation, types of gears, sprockets), drawing of mechanical assemblies (e.g., gearboxes), three-dimensional (3D) representation (types of 3D representations, oblique projection, axonometric projection, perspective representation).
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to: • comprehend fundamental concepts related to connection elements and construct a correct Mechanical Drawing employing these, • demonstrate knowledge about symbolic representation of welded/brazed/soldered joints in drawings, • comprehend issues related to assembly drawings and construct such a drawing, • demonstrate knowledge and apply drawing techniques related to manufacturing processes, • fully comprehend issues related to tolerances/deviations/fits and apply them in Mechanical Drawing, • construct a correct Mechanical Drawing (for an object of low or medium complexity) using appropriate Computer-Aided Design (CAD) software, • demonstrate basic knowledge of difficulties (and research issues) related to applying ISO rules and mechanical CAD in the manufacturing industry.
Teaching methods	Lectures (13 weeks x 2 hours of Theory and 2 hours of Drawing Exercises)

ENGLISH (ESR/EAP)	
Course code	142
URL	eclass.uowm.gr/courses/ICTE142/
Recommended Prerequisites	• English
Course content	• Basic concepts in Engineering: Materials • Manufacturing processes & machine tools • Conventional machine tools: Lathe • Conventional machine tools: Milling machine • CNC Machines • Internal Combustion Engines • Electricity Generation • Renewable Energy Sources • Turbines • Heating – Ventilation – Air Conditioning (HVAC) • Computer-Integrated- Manufacturing • Production Planning & Control
Expected learning outcomes and competences to be acquired:	The course is focused on improving learning strategies and knowledge in the relevant discipline, and further developing critical thinking and academic skills to enable students to identify, understand and write academic discourse (scientific texts, reports, descriptions, etc.), and use the relevant literature. In particular, the course emphasises the development of two basic skills, reading and writing, which are required at all levels of Higher Education, and qualifies students with: • further improving and expanding knowledge of the lexis and structure of various academic and scientific texts (research papers, theses, etc.) • interpreting key information and producing information from charts, tables etc. • developing skills and strategies employed in academic discourse (paraphrasing, paragraph composition, abstracts, etc.) • practising writing skills for research papers and theses • using referencing and bibliography
Teaching methods	2 **Hours per week** (lectures)

STRENGTH OF MATERIALS	
Course code	110
URL	http://eclass.uowm.gr/courses/MECH155/
Recommended Prerequisites	• Statics • Science and Technology of Materials I • Science and Technology of Materials II
Course content	Axial loading, shearing stress, bearing stress in connections, stress under general loadings, Safety Factor, Hooke's law, Modulus of Elasticity, elastic vs. plastic behavior, static indeterminacy, thermal stresses, Poisson's ratio, generalized Hooke's law, shearing strain, Saint-Venant's principle. Torsion: Stress, strain, angle of twist in elastic range, statically indeterminate shafts, design of transmission shafts, stress concentrations. Pure Bending: Deformations in symmetric member, strain due to bending, bending of members made of several materials, stress concentrations, asymmetric bending, general case of eccentric axial loading. Design and analysis of beams: N,Q,M diagrams, determination of the shearing stress in common or complex types of beams, shear stresses in thin-walled members. Stress–Strain Transformations: Plane stress transformation, principal stresses, maximum shear stress, Mohr's Circle for plane stress and general Three-Dimensional analysis of stress and strain.Deflection of beams: Deformation of a beam under transverse loading, equation of the elastic curve, determination of the elastic curve from the load distribution, method of superposition, moment–area theorems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • analyse a given problem in a simple and logical manner, • apply in a solution some fundamental and well understood principles, • understand the concepts of deformable solid body by applying the principles of the theory of elasticity, • acquire the knowledge to analyse stresses in particular

	building blocks, components of machines or devices, with specific support, at constant or anticipated external loads applied in certain ways, • understand the concepts of tension, compression, torsion, bending, eccentric axial loading and deflection, • determine the expected mechanical behaviour of structural elements or components of machines or devices, as the basis of proper design or validation of their safety factor.
Teaching methods	Hours of Instruction 65 (Theory: 26, Exercises: 39)

STATISTICS

Course code	107
URL	http://eclass.uowm.gr/courses/MECH164/
Recommended Prerequisites	Mathematics I & II
Course content	Descriptive statistics: data summary and presentation, frequency distribution, histogram, characteristic values (mean, median, mode, range, variance, standard deviation). Probability theory: basic concepts, events, conditional probability, addition and multiplication law of probabilities, Bayes theorem. Probability distributions, discrete and continuous random variables, expected value, variance and standard deviation. Important distributions: Bernoulli, binomial, geometric, Poisson, uniform, exponential, gamma, normal distribution and the central limit theorem, Student, X2 and F distributions. Statistical estimation: sampling distributions, point estimation, properties of estimators, confidence intervals. Statistical hypotheses: hypothesis testing, type I and type II errors, required sample size, goodness of fit tests.
Expected learning outcomes and competences to be acquired:	This course is the introductory course in the concepts, techniques and tools of statistics. The aim of the course is to introduce the basic concepts of probabilities and statistics and to present the main tools and scientific methods of both descriptive and inferential statistics. An additional aim of the course is to present alternative applications of statistical

	methods used in a variety of operational (and not only) problems. The course is the basis for several advanced courses in the industrial management direction of studies, on which specific statistical methodologies and techniques are developed and applied. After successful completion of the course, students will be able to: • process data sets • apply the basic principles of the probability theory • perform Bayesian updating • identify and use the basic probability distributions • calculate probabilities using probability (density) functions • perform statistical estimates • calculate confidence intervals • perform and interpret statistical hypothesis testing.
Teaching methods	Hours of Instruction 65 (Theory: 39, Exercises: 26)

THERMODYNAMICS I

Course code	119
URL	http://eclass.uowm.gr/courses/MECH105/
Recommended Prerequisites	• Physics • Mathematics I • Mathematics II
Course content	Basic principles of Thermodynamics. The First Law of Thermodynamics in closed systems, properties of pure substances, Phase diagrams for gases and liquids, equations of State, the First Law of Thermodynamics for open flowing systems, The Second Law of Thermodynamics, Entropy and the third Law, Power, refridgeratıon and heating cycles, Gas and vapor cycles: Carnot, Otto, Diesel, Brayton, Rankine.
Expected learning outcomes and competences to be	Course focuses on the understanding of the fundamental concepts and principles in thermodynamics with emphasis on the solution of engineering problems and on the analysis

acquired:	of energy systems and flow processes.
Teaching methods	Oral presentations and exercises

MATHEMATICS III	
Course code	132
URL	http://eclass.uowm.gr/courses/ ICTE109/
Recommended Prerequisites	• Mathematics I • Mathematics II • Linear Algebra
Course content	Introduction. First-order ordinary differential equations. Separable equations. Exact equations, integrating factors. Linear equations. Solution via substitution. Higher-order ordinary differential equations. Linear equations with constant coefficients. Order reduction. Solution of inhomogeneous differential equations. Laplace transform and its use for solving differential equations. Series solution of differential equations, ordinary and singular points. Systems of differential equations, solution with the matrix method. Complex numbers. Complex functions. Differentiation of complex functions. Integration of complex functions.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • recognize the mathematical models for certain physical problems, • identify the general form of differential equations, • apply appropriate methods for determining partial and general solutions, • solve initial value problems, • determine solutions in the form of power series, • exploit the Laplace transform, • solve systems of differential equations, • graphically solve certain types of differential equations, • deal with fundamental problems of complex analysis.

Teaching methods	Lectures, exercises

MATERIALS SCIENCE AND TECHNOLOGY II	
Course code	135
URL	http://eclass.uowm.gr/courses/MECH199/
Recommended Prerequisites	• Statics • Strength of Materials • Mechanical Drawing • Machine Elements I
Course content	Equilibrium phase diagrams in binary systems (complete solid solubility, lever rule, eutectic phase diagrams and peritectic phase diagrams). The Fe-C system. Basic solidification mechanisms. Nucleation and Growth, Casting, Segregation. Phase transformations and thermal processing of steel alloys and cast metals (fabrication processes, precipitation processes, annealing processes, recovery, recrystallization and grain growth). Diffusion phase transformations. TTT and CCT diagram. Hardening and strengthening of steels. Precipitation hardening. Jominy test. Engineering materials (steels, cast irons, copper alloys, light metals, titanium alloys, Zn alloys, Pb alloys, superalloys. Corrosion and surface protection. Ceramics
Expected learning outcomes and competences to be acquired:	To acquire general knowledge about the properties of materials and their significance in various applications To study the materials by using the phase diagram, so as to correlate, to a first approximation, the properties of materials with their structure. To realize the importance of phase transformations and thermal processing of materials in mechanical applications. To familiarize with the different industrial alloys.
Teaching methods	Lectures and tutorials

DYNAMICS	
Course code	112
URL	http://eclass.uowm.gr/courses/MECH127/
Recommended Prerequisites	• Statics
Course content	Kinematics of particles (position vector, velocity, acceleration, rectangular coordinates, cylindrical coordinates, tangential coordinates, relative motion), Kinetics of particles (Newton's and Euler's laws of motion, principles of impulse and momentum, principles of work and energy), Kinematics of rigid bodies (translation, pure rotation, plane motion, rotation about a fixed point, spatial motion, relative motion), Kinetics of rigid bodies (inertia tensor, Newton's and Euler's laws of motion, principles of impulse and momentum, principles of work and energy, inertia forces), Applications (eccentric impact, balancing of rotating rigid bodies, axisymmetric rigid body rotation).
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • have a full understanding of the basic principles of dynamics. • understand the relationship between the movement of material bodies and the forces that cause motion or develop during motion. • classify the equilibrium benefits of material points and solid bodies. • analyze the movement of dynamic systems consisting of material points or solid bodies. • calculate the mass parameters of inertia of solid bodies. • apply the basic principles of dynamic problem solving with emphasis on the analysis and determination of motion and the forces that develop during the motion of the bodies. • solve typical examples using analytical and numerical methods.

Teaching methods	Lectures (13 weeks x 3 hour of Theory and 2 hours of Exercises) and homeworks.

MACHINE ELEMENTS I	
Course code	108
URL	-
Recommended Prerequisites	• Statics • Strength of Materials • Mechanical Drawing
Course content	Introduction to engineering analysis, Load, stress and strain, Normal, torsional, bending and transverse shear stresses and strains, Failure prediction for static and dynamic loading, Operating stresses, Calculation of static and dynamic strength, Combined stresses and equivalent stresses, Permissible stresses, Strength safety factors, Fasteners and screws. Welded joints.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • realize the importance of materials choice used in mechanical construction • perform study calculations and control studies on simple parts of machine components • understand the importance of machine elements design • construct and assembly various machine elements • carry out simple machine components project studies • work as designers or manufacturers at a machinery.
Teaching methods	Hours of Instruction 65 (Theory: 39, Exercises: 26) and 1 semester exercise (optional)

FLUID MECHANICS I	
Course code	120
URL	http://eclass.uowm.gr/courses/MECH103/
Recommended Prerequisites	• Physics • Thermodynamics I • Mathematics II
Course content	Basic definitions. Properties of fluids. Fluid Statics: Measurement of pressure, hydrostatic forces, buoyancy and Archimedes's law. Introduction to Fluid Dynamics: Bernoulli's equation and its applications. Kinematics of fluids, Eulerian and Lagrancian description of flow. Reynolds transport theorem. Control volume formulation and application in mass, momentum and energy conservation. Differential analysis of flow fields: stream function, vorticity and potential; elementary ideal, potential, flows and their combinations, examples and applications. Continuity equation, Euler and Navier Stokes equations of motion, Energy equation and their applications. Viscous flows and their application in simple geometries: Poiseuille flow in a slit channel and a cylinder, Quette flow. Dimensional analysis, similarity and dimensionless numbers. Π- Buckingham's theorem. Flow in tubes: Fully developed flow, introduction to turbulence and the concept of the boundary layer. Dimensional analysis and the use of Moody's charts to determine the pressure drop in smooth and rough tubes.
Expected learning outcomes and competences to be acquired:	This course serves as an introduction to the basic principles of Fluid Mechanics. After completion, the students will have: • acquired knowledge of the application field, laws and basic principles of Fluid Mechanics. • acquired well-established knowledge regarding the principles and methods, as well as the importance of applying them for solving technical problems. • learned how to evaluate the suitability of each method, given the characteristics and particularities related with each specific problem.

	• acquire knowledge to solve, among others, the following problems: • Measurement/estimation of hydrostatic pressure • application of Bernoulli's equation for ideal flows • implement control volume analysis • application of Poiseuille's equation for viscous flows determination of pressure drop in tubes, etc
Teaching methods	Hours of Instruction 65

MATHEMATICS IV

Course code	137
URL	http://eclass.uowm.gr/courses/ICTE217/
Recommended Prerequisites	• Linear Algebra • Mathematics II • Mathematics III
Course content	Introduction to Partial Differential Equations (PDEs). Examples of PDEs. First-order PDEs. Linear, semi-linear, and quasi-linear PDEs. Characteristic curves. The Cauchy problem. Second-order PDEs, classification, standard forms. Eigenvalue problems. The Laplace equation, solution in Cartesian and polar coordinates, cases of homogeneous and inhomogeneous boundary conditions and infinite domains. Orthogonal functions, Fourier series and Fourier integrals. The heat equation, solution in finite and infinite spaces. Special functions. The wave equation, finite and infinite strings.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • identify different types of PDEs, • derive the mathematical models for different problems, • solve PDES with the method of characteristics, • deal with eigenvalue problems, • reduce PDES to their canonical forms,

	• apply separation of variables and other techniques for the solution of PDEs, • solve problems in different coordinate systems, • solve problems in finite, semi-infinite or infinite spaces, • use orthogonal functions and exploit Fourier series and integrals.
Teaching methods	Lectures, exercises

FUNDAMENTALS OF MACHINING

Course code	114
URL	-
Recommended Prerequisites	• Science and Technology of Materials I • Science and Technology of Materials II • Strength of Materials
Course content	Introduction to engineering analysis, Load, stress and strain, Normal, torsional, bending and transverse shear stresses and strains, Failure prediction for static and dynamic loading, Operating stresses, Calculation of static and dynamic strength, Combined stresses and equivalent stresses, Permissible stresses, Strength safety factors, Fasteners and screws, Welded joints.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • obtain a first look with the subject of machining processes, • understand the basics of forming methods, • choose the most appropriate machining method of an object considering dimensional precision requirements and general qualities and quantities, • recognize and understand concepts related to the modern systems, • compose and re-design products according to the needs of construction, • select the optimum parameters required at various

	machining, • have the theoretical background concerning the knowledge of conventional machine tools.
Teaching methods	Hours of Instruction 65

THERMODYNAMICS II	
Course code	133
URL	http://eclass.uowm.gr/courses/MECH129/
Recommended Prerequisites	• Mathematics I • Mathematics II • Physics • Thermodynamics I
Course content	Exergy, Ideal gas mixtures, Gibbs and Helmholtz functions. Combustion process. Mass transfer calculations in complete combustion, application of the first law of thermodynamics in combustion processes, heating value, enthalpy of reaction. Application of the second law in combustion processes. Thermodynamic relations, Maxwell's equations. Thermodynamic properties of systems with variable chemical composition, Equilibrium of thermodynamic systems. Chemical potential and chemical equilibrium. Dissociation. Thermodynamics of special systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, students will be able to: • Calculate exergy and its changes in several thermodynamic systems. • Calculate intensive and extensive properties of mixtures. • Apply the 1st and 2nd thermodynamic laws to reactive systems. • Calculate adiabatic flame temperature and heat of reaction in combustion applications. • Calculate the changes in entropy, enthalpy and internal energy of thermodynamic systems based on measured sizes and the use of Maxwell equations.

	• Choose the appropriate equation of state for each thermodynamic system. • Calculate concentrations and temperatures in thermodynamic systems where chemical equilibrium has occurred.
Teaching methods	Oral presentations and exercises

HEAT TRANSFER

Course code	118
URL	http://eclass.uowm.gr/courses/MECH105/
Recommended Prerequisites	• Thermodynamics I • Mathematics I • Mathematics II
Course content	Introduction to the mechanisms of heat transfer: conduction, convection and radiation. Conduction: Fourier's law, thermal conductivity, heat diffusion equation in Cartesian, polar and spherical coordinates. Steady-state conduction: heat resistance concept, critical radius of insulation, multi-dimensional configurations (analytical, graphical and numerical solutions), shape factor in common configurations, heat-transfer enhancement via fins. Transient heat conduction: Biot number, lumped-capacitance method, analytical solutions in simple geometries, Heissler charts, semi-infinite media. Forced convection: Newton's law of cooling, local and average heat-transfer coefficient, Nusselt number, Prandtl number, Reynolds number, dimensional analysis, analogy between heat/mass and momentum transport, internal and external flows, laminar and turbulent flow, flow and heat transfer over flat plates, cylinders and tube bundles, flow and heat transfer inside pipes. Natural convection: natural convection currents, Grashof number, Rayleigh number, natural convection over open surfaces and enclosed regions, Bernard convection cells, combined natural and forced convection. Boiling and condensation: pool boiling, boiling curve,

	empirical relationships for nucleate boiling, tube boiling, drop and film condensation, condensation over tubes and tube bundles. Thermal radiation: fundamentals of electromagnetic radiation and waves, Wien's displacement law, black-body radiation, Stefan-Boltzmann equation, interaction between radiation and real surfaces, heat exchange between surfaces, view factor.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, the students will be able to: • Understand the mechanisms of heat transfer and their influence on practical problems • Carry out energy balances • Solve the heat diffusion equation for specific cases • Utilize the concept of heat resistance to calculate the rate of heat transfer • Estimate the efficiency and effectiveness of fins • Understand and use different methodologies to estimate the time required for the transfer of specific amount of heat • Identify the dimensionless variables that govern heat convection problems • Estimate the convection heat transfer coefficients in internal and external flows • Understand the physical mechanisms of boiling and condensation • Estimate heat transfer coefficients associated with phase change • Know the basic types of heat exchangers • Analyse the performance and design heat exchangers
Teaching methods	Lectures and Tutorials

MECHANICAL VIBRATION AND MACHINE DYNAMICS

Course code	140

URL	http://eclass.uowm.gr/courses/MECH107
Recommended Prerequisites	• Dynamics
Course content	Free vibration and forced response of single degree of freedom linear oscillators to impulsive, harmonic, periodic and transient excitation (natural frequency, damping ratio, resonance). Response of multiple degree of freedom linear oscillators (formulation of the equations of motion, determination of natural frequencies and mode shapes, modal analysis). Axial, torsional and bending vibration of bars. Applications (measurement and evaluation of vibration characteristics, vibration isolation, vibration absorption, balancing, torsional vibration). The course, beyond the theoretical teaching, introduces the student and into programming, based on application programs in an environment of MATLAB. In the course, three (3) laboratory exercises are conducted from which students are informed about the experimental methods in vibrations of mechanical systems and have the opportunity to see the connection of the theory with the actual constructions.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • have a full understanding of the underlying principles of oscillation. • develop simplified models of mechanical systems. • develop and solve the motion equations of mechanical systems. • predict dynamic and oscillating behavior of systems based on model analysis. • understand the basic dynamic characteristics that affect the dynamics of mechanical systems. • apply the methodologies in the design of mechanical vibration isolation devices. • solve typical examples using analytical and numerical methods.
Teaching methods	Lectures (13 weeks x 3 hour of Theory and 2 hours of Exercises) and homeworks.

OPERATIONS RESEARCH I	
Course code	147
URL	http://eclass.uowm.gr/courses/MECH165
Recommended Prerequisites	• Statistics
Course content	Introduction to optimization, mathematical programming models, variables, objective function parameters, constraints. Linear programming theory, graphical solution, Simplex method, sensitivity analysis. Linear programming problem solving using computer software (lindo, lingo, EXCEL solver). Integer programming. Branch and Bound algorithm. Binary programming. Applications to real-world problems.
Expected learning outcomes and competences to be acquired:	The course introduces students to the basic knowledge of Quantitative Analysis. Particular emphasis is given to optimization techniques for real production processes and systems. The course also studies case studies to prepare students for modeling real process optimization problems. Upon completion of the course, students will understand the basic functions and the most important decision making tools within production systems (such as inventory management, equipment maintenance, quality control, demand forecasting, production planning) as well as their interactions, and they should be able to: • understand the relationship between real problems and mathematical modeling • identify and use basic operations research tools • model real problems using mathematical programming • solve and obtain optimum solutions for various engineering problems • analyze existing solutions of engineering problems.
Teaching methods	Hours of Instruction 65 (Theory: 39, Exercises: 26)

ELECTROTECHNICS	
Course code	116
URL	http://eclass.uowm.gr/courses/ICTE163/
Recommended Prerequisites	-
Course content	Electrical charge, current, voltage, power. Kirchhoff laws and Tellegen theorem. Electrical components and their connection. Resistance, impedance, conductivity, complex conductivity. Methods of analysis of circuits in DC and AC (voltage division, current division, Millman theorem). Use of phasors and complex numbers. Systematic methods of analysis of electrical circuits (loop method, node method). Electrical circuit theorems (superposition, maximum power transfer, Thevenin, Norton). Power and energy in sinusoidal excitation circuits. Power triangle, power factor and correction. Symmetric three-phase circuits.
Expected learning outcomes and competences to be acquired:	The aim of the course is to introduce the student to the basic knowledge of theory and analysis of electrical circuits. Through this course the student acquires the necessary knowledge in order to be able to understand (in following courses) aspects of electric machines as well as issues of power production, transmission, distribution and use. Upon successful completion of the course, the student will: • Be familiar with the basic laws governing electrical circuits (DC and AC). • Be able to analyze DC and AC electrical circuits and calculate basic current, voltage and power quantities. • In the case of AC circuits convert circuits to the frequency domain and analyze them with phaset using the complex number theory. • Use the theorems of electrical circuits and synthesize equivalent circuits. • Apply general methods of solving and analyze electrical circuits of any complexity. • Recognize the basic circuits of three-phase circuits and make basic calculations using the one-phase equivalent.

	• Understand the advantages and disadvantages of using DC, AC and AC three-phase current. • Develop problem-solving abilities and evaluate numerical calculations to understand the order of magnitude.
Teaching methods	Hours of Instruction 52 (Theory: 32, Laboratory: 20)

MACHINE ELEMENTS II

Course code	138
URL	http://eclass.uowm.gr/courses/ MECH121/
Recommended Prerequisites	• Statics • Strength of Materials • Mechanical Drawing • Machine Elements I
Course content	Lubricants and lubrication, Hydrodynamic bearings and seals, Shafting and associated parts, Power transmission, Flat, synchronous and V-belts, Parallel axis gears, Planetary gear trains, Nonparallel coplanar and non-coplanar gears, Gearboxes, Design of power transmission systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • understand the different methods of support shafts and spindles and the diversity of bearings versus sliding bearings usage, • understand the basic concepts of motion and power transfer from axis to axis, by means of straps, chains and gears, • have the ability to assess and solve complex problems of movement and power transfer, • develop operational provision engines in laboratory spaces, • carry out complex machine components project studies, • work as designers or manufacturers at a machinery.

Teaching methods	Hours of Instruction 65 (Theory: 39, Exercises: 26) and 1 semester exercise (optional)

ELECTRICAL MACHINES	
Course code	117
URL	http://eclass.uowm.gr/courses/MECH170/
Recommended Prerequisites	• Electrotechnics
Course content	Fundamental principles of electromagnetism and principles of operation of AC and DC electric motors. Single-phase and three-phase transformers. Equivalent circuit. Synchronous generators. Equivalent circuit and parallel operation. Synchronous motors. Induction motors. Equivalent circuit. Typical torque-speed. Speed regulation, starting and motor selection.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, the student will: • Have understood the phenomenon of electromechanical energy. • Be familiar with the basic types of AC electric motors. • Use equivalent electrical circuits to analyze electrical machines and extract their functional characteristics. • Have understood the behavior of generators and engines in changing their loads. • Be able to choose the appropriate type and size of engines for specific applications. • Be able to choose appropriate engine start and engine methods. • Have understood the operation of the overall production, transmission, distribution and use of electricity. • Develop problem-solving abilities and evaluate numerical calculations to understand the order of magnitude.
Teaching methods	Hours of Instruction 52 (Theory: 32, Laboratory: 20)

ALTERNATIVE ENERGY SYSTEMS

Course code	127
URL	http://eclass.uowm.gr/courses/MECH132/
Recommended Prerequisites	• Statistics • Thermodynamics • Mathematics
Course content	Introduction to energy policy issues. Energy in the European Union. The EU Green Bible for the security of the energy supply. The EU White Bible for the Renewable Energy Sources. Energy reserves and resources. The Greek energy system. Solar energy-basic principles. Solar collectors and photovoltaics. Wind energy and wind parks. Energy from biomass. Energy utilization of biomass. Hydropower and power plants – Advantages and disadvantages. Geothermal energy and geothermal fields. Tidal and wave energy. Ocean thermal energy. Energy conservation. Thermodynamic analysis of the renewable energy systems. Environmental analysis of the renewable energy systems. Social and economic impacts.
Expected learning outcomes and competences to be acquired:	The course presents systematically the renewable energy sources the systems and the cutting edge developments. After the completion the students will be able to approach effectively the issues of RES and to handle design and implementation problems, by means of scientifically rigorous quantitative methods.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26) – Home works 3

INDUSTRIAL MANAGEMENT

Course code	123
URL	http://eclass.uowm.gr/courses/MECH177/
Recommended Prerequisites	• Statistics

	• Operations Research
Course content	Introduction to production operations. Forecasting: time series and causal models; constant, linear-trend and seasonal models. Design of Production Systems: product design; process selection and capacity planning; facilities layout. Planning and Control of Production Systems: long, medium and short range production planning; inventory management; quality control; equipment maintenance and replacement.
Expected learning outcomes and competences to be acquired:	The aim of the course is to examine problems related to the design and operation of production units. Appropriate methods for decision making are presented and analyzed both for the design (position selection, organization of production methods, means and administrative structure) and for the operation of production companies (production planning and control, work schedule and procurement strategies). After successful completion of the course, students will be able to: • tackle problems related to the design and operation of a production plant • use forecasting techniques • apply specific methods for selecting location • calculate the required capacity and equipment of a production unit • select the appropriate working method apply production planning tools • optimize the job schedule • optimize the allocation of resources for a set of tasks • apply techniques for balancing and smoothing production lines • organize the procurement decisions
Teaching methods	Oral presentations and exercises

NUMERICAL ANALYSIS	
Course code	106
URL	http://eclass.uowm.gr/courses/MECH172/
Recommended Prerequisites	-
Course content	Introduction to numerical analysis methods using MATLAB. Basic concepts of analysis. Representation of numbers and numerical solutions errors. Linear systems. Roots of equations. Nonlinear systems. Optimization. Curve fitting. Numerical interpolation and polynomial approximation. Numerical Differentiation and Integration. Ordinary Differential Equations.
Expected learning outcomes and competences to be acquired:	The aim of the course is to acquire the necessary know-how to study engineering problems with emphasis on fluid flow using computational tools. Emphasis will be given to practical engineering applications. After completing the course the student will have the following skills: • Ability to solve technical problems with computational techniques • Ability to evaluate reasonable solutions and select appropriate levels of processing of these solutions • Understanding the important physical phenomena that need to be integrated into the solution of the system from the formulation of the problem • Development of appropriate equations and computational models for the given system • Ability to solve computational models for various processes / modules and simulation of the processes involved
Teaching methods	Hours of Instruction 65 (Theory: 26, Lab - Exercises: 39)

AUTOMATIC CONTROL SYSTEMS	
Course code	219
URL	http://eclass.uowm.gr/courses/MECH219/
Recommended Prerequisites	• Mathematics Physics • Introduction to Computing • Electrotechnics
Course content	The course introduces students to the basic principles of automatic control systems. Class lectures provide students with fundamental systems analysis skills with particular emphasis on the applications of control. Lectures cover the following topics. Mathematical model of a physical system and differential equations, electrical and mechanical dynamic systems, Open loop & Close loop control systems, Laplace Transform in control systems, Characteristics equation and Transfer Function, Block diagrams of systems, State space representation, time response for 1st order system, transient response specification of 2nd order system, Steady State error of a system, use of Matlab and Simulink in control topics, Stability of systems, Ruth-Hurwitz criterion.
Expected learning outcomes and competences to be acquired:	By the end of the course, students must be able to understand the basic principle of theory, design and applications in all technical areas of control systems. Typical students will have acquired the following skills: • To extract the mathematical model of electrical and mechanical dynamic systems • Be able to use the Laplace transform for the calculate the time response • To describe a system by the use of transfer function and state space representation • To become familiar with functional block diagrams of control systems • Determine steady state and transient characteristics of first and second-order systems. • Determine stability by calculating positions of poles and by using Ruth-Hurwitz criterion

	• Ability to work with Matlab and Simulink for analysis and design of control systems.
Teaching methods	Lectures and tutorials

INTERNAL COMBUSTION ENGINES	
Course code	206
URL	http://eclass.uowm.gr/courses/MECH125/
Recommended Prerequisites	• Thermodynamics I • Thermodynamics II • Fluid Mechanics I
Course content	Energetic issues of internal combustion engines. Spark ignition engines. Compression ignition engines. Ideal, adopted, and real cycle. Mean pressures and efficiencies of the above cycles. Quality factor. Mechanical efficiency. Energy balances. Combustion chamber geometries. Fuel types and mixture formation, ignition, combustion, flame speed. Pollution due to IC Engines, pollution control. Analysis of indicator diagram. Control practices, representative operation curves at different loads. Operation at partial load. Detailed study of the real cycle of reciprocating engines. Experimental determination of representative cycle characteristics. Control. Heat losses. Basic phenomena and criteria. Cooling systems. Gas flow. Gas exchange mechanisms. Scavenging and supercharging systems. Comparison between commercial and racing internal combustion engines. Modern combustion technologies, homogeneous charge compression ignition engines, hydrogen engines.
Expected learning outcomes and competences to be acquired:	This course provides knowledge of the basic principles of operation and thermodynamics of the internal combustion engines as long as analysis of the operational parameters, indicator diagram, combustion and intake and exhaust processes in natural aspirated and supercharged engines. It is expected that at the end of the course, students familiarize with the above so they are able to study and understand ICE operation for various applications by means of deep study of

	theory and exercises. Upon successful completion of the course the students will be able to: • Have an understanding of the basic principles, operating parameters and processes taking place in internal combustion reciprocating engines (atmospheric or supercharged). • Have knowledge of the tools and techniques used to study the operation of internal combustion engines. • Combine knowledge in order to choose the appropriate internal combustion engine depending on the application. • Use the knowledge from the course material to examine the operation of an internal combustion engine. • Combine information either from the course material or from the international literature to suggest optimization of the operation of an internal combustion engine. • Evaluate the operation data of a reciprocating internal combustion engine and anticipate any failures.
Teaching methods	Oral presentations and exercises

ENVIRONMENTAL TECHNOLOGY

Course code	131
URL	http://eclass.uowm.gr/courses/MECH132/
Recommended Prerequisites	• Chemistry • Fluid Mechanics
Course content	Environmental/Atmospheric pollution, Sources of environmental pollution, Effects of environmental pollution to human health, flora, fauna and materials, Greenhouse effect, Depletion of ozone layer, Acid deposition, Photochemical smog, Atmospheric chemistry, Analysis of gaseous pollutants, Pollution control technologies for stationary and mobile sources, Particulate matter, Technologies for particulate matter control (Cyclones, Electrostatic Precipitators, Baghouses), VOCs, SOX and NOX abatement and control.
Expected learning	The course introduces students to understand the impact of

outcomes and competences to be acquired:	various human activities on the environment. In specific, the causes, trends and technological solutions to address the environmental problems that are related to air pollution (gaseous and particulate pollutants) from stationary and mobile sources, are presented. Emphasis is given to the design (technological and economic) of control pollution technology systems for the control of particulate matter and gaseous pollutants. Upon successful completion of the course the student will be able to: • Understand the meaning and importance of air pollution. • Be aware of sources of pollution and of gaseous / particulate pollutants. • Understand pollution phenomena, such as greenhouse effect, photochemical smog, acid deposition (rain) and ozone layer depletion. • Understand which pollutants and the involved mechanisms are contributing to the greenhouse effect, photochemical smog, acid rain, and depletion of ozone layer. • Be aware of the analytical techniques used to identify and quantify the concentration of gaseous pollutants, such as infrared, chemiluminescent, gas chromatography, LIDAR. • Understand the behavior of particulate matter in fluids • Be aware of the principles of design of control pollution technologies, equipment sizing and costing, fixed and operating costs. • Understand the principles of operation of particulate matter control technologies such as gravity cyclones, centrifugal cyclones, electrostatic precipitators, baghouses and scrubbers. • Be aware of the technologies for controlling VOCs, NOX and SOX. • Be able to select, size, design and calculate the cost of control pollution technologies for particulate matter and gaseous pollutants.
Teaching methods	Hours of Instruction 52 (Theory: 26 h, Exercises: 26 h)

STEAM GENERATORS	
Course code	204
URL	http://eclass.uowm.gr/courses/MECH162/
Recommended Prerequisites	• Heat Transfer • Thermodynamics II
Course content	Preliminary concepts. Optimization of thermodynamic efficiency in steam plants. Energy and exergy efficiency. Evolution of steam power plants. Criteria and classification of modern Steam Generators with natural and forced circulation and once-through flow. Flow of energy. Losses and boiler efficiency. Characteristic temperatures. Stoichiometric combustion and fuel-air ratio. Combustion of fuel mixtures. Incomplete combustion. Ash. Slugging and fouling. Combustion of pulverized coal. Drying and grinding of solid fuels. Solid, liquid, and gaseous fuel burners. Combined cycle power plants. Important parameters. Laboratory exercises designed for the understanding of flame geometry, emissions and heat engineering calculations.
Expected learning outcomes and competences to be acquired:	After successful completion of the course students will be able to: • Know different thermoelectric power stations setups. • Calculate the energy efficiency of a thermal power station based on its operational parameters. • Suggest interventions to reduce the various energy losses. • Know the effect of the operating parameters of a thermoelectric power station.on its performance. • Calculate operational parameters and efficiency of combined cycles. • Know the individual characteristics of combustion applications with different fuels. • Be aware of modern clean coal technologies for power generation.

Teaching methods	Oral presentations and exercises

HEATING - VENTILATION - AIR-CONDITIONING

Course code	207
URL	http://eclass.uowm.gr/courses/MECH271/
Recommended Prerequisites	• Heat Transfer • Thermodynamics I
Course content	Introduction: Content and objectives of HVAC, historical background, review of the basic principles of thermodynamics and heat transfer. Thermal comfort: definition and influencing parameters. Psychrometrics: The thermodynamic properties of moist air and the processes to control them. Heating: Compliance with legislation requirements for building insulation, computation of building heat losses, description of common heating systems, selection and sizing of heating system components. Principles of solar radiation. Heat gains. Air-conditioning: description of common air-conditioning systems, computation of cooling loads, selection and sizing of main components and air- ducts. Cooling: Cooling cycles with vapor as a working fluid, common refrigerants, heat pumps, evaporative cooling. Absorption cooling cycles.
Expected learning outcomes and competences to be acquired:	Through the course, the student is introduced to the basic principles of heating, ventilation and air-conditioning (HVAC), as well as the design and analysis of HVAC systems. Following the successful completion of the course, the students will have achieved/acquired: • Understanding of the basic principles governing the analytical methods, and linking them to the pre-existing knowledge they have acquired (e.g. topics of Fluid Mechanics, Heat Transfer, etc.) • The ability to appropriately apply the methods (e.g. calculation of thermal / cooling loads, checking of thermal insulation capacity, etc.). • Understanding of the particularities of each method (e.g. differences in heat / cooling load calculation methods)

	and evaluate its reliability by weighing the causes of possible complexity or the possibility of adopting more simplified approaches. • The ability to apply the methods for designing the respective installations. The student applies the acquired knowledge by performing two case-studies of HVAC system design; one case study refers to a heating problem while the other refers to a cooling one.
Teaching methods	Hours of Instruction 65

NUMERICAL METHODS IN DESIGN OF MECHANICAL STRUCTURES

Course code	372
URL	http://eclass.uowm.gr/courses/MECH128
Recommended Prerequisites	• Mechanical Vibrations and Machine Dynamics • Statics • Mechanics of Materials.
Course content	Introduction to FEM, The Total Potential Energy of System. Matrix Algebra, Spring, Bar and Beam elements. Stiffness and Mass matrices, Plane trusses Two dimensional problems (membranes, disks, plates, shells)., Stress and strain relations, Strain and displacement relations, the equilibrium Equations. Equations solving, direct and iterative methods. Linear Static analysis, Structural vibration and dynamics, Basic equations, modal equations, damping, transient response analysis. 3D problems. The course, beyond the theoretical teaching, introduces the student and into programming, based on application programs in an environment of MATLAB, and commercial finite element computer software.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • understand and use finite elements to solve mechanical engineering problems and solids engineering with emphasis on the energy method based on the total

	dynamic energy of the body. • write its own programs for the layout and solving of motion equations, constructions consisting of one-dimensional elements, taking into account the properties of the material and the loads (mechanical and / or thermal) stressing the structure. • understand and use numerical integration methods. • solve mechanical systems and constructions in eigen analysis, static analysis, dynamic analysis in the time and frequency domain, using all types of finite elements (one-dimensional, two-dimensional and three-dimensional elements). • understand and evaluate the numerical results with respect to the unknown nodal displacements of the finite elements of a structure and be able to make a design optimization.
Teaching methods	Lectures (13 weeks x 3 hours of Theory and 2 hours of Exercises) and homeworks.

COMPUTATIONAL MECHANICS I	
Course code	228
URL	http://eclass.uowm.gr/courses/MECH186/
Recommended Prerequisites	• Introduction to Programming • Mathematics II, III, IV • Numerical Analysis • Fluid Mechanics I • Heat transfer
Course content	Introduction. The conservation laws and their mathematical foundation and description using Partial Differential Equations (PDE's). Nondimensionalization and boundary conditions. Boundary value problems solution procedure. Finite difference methods. Physical domain discretization. Simple and complex expressions. Higher order approximations. Finite difference methods for parabolic PDE's. Model equation case. Explicit and implicit methods.

	Numerical solution of the transient diffusion (or conduction) equation. Finite difference methods for elliptic PDE's. Model equation case. Solution using direct and iterative processes. Successive Over Relaxation (SOR) methods. The Alternate Direction Implicit (ADI) method. Numerical solution of Laplace's or Poisson's equation. Finite difference methods for hyperbolic PDE's. Model equation case. Up-winding and the problem of artificial dispersion/viscosity. Wave propagation in one-dimension. Non-linear problems. Solution of Burgers equation. Introduction in the solution of the Navier Stokes equations.
Expected learning outcomes and competences to be acquired:	Aim of this course is to make the student become familiar with the basic concepts of computational techniques and the acquisition of the necessary knowhow to solve engineering problems requiring the solution of differential conservation laws in the fluid or solid state. Several techniques will be examined and evaluated in terms of accuracy, stability and consistency. Upon successful completion of the course, the student will be able to develop finite difference numerical schemes to discretize the Partial Differential Equations of Conservation laws and solve them with appropriate computer programming.
Teaching methods	Hours of Instruction 52 (Theory: 26, Laboratories: 26)

EXPERIMENTAL METHODS AND MEASUREMENT TECHNOLOGY

Course code	250
URL	http://eclass.uowm.gr/courses/MECH156/
Recommended Prerequisites	• Statistics • Fluid Mechanics I • Heat Transfer
Course content	Measurement science: mathematical description of measurement systems, input-output signal characteristics, transfer function, measurement standards, static and dynamic calibration, bias and random errors, statistical analysis of data, measurement uncertainty and error propagation, analogue and digital signal processing.

	Measurement techniques for temperature, static and dynamic pressure, local flow velocity, flowrate, strain, displacement, force and torque.
Expected learning outcomes and competences to be acquired:	The course provides an introduction to the basic principles of measurements and experiments. The students become acquainted with measurement science and the methods of statistical analysis of the measurement data and with measurement techniques of mechanical properties. The course comprises laboratory exercises during which students get hands on experience on conducting measurements and analyzing data. Upon successful completion of the course, the students will be able to: • Understand the measurement procedure and its steps • Properly state the results of a measurement • Properly present data in graphical and tabular form • Identify the sources of measurement errors and their attributes • Classify deterministic (bias) and random errors • Estimate the uncertainty of single-sample and multiple-sample direct measurements • Utilize uncertainty analysis to estimate the uncertainty in indirect measurements • Fit empirical relationships to measurement data • Statistically process random data • Understand the basic techniques for the measurement of temperature, pressure, fluid velocity and flow-rate and their error sources
Teaching methods	lectures, tutorials and laboratory exercises

QUALITY CONTROL

Course code	230
URL	http://eclass.uowm.gr/courses/MECH167/

Recommended Prerequisites	• Statistics
Course content	Introduction: brief history of quality methodology, quality management, quality costs, methods for quality improvement. Acceptance sampling: lot-by-lot acceptance sampling for attributes, single, double and multiple sampling plans, statistical and economic design. Statistical Process Control: capability analysis, control charts for attributes and variables, statistical and economic design. Planning, organizing and developing quality systems for industry.
Expected learning outcomes and competences to be acquired:	The course presents systematically the modern methods of quality assurance placing special emphasis on the techniques of Statistical Quality Control (SQC). After the completion of the course the students should be able to: • understand the importance of quality in business • comprehend the economic and operational impact of quality on businesses • model problems related to control and assurance of quality of products and processes by means of scientifically rigorous quantitative methods • obtain optimum solutions to quality-related problems • optimize quality decisions with various criteria.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)

COMPUTER-AIDED DESIGN

Course code	380
URL	http://eclass.uowm.gr/courses/MECH117
Recommended Prerequisites	• Introduction to Computing • Linear Algebra • Mechanical Drawing II • Mathematics IV • Machine Elements II
Course content	Introduction to Computer-Aided Design and to CAD/CAE/CAM Systems. Coordinate systems and geometric transformations. Basic principles of CAD and

	related mathematical & information models. Elements of three-dimensional (3D) Computer Graphics. Mathematical models, data structures and algorithms for geometric modeling of curves, surfaces and 3D solids. Representation and processing/management of mechanical assemblies. Mechanical Computer-Aided Design. Laboratory exercises using CAD systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to • demonstrate knowledge of basic principles of software technology and of their application in Computer-Aided Design (CAD). • comprehend mathematical/information models for three-dimensional (3D) solid objects, • comprehend representation methods/models for mechanical assemblies in CAD, • sufficiently comprehend elementary concepts of 3D Computer Graphics used in CAD, • construct a correct Mechanical Drawing (for an object of medium complexity) using appropriate CAD software, and be experienced in using at-least two different CAD systems, • comprehend fundamental concepts of Computer-Aided Engineering (CAE) and Computer-Aided Manufacturing (CAM), • sufficiently comprehend difficulties (and research issues) related to applying CAD-related software technologies in the manufacturing industry and in the work of mechanical engineers.
Teaching methods	Lectures (13 weeks x 2,5 hours of Theory and 1,5 hours of CAD Exercises)

Advanced Structural Mechanics

Course code	-
URL	

Recommended Prerequisites	• Statics • Mechanics of Materials • Dynamics • Vibrations and Machine Dynamics
Course content	Plasticity: Elastoplasticity Theory (Phenomenological approach to elastoplastic behavior, modeling of single-axial behavior in plasticity, curing laws, failure criteria, analysis of deformations / strains, perfect elastoplastic materials, curing elastoplasty). Loading / unloading / reloading conditions. Boundary analysis method. Energy absorption. Remaining stresses and strains. Relationship of moments - curves. Effect of axial force on inelastic bending. Inelastic bending of beams and frames. Concept of plastic joint. Calculation of the plastic collapse mechanism. Inelastic torsion. Numerical solution of the problem of one-dimensional plasticity. Applications of nonlinear problems in finite element analysis software (modal time history analysis, pushover analysis). Bending of Structural Elements: Introduction to the Theory of Stability. Stability of simple elastic systems. Elastic beam with second order phenomena. Influence of border conditions. Bending and transverse loads. Influence of initial imperfections. Bending bars with numerical and approximate methods. Post-bending behavior. Simple models and columns. Introduction to Slab Theory. Elastic plates. Concept of twist. Slab analysis under specific loading and boundary conditions. Slabs under cylindrical bending.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • have a thorough understanding of the basic concepts of elastoplasticity theory. • understand and use the appropriate failure criteria for each application. • understand the concept of non-linearity and be able to use appropriate methods for the numerical solution of non-linear problems. • solve complex problems of non-linear applications in appropriate finite element analysis software. • understand the concept of stability and bending.

	• have a complete picture of the behavior of slabs and shells. • understand the meaning and practical application of the boundary element method as well as the differences and similarities with the finite element method.
Teaching methods	Lectures and homeworks

ADVANCED MATERIALS - NANOMATERIALS	
Course code	262
URL	
Recommended Prerequisites	• Materials Science and Technology I • Materials Science and Technology II
Course content	Introduction – Main principles, size – scale units, nanoscale phenomena. Definition – Need for advanced materials production. Shape memory alloys. Advanced Ceramics. Biomaterials. Smart materials. Structure – Properties – Application Relationships. Categories of nanomaterials – zero- /one- /two- dimensional nanostructures. Nanomaterials Properties – Optical – Mechanical/ Tribological. Property dependence on size. Nanomaterial Synthesis Techniques - Colloidal Gel Technique (Sol-Gel) - Microprocessing Techniques - Chemical Vapor Deposition Techniques. Characterization methods – Microscopy – Scanning Probe Microscopy (SPM) - Scanning Tunneling Microscopy (STM) - Atomic Force Microscopy (AFM) – Raman spectroscopy - Nanoindentation. Applications – Case study: ceramic nanomaterials for use as catalysts / catalysts supports. Social - environmental aspects of nanotechnology.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • understand the importance of advanced materials - nanomaterials, • study the various categories of advanced materials with emphasis on nanomaterials,

	• correlate the structure, properties and applications of advanced materials - nanomaterials
Teaching methods	Lectures

OPERATIONS RESEARCH II	
Course code	377
URL	http://eclass.uowm.gr/courses/MECH204/
Recommended Prerequisites	• Statistics
Course content	Stochastic processes and discrete-time Markov chains: classification of states, long-run properties. Markovian processes with rewards, control and optimization. Applications in inventory control and maintenance management. Continuous-time Markov chains, birth-and-death processes. Queuing theory: classification of queuing systems and examples of queuing phenomena. Queuing models with a single or multiple servers, finite or infinite queue, finite or infinite population. Priority in queues service. Linear and nonlinear queuing networks. Optimization of queuing systems and networks.
Expected learning outcomes and competences to be acquired:	This course includes fundamental tools and techniques of stochastic operational research. After the successful completion of the course, students will be able to: • identify and analyze discrete and continuous Markov processes • calculate the steady state characteristics of Markov processes • optimize the operation of Markov processes in steady state • apply Markovian techniques in engineering problems (inventory management, equipment maintenance, quality control, etc.) • solve queuing problems • study networks in series and Jackson networks • optimize queuing networks

Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)

DECISION ANALYSIS	
Course code	260
URL	-
Recommended Prerequisites	• Statistics • Operations Research I
Course content	Introduction to decision analysis and game theory, decision making and decision trees, utility theory and probability, games of complete and incomplete information, zero and non-zero sum games, applications of game theory in management science.
Expected learning outcomes and competences to be acquired:	After the successful completion of the course, students will be able to: • apply the fundamentals of decision analysis • derive utility functions • construct decision trees • represent operational problems with appropriate decision theory models • solve game theory problems • plan strategies for decision making • use Bayes Theorem in decision analysis
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)

TURBOMACHINERY	
Course code	205
URL	http://eclass.uowm.gr/courses/MECH158/
Recommended Prerequisites	• Mathematics I

	• Mathematics II • Fluid Mechanics I • Fluid Mechanics II • Thermodynamics • Heat Transfer
Course content	Introduction. Applications and basic concepts of turbomachinery. Basic principles of fluid mechanics and thermodynamics. Velocity diagrams. Energy conversion in turbomachinery, efficiency, degree of reaction. Phase changes and cavitation. Characteristic curves of turbomachines and of systems, determination of operating point, connection in parallel and in series. Concepts of similarity, dimensional analysis, non-dimensional numbers, specific speed, non-dimensional cavitation numbers. Axial machines, airfoil theory, flow phenomena and forces on airfoils, non-dimensional numbers, cascade analysis, deviation angle. Radial equilibrium theory. Secondary flows and losses. Axial pumps, axial compressors and blowers, instability phenomena, supersonic flow compressors. Axial turbines, degree of reaction, types and mechanisms of aerodynamic losses in airfoils, turbine blade cooling. Hydraulic turbines. Centrifugal compressors and pumps, flow and velocity diagrams, manufacturing aspects, blade design, exhaust system.
Expected learning outcomes and competences to be acquired:	The main aim of the course is to provide to the student to the principles governing the operation of turbomachinery. The student will gain knowledge and in depth understanding of the principles of operation, flow phenomena and design characteristics of turbomachinery components. The student will also gain experience in using specific techniques of analysis, design and selection of various classes of turbomachinery. The student will be able to use basic principles of Fluid Mechanics and Thermodynamics in order to design and analyze various types of turbomachinery such as pumps, compressors, turbines, wind turbines etc. He will learn how to effectively use open source software for aerodynamic airfoil analysis as well as software for the design and analysis of gas turbines.
Teaching methods	Lectures, exercises, laboratory tutorials for the use of commercial software. Homework and personal assignments with the application of commercial software on real design

	and analysis problems. Utilization of information technology for the course management.

ENERGY DESIGN OF BUILDINGS I

Course code	251
URL	http://eclass.uowm.gr/courses/MECH227/
Recommended Prerequisites	• Heating, Ventilation and Air-Conditioning
Course content	Objectives & Content of Energy Design of Buildings. Building uses. Building comfort requirements: Thermal comfort, ventilation, visual, acoustic comfort. Estimation of heating & cooling loads. System Design. Bioclimatic design of buildings. Passive solar systems for heating and cooling. Natural and forced ventilation of buildings. Conventional energy systems. Solar thermal systems. Solar air conditioning systems. RES systems in the building. Energy performance analysis of building: Energy load modeling, monthly semi-stationary method, system modeling, energy consumption calculation. Application into optimum building design.
Expected learning outcomes and competences to be acquired:	The course presents the basic design principles for achieving the lowest possible energy consumption in buildings. The course presents the basic design principles for achieving the smallest possible energy consumption in buildings. After successful completion of the course, the students will have: • Understood the difference between designing a building facility and assessing its behavior and profitability • Understood the impact of the environment and the comfort requirements on the energy design of buildings • Understood the objectives of energy planning at a technical, environmental and economical level. • Acquired knowledge of the passive and active systems that can be applied in a building in the direction of energy saving and maximum exploitation of RES systems. • Gained the ability to compose existing methods, tools

	and technologies in the direction of optimal design. • Gained the ability to apply the acquired knowledge to an Energy Planning problem, according to the low / near zero energy design project (of their own choice) assigned to them.
Teaching methods	Hours of Instruction 52

FLUID MECHANICS II

Course code	249
URL	http://eclass.uowm.gr/courses/MECH137/
Recommended Prerequisites	• Fluid Mechanics I • Thermodynamics I
Course content	Review of basic principles of fluid mechanics. Mathematical description of isothermal flow, continuity and Navier-Stokes equations. Boundary layer theory and practice, flow parallel to a flat plate, velocity profile, Pandtl's analysis, Blaussius solution, momentum-integral analysis, skin friction, turbulent boundary layers, law of the wall, effect of surface roughness, boundary layers in flows with pressure gradients, flow separation. External flow over submerged bodies, drag coefficient, aero/hydrodynamic forces on submerged bodies, effect of Reynolds number, unsteady phenomena, flow over a circular cylinder, vortex shedding, Strouhal number, vortex-induced vibrations, vehicle aerodynamics, flow past airfoils, lift, drag-lift curve, dynamic stall. Transition to turbulence, types of transition, linear stability analysis, Orr-Somerfield equation, shear layers and wakes. Turbulent flows, statistical description of turbulence, integral scales, inertial subrange, Kolmogorov theory, energy dissipation, turbulence modelling, eddy viscosity, Reynolds-Averaged Navier-Stokes equations, large-eddy simulation, direct numerical simulation. Compressible flow, speed of sound, Mach number, unidirectional adiabatic and isentropic flow, normal shock waves, Fanno and Raileigh flow. Two-dimensional compressible flows, oblique shock waves.
Expected learning outcomes and	The course aims at advancing students' understanding of fluid mechanics and their introduction to more advanced

competences to be acquired:	fluid flow problems. The students become familiarized with the phenomenology of complex flows and their mathematical description so that they can tackle practical fluid flow problems. Upon successful completion of the course, the students will be able to: • Describe flow fields using streamlines, streaklines, and particle pathlines • Understand flow visualization techniques • State in differential form the conservation laws for mass and momentum • Simplify and solve the differential conservation laws • Understand and utilize approximate solutions of the differential conservation laws • Compute the skin-friction and pressure forces from their distributions around bodies • Estimate the drag force using empirical relationships • Estimate the lift on airfoils and understand stall • Understand the concept of hydrodynamic instability and transition to turbulence • Recognize the consequences of transition in boundary layers • Compute inertial and drag forces in unsteady flows around bodies • Estimate the speed of sound and understand compressibility effects • Calculate property changes in isentropic compressible flows • Calculate property changes across normal shock waves
Teaching methods	lectures and tutorials

COMPUTATIONAL FLUID DYNAMICS	
Course code	263
URL	http://eclass.uowm.gr/courses/MECH263/
Recommended Prerequisites	• Fluid Mechanics I • Thermodynamics I • Numerical Analysis
Course content	Review of fluid motion and heat transfer principles. Differential and integral forms of the general transport equations. Classification of physical behaviours. Main elements of a computational method. Properties of numerical methods. Discretisation methods. Turbulent flow. Transition from laminar to turbulent flow. Reynolds-Averaged Navier–Stokes (RANS) equations and turbulence models. Large eddy simulation. Direct numerical simulation. Computational grids. Coordinate systems. Types of computational grids and cells. Grid quality. The Finite Volume Method. Integral form of the transport equations. Computational grid and control volumes. Discretisation of transport equations. Convective and diffusive terms. The upwind differencing scheme. False diffusion. The central differencing scheme. Hybrid scheme. The SIMPLE algorithm. Boundary conditions and wall functions. The algebraic equations system. Solution methods. Computational simulation of problems using software: Flow in pipes. Flow around vehicles. Heat transfer between fluid and solid. Subsonic flow through a compressor stage. Supersonic flow over wings. Transport of gaseous pollutants.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • classify general transport processes and describe the forms of equations that govern them, • understand turbulent flow analysis using Reynolds-Averaged Navier-Stokes equations and turbulence models, Large Eddy Simulation and Direct Numerical Simulation, • understand and distinguish the different types of computational grids and assess their quality, • understand the finite volume method and compare the discretisation of trasnport equations with different schemes, • apply the finite volume method and model different problems by analysing their parameters and combining knowledge from different fields of fluid dynamics and engineering.
Teaching methods	Lectures, exercise tutorials, computational laboratory tutorials

UNIT OPERATIONS	
Course code	210
URL	http://eclass.uowm.gr/courses/MECH180/
Recommended Prerequisites	• Thermodynamics II • Introduction to Environmental Technology
Course content	Introduction to the basic conservation laws: Momentum, heat and mass transfer. Absorption processes. Phase equilibrium and Henry's law. Absorption using packed towers and transfer units. Resistances to mass transfer between the two phases. Design of absorption towers for dilute and concentrated mixtures. Analytical and graphical methods. Distillation process. Phase equilibrium in binary mixtures. Ideal and azeotropic mixtures and Raoult's law. McCabe Thiele's graphical method and Lewis's computational method. Short-cut methods for the distillation of multi-component mixtures. Cooling Towers. Design using short-cut methods. Adsorption methods. Equilibrium isotherms, Langmuir's equation. Use of laboratory scale experimental breakthrough curves to design middle scale columns. Membrane processes for gas and liquid separations. Simple and complex flow models. The well mixed model; analytical expressions and design equations. Filtration methods: reverse osmosis, hyper-filtration and micro-filtration. Mechanical separations.
Expected learning outcomes and competences to be acquired:	This course aims to introduce the student to traditional and novel unit operation processes used in the industry. The student understands first the basic physicochemical mechanisms of each process and then learns to design each process using short-cut or detailed (graphical or computational) methods.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)

TECHNOLOGICAL SYSTEMS RELIABILITY AND MAINTENANCE	
Course code	241
URL	http://elearn.materlab.eu/course/view.php?id=2
Recommended Prerequisites	• Statistics
Course content	Reliability theory, reliability distributions, exponential distribution, distribution gamma, Weibull distribution, normal distribution. Systems reliability, reliability estimation, Markov reliability chains, estimation of reliability using generic parts, fault tree analysis, Monte-Carlo Simulation, Duane model. Reliability data collection, cost estimation, maintenance policies, maintenance indices, economic implications of idle time. The theory of replacement, deterministic and stochastic replacement policies. Preventive maintenance, total productive maintenance TPM, Use of simulation in maintenance.
Expected learning outcomes and competences to be acquired:	This undergraduate subject aims: • introduce the student to the concepts of reliability and maintainability of simple or complex mechanical components or devices. • introduce the student to the maintenance strategies and replacement policies. • help the student to combine his knowledge of theory of statistics with solving reliability problems and applying scientific based maintenance policies in any industrial environment. • train the student to topics of rationally and scientifically documented maintenance policies in business and industrial environment. • train the student to use simulation models of maintenance and replacement. • train the student to use computer based tools in maintenance management.
Teaching methods	Lectures (13 wks x 3 hrs theory and 2 hrs computer based laboratory exercises) and two homework projects.

INVENTORY MANAGEMENT

Course code	255
URL	http://eclass.uowm.gr/courses/MECH169/
Recommended Prerequisites	• Statistics
Course content	Introduction: The significant role of Inventory management and Logistics. Introduction to Supply Chain Management. Forecasting Methods. Deterministic systems of inventory management: (a) the case of known and constant demand (EOQ methods) and (b) the case of known and inconstant. Stochastic systems of inventory management: sQ, RS, sS, RsS systems. Seasonable and innovative products (Newsvendor problem). Introduction to Supply Chain Management and multi-echelon inventory optimization.
Expected learning outcomes and competences to be acquired:	To familiarize students with the techniques and tools for organizing and optimizing inventory systems and supply chains in the industrial environment. After the completion of the course the students should be able to: • understand the importance of inventory management in enterprises • comprehend the economic and operational impact of inventories on businesses • model real inventory management systems • solve real inventory management problems • optimize design parameters economically and statistically
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)

STRATEGIC MANAGEMENT

Course code	224

URL	-
Recommended Prerequisites	-
Course content	Strategic management is defining the fundamental long-term goals and objectives of a company, as well as the adoption of a series of acts and the determination of the necessary instruments for the realization of these objectives the strategy Strategic management takes into account the conditions prevailing on the exterior and interior environment of a company before determining its mission, objectives, strategies and options of how to implement and evaluation. SM sets guidelines for support in order to obtain uniform decisions and the definition of a business in connection with the competition.
Expected learning outcomes and competences to be acquired:	After completion of the course the student should be able to: • understand simple fundamentals that govern workplace Business Strategy, • analyze the contribution of each aspect of the strategy • develop the entrepreneurial project. • analyze the internal environment of the company • analyze the establishment environment of business can market strategy selects or industry • evaluate strategies • implement strategies
Teaching methods	Lectures (13 wks x 5 hrs theory) and one big homework project.

COMPUTER AIDED MANUFACTURING FOR INDUSTRIAL PRODUCTION

Course code	252
URL	http://eclass.uowm.gr/courses/MECH252/
Recommended Prerequisites	• Fundamentals of Machining
Course content	Introduction to Computer Numerical Control (CNC) Machines, CNC Lathe, CNC Milling. CNC Programming

	Languages. Fundamentals of CNC programming using G-code. Rapid Prototyping, 3D Printing, Additive Manufacturing. Basic principles of 3D parametric design in CAD system, CAD/CAM interoperability. Preparation of CNC manufacturing programs and simulations with CAM systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course the student will: • have a thorough understanding of the common types of CNC machines. • have a thorough understanding of the fundamental principles of Numerical Control (NC & CNC). • have a thorough understanding of the fundamental programming principles of CNC machines using G-code. • Be able to prepare programs in G-code for CNC Lathe and / or CNC Milling. • Be able to design any component in a CAD system. • Be able to prepare the program and the manufacturing simulation of any component using a CAM system. • Be able to perform all the necessary functions / tasks to construct a three-dimensional CAD component in a Rapid Prototyping machine.
Teaching methods	13 weeks of Instruction (5 weeks of CNC theory and G-code programming exercises, 3 weeks of CAD theory and laboratory exercises, 3 weeks of CAM theory and laboratory exercises, 1 week of Rapid Prototyping theory and laboratory exercises).

NONDESTRUCTIVE TESTING

Course code	256
URL	http://eclass.uowm.gr/courses/MECH171/
Recommended Prerequisites	-
Course content	Non-destructive testing of materials and structures. Radiography method, ultrasound method, electromagnetic

	methods (eddy currents, magnetic leakage), magnetic particle and liquid penetrant methods, visual inspection, thermography and other methods. International Standards and Specifications.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, the student will be able to: • Understand the phenomenon of any recognized Non-Destructive Check method. • Perform simple laboratory tests with at least 4 methods (Magnetic, Penetrating, Edge, Ultrasound). • Interpret industrial radiographs. • Evaluate the application and the expected errors in the test specimen. • Choose the appropriate Non-Destructive Check method. • Interpret specifications. • Prepare simple reports of non-destructive testing. • Develop problem-solving abilities and evaluate numerical calculations to understand the order of magnitude.
Teaching methods	Hours of Instruction 52 (Theory: 38, Laboratory: 14)

DESIGN AND ANALYSIS OF EXPERIMENTS

Course code	257
URL	http://eclass.uowm.gr/courses/MECH205/
Recommended Prerequisites	-
Course content	Analysis of variance: the fixed and random effects models for one factor. Design of statistical experiments: factorial and fractional factorial experiments, design and statistical analysis. Simple and multiple linear and nonlinear regression analysis. Correlation.
Expected learning outcomes and competences to be acquired:	After the successful completion of the course, students will be able to: • perform statistical experiments with a single factor and interpret the results

	• perform special types of statistical experiments with a single factor and interpret the results • perform statistical experiments with more than one factors and interpret the results • design fractional factorial experiments with several factors at two levels • use orthogonal arrays • identify the significant factor effects and interactions • perform simple and multiple linear regressions • perform significance tests of the regression variables • calculate confidence intervals and prediction intervals in regression models
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)

BIOMEDICAL ENGINEERING

Course code	258
URL	http://eclass.uowm.gr/courses/MECH258/
Recommended Prerequisites	• Technology of Materials I & II • Statics • Dynamics • Numerical Methods in design of mechanical structures
Course content	Basic principles of biology, biological materials and their properties (tissues, cells, proteins, amino acids, blood, etc.). Understanding biological systems and interactions between them. Mechanisms of mechanical signal transmission and its conversion into biochemical. Evolutionary mechanics and effect of daily loads on tissue morphogenesis. Techniques, biocompatibility, biodegradation and principles governing implants. Types of implants and their peculiarities based on the intended use. Smart / biomimetic materials and nano-materials. Implant design, material selection, clinical trials, optimization, and legislative framework for disposal. Examples of orthopedic and dental engineering and interdisciplinary benefits.

Expected learning outcomes and competences to be acquired:	After the successful completion of the course, students will: • acquire the theoretical background in various fields of biomedical technology and knowledge for the application of engineering in medicine. • be able to understand, describe and categorize key technologies used in Biomedical, with diagrams and data. • be able to evaluate comparatively and substantiates the relative advantages and disadvantages of alternative technology approaches and solutions. • be able to select the appropriate among the alternative descriptions of the digital system, based on the problem it faces. • be familiar with the basic principles of material technology in all materials used in bio-medical devices. • be familiar with the basic principles of biomaterial manufacturing and their properties as well as prosthetic members.
Teaching methods	Lectures (13 weeks x 2 hour of Theory and 2 hours of Exercises) and homeworks.

ADVANCED INFORMATION TECHNOLOGIES AND PROGRAMMING FOR MECHANICAL ENGINEERS

Course code	259
URL	http://eclass.uowm.gr/courses/MECH259/
Recommended Prerequisites	• Numerical Methods in design of mechanical structures • Introduction to Computing • Numerical Analysis and Simulation
Course content	Introduction to Computer Programming. Representation and processing of information, Introduction to high level programming languages (e.g., C, C++, C#, Java). Object Oriented programming and application in the analysis of mechanical structures. Command line and GUI applications, Programming with C++ (Selections, Loops, Arrays and Pointers, Functions, Strings, Files, Libraries), Memory and Disk management, Algorithms, Debugging, Computational

	Accuracy in the analysis of mechanical structures. Special issues in Algorithms and Data Structures with emphasis on the representation of mechanical systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the students should be able to: • recognize the contribution of programming to the analysis and solution of mechanical engineering problems, • have adequate knowledge of the fundamental principles of Object Oriented Programming (hierarchy, polymorphism, data abstraction etc.), • formulate specifications and analyze requirements for the creation of an computer program in the engineering field, • utilize core programming techniques in the application creation process, • apprehend and utilize fundamental data structures (lists, trees, graphs) for the representation of technological data, • utilize software libraries for the creation of new applications, • implement programming techniques to discover possible problems and debug applications
Teaching methods	Lectures (13 weeks x 2 hours theory and 2 hours practice problems in the lab).

Structural Dynamics	
Course code	M382
URL	https://eclass.uowm.gr/courses/MECH114/
Recommended Prerequisites	• Statics • Mechanics of Materials • Dynamics • Vibrations and Machine Dynamics • Numerical Methods in Design of Mechanical

	Structures
Course content	Non-linear vibrations and stability of dynamic systems. Determining the dynamic behavior of multibody vehicles and other mechanical systems. Signal Analysis, Frequency Field Analysis, Frequency Response Functions and Experimental Identification of Mechanical Systems Parameters. Free vibration and forced response of single degree of freedom linear oscillators to impulsive, harmonic, periodic and transient excitation (natural frequency, damping ratio, resonance). Response of multiple degree of freedom linear vibrations (formulation of the equations of motion, determination of natural frequencies and mode shapes, modal analysis). Axial, torsional and bending vibration of bars. Applications (measurement and evaluation of vibration characteristics, vibration isolation, vibration absorption, balancing, torsional vibration). Jeffcott rotor with inelastic and flexible bearings, Damping effect, Forward and rear vortex, Critical speeds, Gyroscopic effects, Peculiarities and Peculiarities, Campbell diagram, Roller bearings, Linear and non-linear gear modeling. Introduction to rotordynamics finite element modeling.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • has a complete picture of the practical applications of nonlinear systems. • understands the analysis of structures in the frequency field. • analyze mechanical systems with multiple solid or flexible members. • understands through a series of methodologies the dynamic behavior of rotating systems. • uses appropriate computing tools and software in typical examples. • is able to develop simplified rotor models. • develop and solves the rotation system motion equations. • develop and solves rotor system motion equations in torsional oscillations through analytical dynamics.

Teaching methods	Lectures and homeworks

Structural Optimization	
Course code	-
URL	
Recommended Prerequisites	• Statics • Mechanics of Materials • Dynamics • Vibrations and Machine Dynamics
Course content	Plasticity: Elastoplasticity Theory (Phenomenological approach to elastoplastic behavior, modeling of single-axial behavior in plasticity, curing laws, failure criteria, analysis of deformations / strains, perfect elastoplastic materials, curing elastoplasty). Loading / unloading / reloading conditions. Boundary analysis method. Energy absorption. Remaining stresses and strains. Relationship of moments - curves. Effect of axial force on inelastic bending. Inelastic bending of beams and frames. Concept of plastic joint. Calculation of the plastic collapse mechanism. Inelastic torsion. Numerical solution of the problem of one-dimensional plasticity. Applications of nonlinear problems in finite element analysis software (modal time history analysis, pushover analysis). Bending of Structural Elements: Introduction to the Theory of Stability. Stability of simple elastic systems. Elastic beam with second order phenomena. Influence of border conditions. Bending and transverse loads. Influence of initial imperfections. Bending bars with numerical and approximate methods. Post-bending behavior. Simple models and columns. Introduction to Slab Theory. Elastic plates. Concept of twist. Slab analysis under specific loading and boundary conditions. Slabs under cylindrical bending.
Expected learning outcomes and competences to be	Upon successful completion of this course, students will be able to: • fully understands the basic concepts of optimization.

acquired:	• understands the meaning and process of sensitivity analysis. • understands the meaning and differences between deterministic and stochastic optimization methods. • has a complete picture of the practical applications of structural optimization. • understands the concept of shape and topology optimization. • understands the concept of analysis and uncertainty quantification as well as their practical significance. • uses appropriate computing tools and software in typical examples
Teaching methods	Lectures and homeworks

ENERGY DESIGN OF BUILDINGS II

Course code	327
URL	http://eclass.uowm.gr/courses/MECH217/
Recommended Prerequisites	• Energy Design of Buildings I
Course content	National regulation for the Energy Performance of Buildings (KENAK), basic principles. Estimation of building energy performance, available methodologies and calculation tools. Energy inspection of the building as a whole, as well as of its installations. Requirements and equipment for the inspection. Laboratory exercise: Study of the operation of a system responsible for the regulation of thermal comfort conditions (Psychrometry, Cooling cycle).
Expected learning outcomes and competences to be acquired:	The course aims at acquainting students with the certification of the energy performance of buildings and its requirements; methodologies and software tools are included. The theoretical knowledge gained from the Energy Design of Building I course can be re-examined with regard to the applied character of the Regulation for the Performance of Buildings (KENAK). The laboratory exercises in the regulation of thermal comfort conditions, also contribute towards a more applied direction. Within the

	context of the course, the students select an existing building and proceed to its certification, while also proposing specific interventions towards the upgrading of its energy class. After successful completion of the course, the students will have: • Understood the difference between methodological tools for building energy performance assessment and certification. • Acquired knowledge of the key processes anticipated by KENAK (e.g. energy study, inspection). • The ability to apply the acquired knowledge, including the TEE-KENAK energy analysis software, to an actual building (of their own choice). • Gained experience on actual issues of thermal comfort / HVAC facilities through laboratory exercises. • Understood the effect of conventional fuel consumption on the environmental performance of a building
Teaching methods	Instruction, Specialized software practice, Execution of laboratory exercises (total hours 52)

SOLAR TECHNIQUE/PHOTOVOLTAIC SYSTEMS

Course code	316
URL	http://eclass.uowm.gr/courses/MECH197/
Recommended Prerequisites	• Heat Transfer
Course content	Solar Radiation. Parameters and Calculation of the Incoming Solar Radiation on horizontal and Inclined Surface. Calculation of the Energy Needs in Space Heating and Domestic Water Heating. Flat Plate Solar Thermal Collectors. Concentrating Solar Thermal Collectors. Storage of Solar Energy in Heating Processes. Integrated Solar Energy Systems for Heating Processes. F-Chart Method. Technology of the Photovoltaics. Photovoltaic Panels. Photovoltaic Systems. Dimension Process in Photovoltaic Systems.

Expected learning outcomes and competences to be acquired:	The course deals with the basic principles of the exploitation of Solar Energy. After the completion of the course the students should be able to: • Calculate the potential of Solar Energy • Calculate the components of solar radiation falling on a flat plane • Calculate the thermal efficiency and the productive thermal energy of a solar thermal collector • Calculate the thermal efficiency of solar thermal systems combined with collectors and storage tanks • Insert the dimensions of a solar thermal system • Understand the photovoltaic conversion of solar energy • Calculate the maximum electrical efficiency of a photovoltaic module • Insert the dimension of a photovoltaic system
Teaching methods	Hours of Instruction 52

ATMOSPHERIC POLLUTION	
Course code	391
URL	http://eclass.uowm.gr/courses/MECH239/
Recommended Prerequisites	-
Course content	The atmosphere: Origins - Structure – Composition. Key features and principles of the atmosphere - The Boundary layer. Atmospheric pollutants and their sources. Basic principles of air pollution. Air pollution meteorology. Atmospheric stability. Basic atmospheric diffusion principles. Effective emission height. Atmospheric diffusion modeling. Scalar transport theory. Pollutants deposition. Instrumentation - Measurement of Meteorological Parameters.
Expected learning outcomes and competences to be acquired:	The aim of this course is to provide students the basic principles of physics and atmospheric dynamics, the sources of pollution, the life cycle of atmospheric pollutants starting from their emissions or formation and until their final

	removal from the atmosphere, the environmental burden mechanisms and the impacts on health and ecosystems. The course is especially focused on industrial processes and plants. Students will also be introduced to the European legislative framework on air quality and to international conventions. After the teaching of this course, the student will be able to apply integrated approaches towards environmental impact assessment. Specific objectives are listed below. • Gain understanding of the basic concepts of air pollution and its effects on human and ecosystem health. • Explore how atmospheric chemical composition both drives and responds to changes in the earth system, including climate change. • Look at the major air pollutants, their sources, chemical transformations in the atmosphere and impacts. • Articulate current air pollution policies applied in Europe for criteria pollutants. • Know how to interpret meteorological data for atmospheric stability and air pollutant transport and dispersion. • Get an insight into the fundamentals of air quality models.
Teaching methods	Hours of Instruction 52 (Theory: 34, Lab - Exercises: 18)

WIND AND WATER TURBINES, HYDROELECTRIC PLANTS

Course code	318
URL	http://eclass.uowm.gr/courses/MECH159/
Recommended Prerequisites	• Fluid Mechanics I • Turbomachinery
Course content	Wind turbines. Introduction to wind energy and wind turbines. Atmosphere and wind energy potential. Types of wind turbines and subsystems. Aerodynamic design of horizontal axis wind turbines. Aerodynamic design of vertical axis wind turbines. Static and dynamic wind

	loading. Selection of installation site. Wind farms. Turbine components' selection. Economics of wind energy. Water turbines and hydroelectric plants. Global and national situation, benefits and impacts. Hydroelectric plants and their classification , advantages and disadvantages, hydrodynamic potential, hydrographs. Principles of operation and classification of water turbines, impulse turbines, reaction turbines, similarity theory, specific speed, cavitation phenomena.
Expected learning outcomes and competences to be acquired:	The main aim of the course is to provide the student with an introduction to the principles governing the operation of wind generators and water turbines. The student will gain an in depth knowledge and understanding of the principles of operation, of the flow phenomena and the design characteristics of these machines. He / she will also gain experience in using specific techniques for the analysis, design and selection of various classes of wind and water turbines. During the course the development and use of computational methods are encouraged, and there is also requirement for an experimental activity and a group project. The student will be able to assess the wind potential of an area, to select the location for the installation of wind turbines and perform economic and technical evaluations. In addition, the student will be able to assess the hydrological potential of a region, select the appropriate type of turbines and assess the expected power output.
Teaching methods	Lectures, exercises, laboratory tutorials for the use of open source software. Homework and personal assignments with the application of software on real design and analysis problems. Utilization of information technology for the course management.

APPLIED AERODYNAMICS	
Course code	397
URL	http://eclass.uowm.gr/courses/MECH397/
Recommended Prerequisites	• Fluid Mechanics I • Fluid Mechanics II
Course content	Fundamental principles and equations. Two-dimensional flow around airfoils. Incompressible flow. Circulation and dynamic

	lift. Thin airfoil theory. Stall. High-lift devices. Aerodynamic performance of airfoils. Airfoil analysis methods. Flow around finite length wings. Velocity and pressure distribution around wings. Wing geometry. Lifting line theory. Induced drag. Three-dimensional incompressible flow. Tip vortex and induced drag. Compressible subsonic, transonic and supersonic flow around airfoils and wings. Shock waves in external flows and Prandtl-Meyer compression and expansion waves. Drag coefficient in transonic flows. Basic principles and real flow equations. Turbulent flow around aerodynamic bodies. Laminar to turbulent flow transition models. Impact of shock waves on the development of boundary layers. Aircraft aerodynamics. Flight at sonic, transonic and supersonic speeds. Aerodynamics of ground vehicles. Developing forces and performance. Noise. Conventional vehicles. High performance vehicles.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • describe the development of aerodynamic forces on airfoils, understand the stall of an airfoil and evaluate the aerodynamic performance of an airfoil, • apply airfoil analysis methods, • apply the lifting line theory and describe the development of wing tip vortex and the induced drag, • understand the principles governing subsonic, transonic and supersonic flow around airfoils and wings, • describe the development of shock waves and Prandtl-Meyer compression and expansion waves, • analyze the effect of shock waves on the development of boundary layers, • understand how turbulent flow develops around aerodynamic bodies and apply appropriate transition models, • analyze and compare the effect of flight speed on the aerodynamics of the aircraft, • identify and analyze the factors influencing the aerodynamic behavior of ground vehicles.
Teaching methods	Lectures, exercise tutorials, laboratory tutorials.

Design of Welded Structures	
Course code	-
URL	
Recommended Prerequisites	• Computer Machining for industrial production
Course content	Introduction to welding, welding methods, welding materials, welding calculation, welded component configurations, symbolic and schematic representation of welded components, design of welded structures with CAD environment and item catalogs, cutting lists.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • Has a thorough understanding of welding methods used in industry • Calculates the strength of welds • Prepares mechanical drawings of welded structures and machinery • Manages the structure of welded parts and machines in CAD system • To design welded structures (frames) from structural elements • To design parts from sheets of metal parts • Manage cutting lists and item lists
Teaching methods	Lectures and laboratory exercises

TECHNOLOGY, RESEARCH, INNOVATION POLICIES AND ENTREPRENEURSHIP	
Course code	356
URL	http://elearn.materlab.eu/
Recommended	• Technology and Innovation-Economic Science and

Prerequisites	Entrepreneurship
Course content	Innovation and competitiveness, Innovation as a management process, Innovation Systems, Technological entrepreneurship, Entrepreneurship and innovation practices, Research, Technology and Innovation Policies in America, Europe and Greece, Indicators of innovation measurement, Drafting and Developing a Business Plan
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course, students will be able to: • List the innovation types. • Describe the concepts of posture, propensity and innovation performance. • Identify the difference between innovation and invention. • Describe the types and characteristics of innovation. • Apply the standards of the innovation process. • Recognize innovation systems. • Identify the types of entrepreneurship. • Choose appropriate financial tools for entrepreneurship. • Compare innovation policies. • Draw up a business plan.
Teaching methods	Oral presentations

RISK MANAGEMENT AND SAFETY OF LARGE INDUSTRIAL SYSTEMS

Course code	389
URL	-
Recommended Prerequisites	-
Course content	This course covers the scientific area of Risk Management and Safety of Large Industrial Systems with emphasis to Petroleum Industry. The following subjects are covered In details: Safety and loss prevention, definition of hazard, risk

	and risk assessment, scope and outline of risk management, frequency and severity, intrinsic and extrinsic safety, risk balance, Pareto principle, epidemiological approach, hazard warning. Identification of hazards and basic definitions: toxicity, flammability, sources of ignition, fires, explosions, ionizing radiation, noise pollution, temperature and pressure deviations. Fire protection: classification of fires, fundamentals of fire suppression, fire protection systems and facilities, thermal radiation. Hazard and operability studies (HAZOP): basic principles, explanation of guide, procedures, critical examination of flow sheets. Risk analysis; acceptable risks and safety priorities, frequency of accidents, safety checklists and fault trees, assessment of risks from complex plants. Strengths and limitations of quantitative risk assessment, modeling, a systematic approach to risk reduction, human factors, and management of process safety, insurance. Industrial hygiene, identification MSDS, evaluating exposure to volatile toxicants. Flow of fluids through a pipe, liquids through pipes Toxic release and dispersion models, parameters affecting dispersion.
Expected learning outcomes and competences to be acquired:	The aims of this course are: • The understanding the fundamental principles governing the safety and risk management. • The understanding of related to the practical application of safety and risk management issues • The deepening of topics related to the practical implementation of security management. • The deepening of topics related to the study of risk management development skills related to the design, development and submission of written reports. • The development of understanding of professional obligations associated with the discipline of security and risk management. • The familiarity with personal protective equipment measures • The familiarity with labor and industrial hygiene and safety signals
Teaching methods	Lectures, Notes, Related Practical Guides, Internet Sources, Lectures (13 wks x 3 hrs theory and 1 hr computer based

	laboratory exercises) and two homework projects.

TECHNICAL AND ENERGY LEGISLATURE	
Course code	376
URL	http://eclass.uowm.gr/courses/MECH128
Recommended Prerequisites	-
Course content	General principles of law. The basic legal concepts are discussed and explained. The various branches of law are presented and briefly analyzed. The "Technical & Energy legislation" includes the subjects of "Construction works", "Environmental legislation", "Energy legislation", "Energy market deregulation", "Health and safety legislation".
Expected learning outcomes and competences to be acquired:	The course presents systematically the engineering and energy legislation issues. It provides fundamental information in the context of the EU and Greek legislation with respect to energy, environment, construction works, health and safety and energy market liberalization. After the completion the students will be able to approach effectively the issues of licensing industrial plants and energy markets as well, and to handle establishment and operation of construction works, energy generation, distribution and services, by means of scientifically rigorous methods.
Teaching methods	Hours of Instruction 39 (Theory: 27, Exercises: 12) & Three home works (3)

SUPPLY CHAIN MANAGEMENT	
Course code	393
URL	-
Recommended Prerequisites	• Statistics • Operations Research I

	• Inventory Management
Course content	Introduction. Management methods, challenges and decision making analysis through every aspect of the process flow, from the raw material procurement to final product delivery to the customer. Customer service. Procurement. Inventory management. Warehousing. Transportation. Information in supply chain and Bullwhip effect. Contemporary product traceability methods. Information systems in supply chains. Supply chain integration strategies: Push-Pull strategy, Risk Pooling, Transshipment etc. Special topics in supply chain management: Reverse Supply Chains, Closed Loop Supply Chains and Humanitarian Logistics.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the student will be able to: • define the basic principles in supply chain management, • evaluate the importance of customer service in supply chain, • describe principles and techniques in procurement, • describe principles and techniques in inventory management, • describe principles and techniques in warehousing, • organize and conduct the proceedings related to the product transportation and distribution, • solve travelling salesman problem, find a minimum spanning tree and solve maximum flow problems, • evaluate importance of information flow in supply chain, • measure supply chain performance through specific metrics.
Teaching methods	Presentations (Oral) (Teaching Hours: 52, Theory: 26, Exercises: 26).

ADVANCED ROBOTICS TECHNOLOGY IN MECHANICAL MANUFACTURING

Course code	394
URL	http://eclass.uowm.gr/courses/MECH394

Recommended Prerequisites	• Statics • Dynamics • Automatic Control Systems
Course content	Acquaintance with industrial robots. Structural analysis of spatial mechanisms. Special Mechanisms. The kinematic problem. Robotic problems in the mechanical engineering industries. Transformations in space. Kinetic equations. Identification of a Jacobian registry. Solutions to the inverse kinematic problem. Speeds and static forces. Calculation of track in Cartesian space. Interference in the field of joint variables. Robot position control with one and many degrees of freedom. Control systems referenced in the Cartesian coordinate system. Implementation of computer and mechanical CAD technologies in the study of robotic systems. Movement with compassion. Power sensors. Power control algorithms. Natural and artificial constraints with emphasis on mechanical applications. Hybrid position / power control - Programming and languages of industrial robots. Applications of industrial robots. Special machining and welding issues. Sensors & actuators (conventional and non-conventional), microprocessors and external communication, signal converters from analog to digital and vice versa, digital signal processing. Mechanical study of the robotic system. Application to robotic machining and welding systems. Machining robot simulation with Mechanical CAD system.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the student will be able to: • analyze, design and implement robotics applications. • understand the basic principles of operation of Robotic Systems • understand, recognize, formulate and analyze industrial robotic systems. • prepare and present examples of integrated robotics with sensors, action instruments, control unit. • identify kinematic and dynamic analysis of industrial robots, arm structure and geometry. • study and optimize a robot workspace. • understand the contribution of industrial robots to

	machining.
Teaching methods	Lectures (13 weeks x 2 hour of Theory and 2 hours of Exercises) and homeworks.

ENVIRONMENTAL MANAGEMENT	
Course code	387
URL	-
Recommended Prerequisites	-
Course content	Introduction to environmental management. Applications in solid waste management. Learning of computational tools for the calculation of the biogas produced by waste disposal sites. Renewable energy and related advanced technologies. Environmental management systems.
Expected learning outcomes and competences to be acquired:	The course aims at familiarizing students with the basic principles of environmental management. After completion of the course the student should be able to understand the basic environmental management issues, to use various tools for designing environmental management solutions.
Teaching methods	Instruction of theory, discussion of applications, debate skills

Design and Development of Mechanical Products	
Course code	M396
URL	
Recommended Prerequisites	• Mechanical Drawing I • Mechanical Drawing II • Machine Elements I • Mechanics of Materials
Course content	Introduction to Engineering Design Methods for Mechanical Products. Customer needs acquisition and Product Design Specifications (PDS). Translating customer needs into product specifications, the Quality Function

	Deployment method (QFD). Developing alternative product concept designs Evaluation of alternative product concepts and optimal idea selection. The Controlled Convergence method. Design for Manufacturability (DFM), essential design principles for reducing component manufacturing costs, essential principles of Design For Machining and Design For Sheetmetal. Design for Assembly / Disassembly, essential design principles for reducing assembly costs. The methods: Hitachi Assemblability Method (AEM), Lucas Design For Assembly (DFA / MA), Bothroyd & Dewhurst Design for Manufacturing and Assembly (DFMA). Failure Mode and Effects analysis methods (FMEA & FMECA). Concurrent Engineering. Essential principles of Virtual Prorotyping: Detailed design, product modeling and simulation with CAD / CAM / CAE systems.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • Prepares the Product Design Specifications (PDS) for new products based on customer needs. • Converts customer needs into product specifications using the Quality Function Deployment (QFD) method. • To manage and systematically evaluate alternative product implementation ideas. • To systematically evaluate design solutions based on their ease of construction using Design For Manufacturability principles (DFM). • To systematically evaluate design solutions based on their ease of assembly , using Design For Assembly (DFA) methods. • Systematically studies the possible failures of product components and their consequences (FMEA & FMECA). • Has a full understanding of the principles of Concurrent Engineering. • Has a full understanding of the use of CAD / CAM / CAE systems in the design and development of mechanical products.

Teaching methods	Lectures

PRODUCTION OF ENVIRONMENTALLY FRIENDLY FUELS	
Course code	399
URL	
Recommended Prerequisites	• Chemistry • Thermodynamics I • Environmental Technology
Course content	The current status in fuel markets for the energy and transport sectors, The necessity to develop environmental friendly fuels, The production of environmental fuels, Crude oil (extraction, types, properties), Brief presentation of an oil refinery and produced fuels/chemicals, Catalytic reforming, Isomerization, Fluid catalytic cracking of heavy oil fractions, Hydro-processing of oil products, Modifications and fuel additives, Natural gas (production, types, properties, treatment and uses), Overview of alternative fuels and prospects in the future fuel market, CO2 capture and utilization.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: be aware of the world fuel market, the trends and prospects for a sustainable energy future, • learn the crude oil types, characteristics and properties, • be familiar with the different processes occurring in an oil refinery to cover the market requirements and to produce environmental friendly fuels, • learn the processes (thermodynamics, operational conditions, catalysts) of catalytic reforming, isomerization, fluid catalytic cracking and hydro-processing, • be aware of the processes to improve the energy and environmental efficiency of generated fuels, • learn the natural gas production processes, types and properties, • be familiar with the treatment processes of natural gas to be delivered in the gas pipe network. • learn the production processes of alternative fuels for the energy and transport sectors, such as the liquid biofuels of 1^{st}, 2^{nd} and 3^{rd} generation, ammonia and methanol

	• learn the processes to capture and utilize CO_2 emissions toward the production of synthetic natural gas and synthetic liquid fuels through the Fischer-Tropsch process.
Teaching methods	Lectures, tutorials

GAS TURBINE TECHNOLOGY

Course code	385
URL	http://eclass.uowm.gr/courses/MECH265/
Recommended Prerequisites	• Fluid Mechanics I • Thermodynamics I • Turbomachinery
Course content	Introduction and applications of gas turbines. Open cycle configurations. Closed cycle configurations. Aircraft Propulsion. Industrial applications. Environmental issues. Power Cycles. Ideal cycles. Gas turbine component losses. Operation at the nominal operating point. Combined cycle and cogeneration schemes. Gas turbine cycles for aircraft propulsion. Simple Turbojet engine. The Turbofan engine. The Turboprop engine. The Turboshaft engine. Auxiliary power units . Axial and radial flow Compressors. Principles of operation. Work done and pressure rise. Dimensional flow. Compressor performance characteristics and design processes. Combustion systems. Types of combustion systems. The combustion process. Emissions. Coal gasification. Axial and radial flow Turbines. Basic theory. Selection of aerodynamic parameters. Blade cooling. Performance prediction of simple gas turbines. Components characteristics. Operation at off-design conditions.
Expected learning outcomes and competences to be acquired:	The purpose of this course is to introduce to the students the basic operating principles, the components and the applications of gas turbine. Upon completion of the course the student will be able to obtain state-of-the-art knowledge in the area of operation and thermodynamics of modern gas-turbine engines. The student is expected to acquire knowledge and be able to analyze thermodynamic cycles of various types of gas turbine engines for aircraft propulsion

	and industrial applications. The student will be able to calculate the thrust and specific consumption of various types of aircraft engines such as turbojet, turbofan and turboprop; and, to assess the effects of speed and altitude on performance characteristics. In addition, the students will be able to select the main operating parameters of industrial gas turbines and calculate the effect of the characteristics of individual components on the overall engine performance such as the power output and the specific consumption. The student will be able to use specialized software for the preliminary design and analysis of the operation of gas turbines.
Teaching methods	Lectures, exercises, laboratory tutorials for the use of commercial software. Homework and personal assignments with the application of commercial software on real design and analysis problems. Utilization of information technology for the course management.

UNSTEADY FLOWS	
Course code	
URL	
Recommended Prerequisites	• Calculus • Vactor calculus • Fluid Mechanics I • Fluid Mechanics II
Course content	Classification of unsteady flows Review of basic principles of fluid dynamics Unsteady flows without separation Rigid-column theory in internal flows Rayleigh and Stokes solutions Flow instability and speration Unsteady flows with sepration Quasi-steady external flows Osciallatory flow around a cylinder Hydrodynamic inertia and damping coefficients Flow-induced vibration due to cross flow

	Vortex-induced vibration Galloping Flow-induced vibration in tube arrays Externally-induced vibration by unsteady flows Turbulence buffeting Flow-induced vibration due to internal flow Water hammer Two-way coupling of internal flow and tube deformation Flow diagnostics of unsteady flows and data analysis
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course students will be able to • identify and classify unsteady flows • recognize the dimensionless parameters that govern unsteady flow problems and problems involving dynamic flow-structure interactions • estimate the forces due to external unsteady flows • predict possible flow-induced vibrations and their characstersistics • suggest counter-measures for reduction/suppression of unwanted flow-induced vibrations in design stage or during operation
Teaching methods	Lectures, labs, tutorials

COMBUSTION PHENOMENA

Course code	348
URL	http://eclass.uowm.gr/courses/MECH144/
Recommended Prerequisites	• Thermodynamics I • Thermodynamics II • Fluid Mechanics I
Course content	Kinetic theory of gases, transport phenomena, chemical thermodynamics. Reaction speed, steady state phenomena,

	chemical equilibrium. Overview of chemical kinetics: order of reaction, chain reactions. Detonation limits and oxidizing characteristics of fuels (hydrogen, carbon monoxide, methane, paraffins, aromatic hydrocarbons). Premixed flames: 1-D flow, laminar flame structure, flame speed (Mallard and LeChatelier), ignition limits, quenching distance, flashback and blowoff, flame stability limits. Turbulent flows with flames, turbulent flame structure, turbulent flame speed, flame stabilisation in high velocity flows, Diffusion flames: Phenomenology, 1-D flame balances, turbulent fuel jets. Ignition: chain ignition, forced thermal ignition. Optical experimental techniques for the investigation of combustion phenomena.
Expected learning outcomes and competences to be acquired:	Upon successful completion of the course students will be able to: • Understand basic characteristics of combustion, related either to thermodynamic or fluid dynamic parameters, and the differences between laminar and turbulent combustion. Students will also have an understanding of the turbulent combustion areas as well as of the basic chemical kinetics of combustion. • Know the technological tools used for the study of fundamental combustion. • Distinguish the type of combustion studied. • Use the acquired knowledge to design combustors or to optimize their operation. • Combine the operating data of a combustion application and predict operating stability. • Evaluate the operation of a combustor
Teaching methods	Oral presentations and exercises

RENEWABLE ENERGY SOURCES LABORATORY

Course code	390
URL	http://eclass.uowm.gr/courses/MECH231/
Recommended Prerequisites	• New & Renewable Energy Sources • Energy Design of Buildings I

Course content	Introduction to Renewable Energy Sources (RES), RES in buildings. Laboratory exercise: Measurements, quality of measurements and uncertainties. Laboratory exercise: Instrument calibration. Application in liquid flowmeter. Laboratory exercise: Meteorological station. Measurement of ambient temperature, Use of pyranometers for the measurement of solar radiation. Measurement of wind velocity and direction. Measurement of humidity. Laboratory exercise: Photovoltaic systems. Study of a photovoltaic panel. Measurement of the I-V characteristic, Measurement and estimation of the characteristic electrical parameters. Design of a PV system. Laboratory exercise: Solar thermal energy. Study of a flat plate solar collector. Estimation of optical efficiency and thermal losses. Study of thermal solar system performance. Heating storage thermal losses. Complete system estimation of performance.
Expected learning outcomes and competences to be acquired:	Students perform lab tests on the operation and efficiency of RES systems, focusing on systems that are applicable to buildings. After successful completion of the course, the students will have: • Understood the importance of applying accurate measurements to determine and evaluate the efficiency of an RES system • Understood the particularities of the analysis in the laboratory environment, in terms of infrastructure (including measuring instruments) and methods. • Acquired knowledge about quantification of measurement quality through the concept of uncertainty. • Acquired knowledge on experimental methods of assessing RES systems performance. • Acquired knowledge about the actual operation of RES systems.
Teaching methods	Instruction (13 hours), execution of Laboratory Exercises (26 hours)

SPECIAL TOPICS ON POLLUTION CONTROL TECHNOLOGIES

Course code	350
URL	http://eclass.uowm.gr/courses/MECH131/
Recommended Prerequisites	• Chemistry • Environmental Technology
Course content	Introduction, Wastewater (Physicochemical Properties, Quantities), Wastewater Treatment Technologies, Pretreatment, Primary, Secondary, Advanced Wastewater Treatment, Solid Waste, Integrated Solid Waste Management, Thermochemical and Biological methods for the energy exploitation of waste (Gasification, Pyrolysis, Anaerobic Digestion), Mobile Sources of Pollution, Pollution control technologies in Otto and Diesel Engines, Otto Cycle, Three-way Catalytic Converters, λ sensors, Control pollution technologies in Diesel engines, Diesel Cycle, Formation of soot particles, Soot traps, Control pollution technologies in air transport, Brayton cycle, Catalytic ozone abatement, Hybrid vehicles, Fuel cell vehicles, Alternative fuels.
Expected learning outcomes and competences to be acquired:	The course focuses on the methods of control pollution technologies used in the case of wastewater and solid waste as well as in the case of mobile sources. Through lectures and dedicated exercises, the students are introduced to wastewater treatment technologies and learn how to design such plants. The students are also introduced into the concept of integrated solid waste management. Finally, emphasis is given on control pollution technologies employed in Otto and Diesel cars (three-way catalytic converters, soot traps) as well as on hybrid and fuel cell. Upon completion of the course the student will be able to: • Understand the origin of wastewater (sources, categories, quantities) • Understand the physicochemical (solid, gases, BOD, COD, TOC) and biological (microorganisms) characteristics of wastewater, and how they can be measured/estimated. • Understand the technologies employed in wastewater treatment plants

	• Be able to design screens, aerators, primary sedimentation tanks, aerobic reactors, anaerobic tanks for biogas production • Be aware of the types of solid waste and physicochemical characteristics • Be aware of methods of waste collection • Understand the use and operation of landfills. • Understand which processing technologies should be used depending on the physicochemical characteristics of the waste, • Be aware of combustion and composting technologies • Be aware of the thermochemical (combustion, gasification, pyrolysis) and biological (anaerobic digestion) processes of the organic fraction of the waste. • Be aware of the contribution of transport to air pollution and the significance of control pollution technologies. • Understand the principle of operation of three-way catalytic converters • Understand the principle of soot traps in diesel engines' • Being adequately informed of hybrid vehicles and hydrogen powered vehicles. • Calculate the equivalent air/fuel ratio • Be able to calculate the amount of exhausts according to the employed air/fuel ratio.
Teaching methods	Hours of Instruction 52 (Theory: 26 h, Exercises: 26 h)

MATERIALS FOR ENVIRONMENTAL & ENERGY APPLICATIONS

Course code	379
URL	http://eclass.uowm.gr/courses/MECH233/
Recommended Prerequisites	• Chemistry • Physics • Thermodynamics

	• Materials Science and Technology I • Materials Science and Technology II • Heat Transfer
Course content	Energy resources sector and environmental impact, Materials for Catalytic Applications - Heterogeneous catalysis, kinetics, external and internal diffusion phenomena in heterogeneous catalyst systems - Catalyst synthesis methods - Methods for physicochemical and surface characterization of catalysts - Morphology and physicochemical properties of catalysts - Applications of catalytic processes in energy (hydrogen production, synthetic fuels via Fischer-Tropsch, CO_2 activation, ammonia synthesis) and in the environment (decomposition / reduction, photocatalysis – water remediation / groundwater / liquid waste). Materials for fuel cells - Basic principles of electrochemistry - Thermodynamics and kinetics of electrochemical reactions - Electrochemical membrane reactors - Fuel cells - Batteries - Electrochemical gas sensors - Applications of electrochemistry in energy and environment. Special Issues – Treatment of industrial wastes / by products towards the for synthesis of new products (circular economy – examples) – Advanced materials for energy and environmental applications (nano materials / nanocomposites)
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • know the special characteristics of specific catalytic & electrochemical processes related to energy and environmental applications • Understand the relationship of the materials manufacturing method on their structure and properties • understand the effect of the physicochemical properties of selected materials on the process performance • Understand the concept of sustainability in the development of materials for energy and environmental applications.
Teaching methods	Lectures and homework

SPECIAL TOPICS ON ENERGY CONVERSION TECHNOLOGIES	
Course code	349
URL	http://eclass.uowm.gr/courses/MECH173/
Recommended Prerequisites	• Heat Transfer • Fluid Mechanics • Thermodynamics • Steam Generators
Course content	Introduction to energy systems, Global, European and National energy balance, Fossil Fuels, Conventional power generation, Wind Power, Biomass & Synthetic Fuels (thermochemical and biological methods of biomass conversion to gaseous, liquid and solid biofuels), Hydrogen production, storage and use in fuel cells, Technoeconomic evaluation, Kwh cost calculation.
Expected learning outcomes and competences to be acquired:	The course deals with a number of special topics related to energy production: (a) conventional & alternative energy conversion technologies; (b) cogeneration; (c) levelized cost estimation of kWh Upon successful completion of the course the student will be able to: • Acquire a general overview of the energy forms and their share in the global, European and national energy balance. • Be aware of the modern trends in energy balances at a global level. • Understand the origin, types and energy flows of conventional forms of energy (coal, oil, natural gas). • Identify the corresponding shares for RES and nuclear energy. • Understand conventional fossil fuel power technologies and the corresponding environmental impacts. • Understand the usefulness of RES (wind, solar, biomass, geothermal). • Understand the principle of operation of energy conversion technologies for converting wind and solar

	power as well as bioenergy into electricity, heat and biofuels. • Understand wind turbines, their sizing and their theoretical performances. • Be able to calculate which part of the wind power potential can be converted into electrical power. • Understand how to design and estimate the cost of wind farms in a given area with a given wind potential. • Understand biomass potential, biomass types, physicochemical characteristics and conversion technologies (gasification, pyrolysis, anaerobic digestion) into biofuels and energy. • Understand the principles of thermochemical (combustion, gasification, pyrolysis) and biological (anaerobic digestion) processes for converting biomass to biofuels. • Design, size and estimate the cost of processes for the conversion of biomass to bioenergy in conventional thermal and alternative energy conversion devices. • Understand the operating principle of fuel cells, their types and their characteristic operating curves. • Understand the hydrogen economy. • Size and estimate the performance of low and high temperature fuel cells as well as of planar and tubular geometry fuel cells. • Understand hydrogen production technologies by reforming hydrocarbons and water electrolysis.
Teaching methods	Hours of Instruction 52 (Theory: 26 h, Exercises: 26 h)

SIMULATION AND SYSTEM DYNAMICS

Course code	367
URL	http://eclass.uowm.gr/courses/MECH168/
Recommended Prerequisites	• Statistics
Course content	Design, analysis and development of simulation, random

	numbers, random numbers generators and simulation sampling, statistical analysis of simulation results. Applications in industrial management and operations research. Practice on specialized simulation software. Fundamental system concepts, the object of a system dynamics analysis.
Expected learning outcomes and competences to be acquired:	To familiarize students with decision making techniques and tools using simulation methods in the complex industrial environment when analytical methods cannot be utilized. After the completion of the course the students should be able to: • understand the importance and usefulness of mathematical simulation • understand the importance and usefulness of dynamic systems • comprehend the need for mathematical simulation in problems where the analytical solution is either impossible or very difficult • develop simulation models for real problems • solve problems and find optimal solutions using simulation • statistically analyze simulation results
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)

Expert Systems For Engineers and Design Automation for Mechanical Products	
Course code	-
URL	
Recommended Prerequisites	• Design and Development of Mechanical Products
Course content	Introduction to Knowledge-Based Engineering Systems for Engineers (KBE), Expert Systems and Rule-Based programming. Basic models Expert Systems development: MOKA, KNOMAD, CommonKADS. Design Automation (DA), CAD systems programming, Design Rules using the

	VB.NET language and the iLogic tool. Differences between: Parametric Design, Design Automation via CAD customization and Expert Systems. Essential principles of Knowledge Engineering using Rules, developing Expert Systems with CLIPS, complexity management for Design Automation in mechanical systems. Connecting Expert Systems to other systems such as: CAD / CAM / CAE, PLM, ERP etc.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • Know the essential principles of Knowledge-Based Systems for Engineers. • Know the basic principles of Knowledge Engineering using rules. • Know the basic models for development of Expert Systems: MOKA, KNOMAD, CommonKADS. • Develop design rules. • Customize a CAD system to automate parts, assemblies and two-dimensional construction drawings. • Know how to extend the capabilities of a CAD system through API programming. • Create custom interfaces that extend the functionality of the CAD system. • Understand how an Expert System can be connected to other systems such as: PLM, ERP, CAD / CAM / CAE etc.
Teaching methods	Lectures

THERMAL PROCESS EQUIPMENT

Course code	401
URL	
Recommended Prerequisites	• Heat Transfer • Thermodynamics I • Thermodynamics II

Course content	Preliminary thermal design of heat exchangers. Scale formation problem. Basic exchanger types. Design of double-pipe exchangers. Construction details, TEMA classification and design of shell-and-tube exchangers. Design of compact heat exchangers, tube-and-fin, plate-and-fin and plate-and-frame. Two-phase pressure drop and heat transfer computations. Physics of condensation and design of condensers. Nucleate and film boiling. Critical boiling, convective boiling. Subcooling boiling. Design of evaporators. Condensers and vacuum technology. Cooling towers-energy analysis. Design and construction elements.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • select among different types of heat exchangers based on the thermo-physical properties and process characteristics of the streams, • perform preliminary calculations of heat transfer area, taking into account scale formation, • perform detailed calculations of shell-and-tube exchangers, • perform detailed calculations of the most popular compact exchangers (tube-and-fin, plate-and-fin, plate-and-frame), • calculate pressure drop and heat transfer coefficients in gas/liquid two-phase flow, • design various types of condensers and evaporators
Teaching methods	Lectures, tutorials

PROJECT MANAGEMENT

Course code	392
URL	-
Recommended Prerequisites	• Statistics • Operational Research I
Course content	Project management: definitions, project goals. Knowledge areas. Project life-cycle. Project identification - feasibility study. Project design: Work Breakdown Structure, Network Analysis, Gantt Chart. Resource allocation and planning. Planning with limited resources. Cost planning and budgeting. Communication planning. Quality assurance

	planning. Project crashing. Stochastic task durations: PERT method. Project Risk Management. Earned value Analysis. Project completion and evaluation. Project management Information Systems: Microsoft Project.
Expected learning outcomes and competences to be acquired:	The ability to develop an effective project plan and the ability to decompose complex projects using hierarchy diagramming. The ability to optimize the duration of a project and the sequence of tasks using CPM. The ability to control project uncertainties using stochastic estimating techniques. The ability to use the earned-value management method to track project status. The ability to apply and control changes to the project management plan. The ability to apply detailed cost estimating techniques and identifying and quantifying projects risks.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26)

TOTAL QUALITY MANAGEMENT

Course code	395
URL	-
Recommended Prerequisites	• Statistics • Operations Research I • Quality Control
Course content	The atmosphere: Origins - Structure – Composition. Key features and principles of the atmosphere - The Boundary layer. Atmospheric pollutants and their sources. Basic principles of air pollution. Air pollution meteorology. Atmospheric stability. Basic atmospheric diffusion principles. Effective emission height. Atmospheric diffusion modeling. Scalar transport theory. Pollutants deposition. Instrumentation - Measurement of Meteorological Parameters.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course the student will be able to: • understand the main principles of quality, • employ tools for measurement, control and improvement of quality, • define cost of quality,

	• evaluate the advantages of TQM, • identify the impediments in implementing TQM • manage practical approaches of TQM implementation, • evaluate importance and demands of quality standard certification.
Teaching methods	Lectures (13 weeks x 2 hour of Theory and 2 hours of Exercises).

TECHNO-ECONOMIC ASSESSMENT	
Course code	352
URL	http://eclass.uowm.gr/courses/MECH163/
Recommended Prerequisites	• Thermodynamics • Mathematics • Statistics • Steam generators • Engineering and energy legislation
Course content	Principles and methodology of financial analysis of industrial plants. Design and optimization methodology. Evaluation indices. Engineering and financial evaluation of investment plans. Design and time scheduling. Methodology of feasibility studies and financial analysis of investments.
Expected learning outcomes and competences to be acquired:	The course presents systematically the design and optimization of industrial plants, as well as the preparation of feasibility studies. After the completion the students will be able to approach effectively the issues of the financial and engineering evaluation of industrial plants and to handle design and optimization problems, by means of scientifically rigorous quantitative methods.
Teaching methods	Hours of Instruction 52 (Theory: 26, Exercises: 26) & Three home works (3)

AERODYNAMIC DESIGN AND CONTROL OF AIRCRAFTS

Course code	403
URL	http://eclass.uowm.gr/courses/MECH403/
Recommended Prerequisites	• Fluid Mechanics I • Fluid Mechanics II • Applied Aerodynamics
Course content	Introduction. Elements of aerodynamics. Aircraft airfoils and wings. Dynamic lift, drag and aerodynamic moments. Three-dimensional flow over wings and compressibility effects. Dynamics and flight parameters. Special aircraft cases. Atmosphere. Aircraft aerodynamic design process and selection of aerodynamic parameters. Computational methods for aerodynamic aircraft design. Aerodynamic design of wings, winglets, flight control surfaces and engine inlets. Feedback control of dynamic systems principles. Time domain, frequency domain and state-space analysis. Stbility of dynamic systems. Design od controllers in time domain, frequency domain and state-space. Aircraft stability and control. Static and dynamic stability. Equations of motion. Longitudinal and lateral motion control. Optimal control techniques. Design of control surfaces.
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • describe the development of aerodynamic forces on an aircraft, the dynamics of the aircraft and correlate them with the flight and flow field parameters, • apply design methods by selecting the appropriate aerodynamic parameters, • apply computational methods of analysis and design of aircraft and individual aerodynamic components, • understand and determine the appropriate aircraft dynamics control systems, • apply aircraft motion control techniques and design appropriate control surfaces.
Teaching methods	Lectures, exercise tutorials, laboratory tutorials.

CONVENTIONAL & ADVANCED ENERGY STORAGE SYSTEMS

Course code	402

URL	
Recommended Prerequisites	• Chemistry • Heat Transfer • Fluid Mechanics • Thermodynamics I
Course content	Current status of the energy sector, Trends and prospects toward a zero-carbon economy, Need for energy storage systems, Energy storage technologies (power to power and power to fuels), Mechanical methods (flywheels, hydroelectric storage, compressed air storage, cryogenic energy storage), Thermal methods (thermochemical heat storage, sensible heat storage, heat storage through phase transition, thermoelectric materials), Electrochemical methods (batteries, electrolysis), Electrical methods (supercapacitors). Chemical energy storage to hydrogen, syngas, ammonia, methanol, synthetic methane and liquid fuels, Smart grids, Examples - Applications
Expected learning outcomes and competences to be acquired:	Upon successful completion of this course, students will be able to: • be aware of the current status in the energy sector, • understand the necessity for the transition to a zero-carbon economy and the role of energy storage technologies toward increasing intermittent RES share in the energy mix, • learn the different energy storage methods and technologies, • learn the mechanical (flywheels, hydroelectric storage, compressed air storage, cryogenic energy storage), thermal (thermochemical heat storage, sensible heat storage, heat storage through phase transition, thermoelectric materials), electrochemical (batteries, electrolysis), and electrical (supercapacitors) methods for the development of conventional and advanced energy storage systems, • be aware of the chemical energy storage technologies to hydrogen, syngas, ammonia, methanol, synthetic methane and liquid fuels.

THE MECHANICAL ENGINEERING CAPSTONE PROJECT

Course code	199
URL	-
Recommended	-

Prerequisites	
Course content	The Mechanical Engineering Capstone project is an early requirement for graduation. The course is a multifaceted assignment designed to encourage students to think critically, solve challenging problems, and develop research skills, planning, goal setting, and skills on oral communication, public speaking, teamwork, self-sufficiency, skills that will help prepare them for their thesis research and writing and generally for modern careers. The projects adopted by students should be interdisciplinary ie. requiring students to apply skills or investigate issues across many different subject areas or domains of knowledge, connecting their projects to community issues or problems, and integrating outside-of-school learning experiences, including activities such as scientific observations, interviews, or internships. Specific content of taught crash courses includes: The role and importance of scientific research – The ethics of research – The research process: Basic terminology, choice of problem areas, revision of research – Structure of a research proposal – Systems of bibliographic reference – Plagiarism – Systematic literature review – Reference lists and bibliographic data bases – Debate techniques
Expected learning outcomes and competences to be acquired:	After completion of the course the student should be able to: • Complete a research /review project • Critically think about challenging problems • Address interdisciplinary subjects and teamwork • Recognize the writing techniques of different forms of scientific research • Skillfully communicate his research results to peers • Understand the oral and written rules of scientific reasoning
Teaching methods	Instruction of theory, discussion of applications and individual projects, community based learning, project based learning

DIPLOMA THESIS	
Course code	-
Instructor(s)	-
Semester	9-10
ECTS	30
URL	-
Hours per week	-
Recommended Prerequisites	-
Course content	Each student can chooses a thesis topic to develop the thesis. The only limitation to this option is that the thesis should correspond to one discipline (at least) from the courses included in Concentration of Studies, which he himself attended. The assignment of the thesis is at the beginning of the ninth semester and preparation is undertaken throughout the period of the fifth year of study.
Expected learning outcomes and competences to be acquired:	This extended written project is an extensive study in a scientific area of the Department. The thesis is meant to demonstrate that the student is able to work and to pursue science in a specific subject.
Teaching methods	-
Assessment methods	-

10. OTHER USEFUL INFORMATION

10.1 ADMINISTRATION OF UNIVERSITY OF WESTERN MACEDONIA

Executive Committee Board Office
St. Demetrios Park, 50131, Kozani
Tel 0030 24 610 56 200. FAX 0030 24610 56201.

Alternatively, all useful information is offered to the public through the University`s website: ***www.uowm.gr***.

10.2 INTERNSHIP

The Department of Mechanical Engineering has also instituted student internships followed by a submitted funding proposal in order to form an integral part of the curriculum.

Students are advised to apply to the Administration Office of the Department for a placement, after a prior agreement between the Department and the companies, clearly defining the terms of employment and work responsibilities during the internship. After assessing the applications by the internship program departmental coordinator, Prof. G. Marnellos and also by Permanent Teaching Staff members who are in charge of the Department's cooperation with each company, the applied students are selected to be placed to specific companies.

The duration of the internship is three (3) months, mainly during summertime (June, July and August).

Students who will gain access to the Internship program must have finished their third Year of studies. Emphasis will be placed mainly on graduating students for participating in internships.

10.3 ERASMUS PROGRAMME

The Department of Mechanical Engineering participates in the Erasmus Plus Programme, which is a European Union student exchange programme for education, training, youth and sport, and aims at the enhancement of students' skills and employability as well as at the upgrading of youth educational and training systems.

Within the framework of enhancing students mobility between universities under the Erasmus Plus Programme, the students of the Department have the opportunity to spend a 3 to12 month period of their curriculum abroad in institutions co-operating with the UoWM. The studies in foreign universities are fully recognized by the UoWM provided that the student has been successfully examined in the courses he/she has chosen.

In addition, within the framework of strengthening students skills and employability under the Erasmus Plus Programme, the students of the Department have the opportunity to practice abroad for a 2 to 12 month period in Universities, Enterprises or Organizations.

The Departmental Coordinator of the Erasmus Plus Programme is Sofia Panagiotidou, Associate Professor.

10.4 DIPLOMA SUPPLEMENT

Since December 2014, the Department of Mechanical Engineering grants a Diploma Supplement to all graduates according to the provisions of Law 3374/2005 and the M.D. F.5/72535/B3/10.08.2006.

10.5 STUDENTS BOARDING AND ACCOMMODATION

Assisting students who face financial difficulties to cope with their studies and based on both ministerial decrees and decisions of the Executive Committee Board of UOWM, the following services are provided:

a. Free boarding to beneficiary students, in the students restaurant of UOWM located in the city of Kozani (Address: 20 Konstantinoupoleos str.- Kozani, tel.nr. 0030 24611 81039)

b. Rent assistance if **not** provided by the state.

The preconditions for free boarding and provision of the rent benefit (if the student is entitled to one) as well as the dates for submitting applications, are announced timely by the Administration Office.

10.6 HEALTH CARE

All students (undergraduate, postgraduate, expatriates and foreign) are entitled to health, medical and nursing care for a period equal to the years of studies which are considered having a minimum duration of the undergraduate studies incremented by two years.

For this purpose the University provides students with a healthcare booklet that can be used in the region of the university concerned and only in exceptional cases outside it.

In case that the student is entitled directly or indirectly to additional health coverage by another healthcare insurer, and still wants the student healthcare plan, he should waive the insurance from the other carrier and choose the student insurance instead by a solemn statement (Law 1599/86), stating that "he is not insured under any other insurance carrier."

Additional information on healthcare is provided in the Healthcare booklet

For obtaining the Healthcare booklet, the students should address to the Administration Office.

10.7 ACADEMIC IDENTITY CARD – STUDENT TICKET

Every student is granted an Academic Identity Card. The relevant acquisition process is described on the website http://academicid.minedu.gov.gr/. The Academic ID Card is valid for as many years as the student membership lasts and covers multiple uses, including the Student Ticket (Pass). The duration of the Student Ticket is valid for n + 4 semesters. The discounts provided to Means of Transportation, are those laid down by the legislation concerned.

The Academic Identity Card is deposited at the Administration Office of the Department with the swearing-in ceremony of the student or when for any reason the student membership ceases to exist (e.g. interruption of studies). No discounts for the Student Ticket are granted to those admitted to the Department with classification, as graduates of other Universities.

University of Western Macedonia
Department of Mechanical Engineering
Faculty of Engineering

http://www.mech.uowm.gr/